Ukraine
Ministry of Agrarian Policy and Food

DATA COLLECTION SURVEY FOR ASSISTANCE FOR RESTORATION AND RECOVERY OF UKRAINE IN AGRICULTURE SECTOR

FINAL REPORT

April 2024

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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KOEI RESEARCH & CONSULTING INC.

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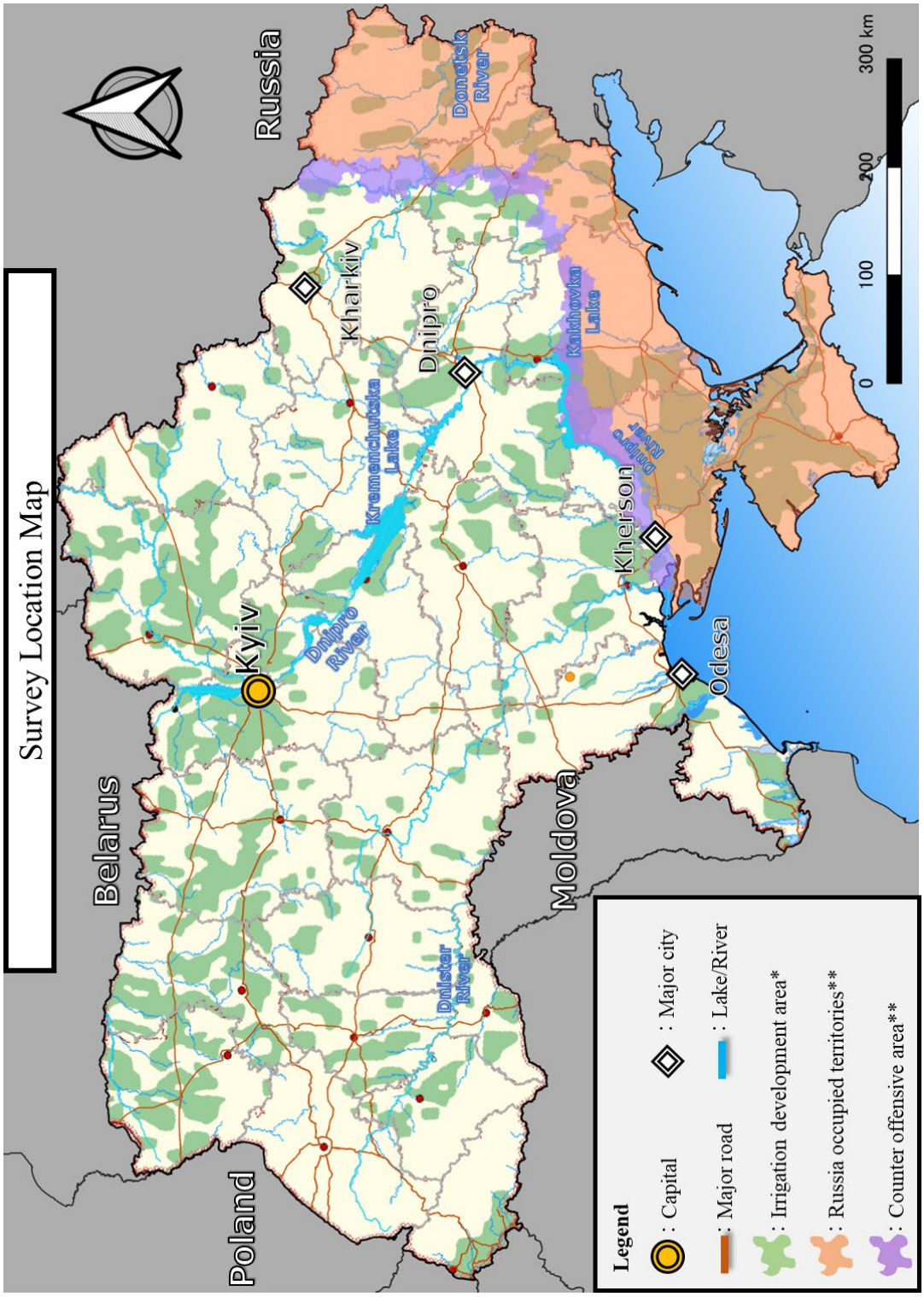


* FAO-AQUASTAT, 2016

** Institute for the Study of War, AEI's Critical Threats Project (31st August 2023)

Survey Location Map

Photographs – Field survey in Poland (1/2)

Interview survey to Kamix (agricultural products distribution company from Ukraine to EU).
Fresh vegetables and agriculture products to be exported to EU from Ukraine through Poland
(Warsaw Poland, Feb 26, 2023)

Interview survey to Kamix (agricultural products distribution company from Ukraine to EU).
Fresh vegetables and fruits to be exported to EU from Ukraine through Poland
(Warsaw Poland, Feb 26, 2023)

Data collection survey on short-term support equipment (PC)
（Rzeszow Poland, Feb 28, 2023）

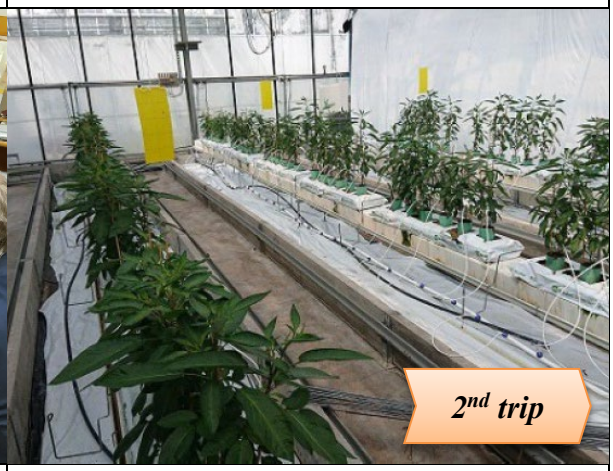
Transshipment base from rail freight cars to trucks
(Medyka (near border) Poland, Mar 3, 2023）

Photographs – Field survey (2/2)

Interview to Van Dyke Technics (Post-harvest technology consultant and equipment supplier company in Kiew)
(Warsaw Poland, June 13, 2023)

Survey of modern fruit and horticultural cultivation (berry farmers) near Warsaw
(Warsaw Poland, June 14, 2023)

Interview with Dr. Kataryzyna Kowalczyk at Warsaw Agricultural University
(Warsaw Poland, June 14, 2023)



Hydroponics and fertilization trials (eggplant vegetables) at Warsaw Agricultural University
(Warsaw Poland, June 14, 2023)

Interview with a representative of the Ukrainian Berry Association
(Ms. Iryna Kukhtina)
(Warsaw Poland, June 15, 2023)

Interview with Eurosad
(Fruits distributing company)
(Warsaw Poland, June 16, 2023)

Photographs – Invitation program (1/2)

Courtesy call to Ministry of Agriculture
(Apr 10, 2023)

Sharing of earthquake recovery experience by Sendai east land improvement district
(Apr 11, 2023)

Site visit to Nagatsura drainage pump station by Kitakami river coast land improvement district
(Apr 12, 2023)

Site visit to advanced agriculture (smart faming)
Igunal farm (Apr 12, 2023)

Site visit to advanced agriculture
(sensing/e-kakash)
Hiramoto farm (April 14, 2023)

Private sector discussion meeting
(April 14, 2023)

Photographs – Invitation program (2/2)

Courtesy call to Ministry of Foreign Affairs
(July 10, 2023)

Site visit to soil reclamation and reuse project in Iidate village
(July 12, 2023)

Site visit to irrigation infrastructure managed by Asaka-sosui land improvement district
(July 13, 2023)

Site visit to advanced agriculture, Yuzuriha farm
(July 13, 2023)

Site visit to biogas plant generation, Noberuzu Company
(July 17, 2023)

Action plan preparation and presentation
(July 19, 2023)

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FINAL REPORT

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Abbreviations

AGRI-Ukraine	Agriculture Resilience Initiative - Ukraine
AGRO	USAID's Agriculture Growing Rural Opportunities
AgVAT	Agriculture Value Added Tax
BDF	Business Development Fund
CAP	Common Agricultural Policy
CAP Project	Credit for Agriculture Producers Project
CCP	Central Communication Port
CMAC	Cambodia Mine Action Centre
CMU	Cabinet of Ministers of Ukraine
COVID-19	Coronavirus Disease 2019
CPF	Country Partnership Framework
CU	Credit Union
DCFTA	Deep and Comprehensive Free Trade Area
DX	Digital Transformation
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
ESA	European Space Agency
EC	European Communities
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FAT	Fixed Agriculture Tax
FREE	Financing of Recovery from Economic Emergency
GAP	Good Agriculture Practice
GEF	Green Environmental Facility
HCIMA	Humanitarian Coordination/Information Management/Assessment
IFC	International Finance Corporation
IFPRI	International Food Policy Research Institute
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
MinAgro	Ministry of Agrarian Policy and Food
MSME	Micro, Small and Medium Enterprises
NBU	National Bank of Ukraine
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organization
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
OECF	Overseas Economic Cooperation Fund of Japan
PEACE	Public Expenditures for Administrative Capacity Endurance
PIM	Participatory Irrigation Management
PJAIT	Polish Japanese Academy of Information Technology

PSE	Producer Support Estimate
PUCC	Polish-Ukraine Chamber of Commerce
SAR	State Agrarian Register
SAWR	State Agency of Water Resources of Ukraine
SECO	Swiss State Secretariat for Economic Affairs
SESU	State Emergency Service of Ukraine
SHEP	Smallholder Horticulture Empowerment and Promotion
SMEs	Small and Medium Enterprises
TRQs	Tariff-Rate Quotas
UNHCR	The Office of the United Nations High Commissioner for Refugees
UNOCHA	United Nations Office for Coordination of Humanitarian Affairs
USA	United States of America
USAID	United States Agency for International Development
UTC	Unity Territory Community
WFP	United Nations World Food Program
WTO	World Trade Organization
WUA	Water Users Association

Units/Currencies

Length

mm	=	Milimetre(s)
cm	=	Centimetre(s)
m	=	Meter(s)
km	=	Kilometer (s)

Area

cm^2	=	Square centimeter(s)
m^2	=	Square meter(s)
km^2	=	Square-kilometer(s)
ha	=	Hectare(s) (10,000 m^2)

Volume

cm^3	=	Cubic centimeter(s)
m^3	=	Cubic meter(s)
L	=	Liter (1,000 cm^3)

Weight

g	=	Gram (s)
kg	=	Kilogram(s)
ton	=	Metric ton(s)

Time

sec	=	Second(s)
min	=	Minute(s)
hr	=	Hour(s)

Others

°C	=	Degrees Celsius
%	=	Percent
MM	=	Man Month

Currency

JPY	=	Japanese Yen
UAH	=	Ukrainian Hryvni
USD	=	US Dollar

USD 1.0 = 38.97 UAH
(March 2024)

CHAPTER 1 OUTLINE OF THE SURVEY

1.1 Background of the Survey

Ukraine, recognized as one of the leading global exporters of key agricultural commodities including wheat, barley, and corn, has faced significant challenges following the Russian invasion on February 24, 2022. The conflict has severely impacted agricultural infrastructure, notably damaging irrigation facilities, grain storage capabilities, and machinery. Furthermore, the blockade of the Black Sea has disrupted the agricultural supply chain, leading to a shortage of grain storage solutions and the stagnation of grain exports. This disruption has resulted in increased domestic prices due to the decreased importation of agricultural inputs, consequently diminishing the profitability for Ukrainian agricultural producers. The escalation in food prices, driven by the reduced export capabilities of Ukraine, poses a significant concern for global food security. A detailed examination of the Ukrainian agricultural sector's current predicament is provided in Chapter 2.

In response to the difficulties it faces, the Ukrainian Government unveiled a comprehensive recovery and reconstruction blueprint, extending until 2032, during the Ukraine Recovery Conference in Lugano in July 2022. The plan articulates specific strategies for the agricultural sector, including the enhancement of irrigation and drainage systems, the development of high-value agricultural produce (e.g., vegetables, fruits, berries, seeds), and the recultivation of lands affected by the conflict. It underscores the importance of not only addressing the immediate challenges through ongoing international aid but also focusing on medium and long-term strategies that will bolster agricultural productivity.

1.2 Objectives of the Survey

The survey aims to delineate the agricultural sector's recovery and reconstruction needs across short, mid- and long-term horizons within Ukraine. It seeks to identify timely and effective support measures that JICA can provide, alongside the conceptualization and execution of pilot activities to evaluate these measures' efficacy. Emphasis will be placed on proposing support in priority areas, such as equipment and material provision, thereby facilitating JICA's initiation of short-term interventions. Additionally, the survey aims to explore avenues for leveraging Japan's agricultural experience and strengths to enhance Ukraine's agricultural productivity over the medium to long term.

1.3 Scope of the Survey

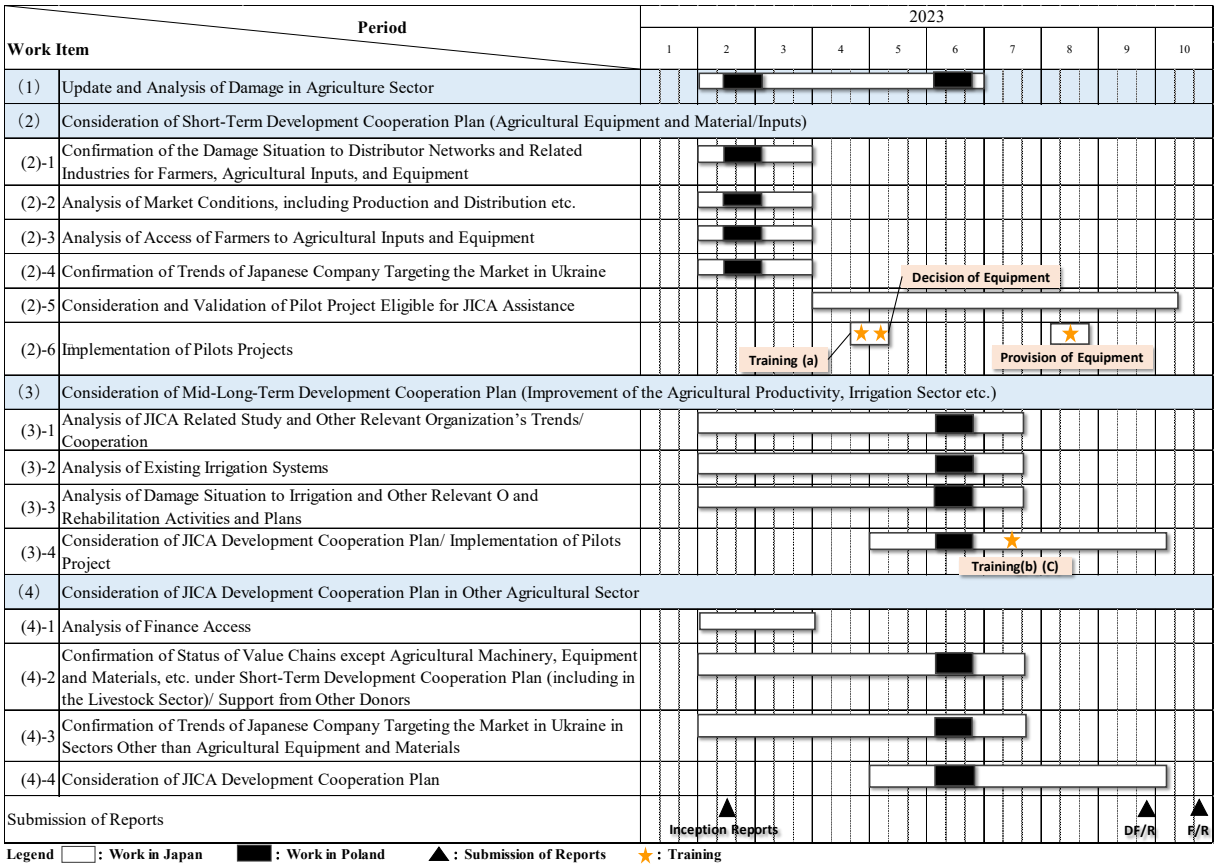
This survey undertakes a comprehensive examination based on the aggregation and analysis of extant data coupled with field investigations. It will (1) furnish an updated analysis of the war-induced damages within the agricultural sector, (2) appraise immediate support strategies including the provision of agricultural equipment and inputs, (3) deliberate on medium to long-term support strategies, and (4) evaluate other potential support mechanisms by JICA within the agricultural sector. As part of a pilot initiative, JICA will offer opportunities for participants to either visit Japan or partake in remote training sessions, in addition to supplying agricultural materials and/or equipment as immediate support measures.

It should be noted that this report consolidates information available as of the end of September 2023, as the survey and data collection period concluded in September 2023.

1.4 Work Plan of the Survey

The work plan, as detailed below, outlines the procedural approach adopted for this survey. Conducted primarily through remote methodologies from Japan, the survey utilized online tools, local experts, and various other resources for information gathering. Additionally, two field trips to Poland were organized to collect more nuanced data—one in February-March and another in June 2023. The initial trip aimed to engage with relevant organizations for insights into the damage and immediate support needs, while the subsequent visit focused on understanding the impact on irrigation facilities, the state of agricultural value chains, and identifying medium to long-term support opportunities.

Training sessions were integral to the survey, with two instances conducted in April and July 2023. These sessions involved 5 and 8 Ukrainian participants, respectively, spanning approximately 7 and 12 days in Japan. These engagements aimed to provide firsthand experience and knowledge transfer to support the agricultural. recovery efforts.



Source: JICA Survey Team

Figure A1.4.1 Work Plan (Actual) of the Survey

Through visit to Poland, the JICA survey teams conducted interviews with farmers of Ukraine, agriculture related organizations and companies etc. Key interviewees through field trips in Poland and objectives of interviews are summarized in Table B1.4.1.

CHAPTER 2 ANALYSIS OF THE AGRICULTURAL SECTOR IN UKRAINE

2.1 Agricultural Policy and Strategy

2.1.1 National Economic Strategy of Ukraine 2030

Ukraine's National Economic Strategy to 2030[1] (March 2021) serves as the foundation for laws, action plans, and new strategic programs by governmental agencies and central administrative bodies in the country. It aims to position Ukraine as a global hub for food security and a leader in value-added food and agricultural services. It includes the following seven strategic goals in the agriculture and food sectors.

1. Develop stimulating and advisory agricultural policies (strengthen institutional capacity, improve policy-making efficiency, and improve the land market).
2. Provide high-quality infrastructure to market participants.
3. Enhance access to agriculture inputs and technology.
4. Balance high-profit and low-profit products to boost sector profitability.
5. Promote processing market development.
6. Increase sales of high-value products domestically and internationally.
7. Ensure the production and export of safe and healthy agricultural food products.

These objectives represent a significant transformation in Ukraine's agricultural policy in recent years.

2.1.2 Agricultural Policy

(1) Transition of Ukraine's Agricultural Policy

Since its independence, Ukraine's agricultural policy has evolved significantly. The evolution since the 1990s includes three distinct periods, each with unique characteristics:

(i) **Planned Economy Period:** Prior to the 1990s, Ukraine's agriculture, as part of the Soviet Union, was under central planning. The state-controlled prices and state-owned enterprises dominated markets for produce, agricultural inputs, food processing, and distribution.

(ii) **Economic Transition Period:** The first reforms began in the late 1980s, and from that time the state began the transition to a market economy. This era introduced individual land leasing from collective farms, enabling private agricultural ventures and the establishment of family farms. However, Ukraine experienced a severe economic crisis in the early 1990s, causing economic contraction and inflation, impacting the agricultural sector and significantly reducing agricultural production and productivity. By the mid-1990s, there was a partial reversion to some of the earlier trade and price liberalization policies.

[1] Original title is “НАЦІОНАЛЬНА ЕКОНОМІЧНА СТРАТЕГІЯ на період до 2030 року”

(iii) **Open Economy Reform Period:** Following macroeconomic stabilization in the 2000s, Ukraine pushed forward with privatization of agricultural enterprises and the restructuring of collective farms. This transition led to approximately 75% of agricultural land becoming privately owned, a marked departure from the pre-1990s when the state owned all land. Established in 2005 and reorganized in 2013, the National Agricultural Fund aimed to manage grain prices through market interventions, grain storage, and providing loans to grain producers[2]. It expanded its activities over time but has not received government funding since 2016, with diminishing state involvement in the agricultural market.

The main issues from Ukraine's agricultural policy transition, as described above, are summarized in the following table.

Table A2.1.1 Evolution of Agricultural Policy in Ukraine

Period	Phase	Changes in Agricultural Policy
Pre-1990s	Planned Economy Era	- Planned agricultural production, state-controlled prices - State-managed value chains and agricultural trade (including market management of agricultural inputs)
1990-2000	Gradual Transition to Market Economy (interrupted by severe economic crisis in the early '90s)	- Increase in import tariffs for agricultural produce and processed foods - Land reforms allowing private ownership - Gradual dismantling of centralized marketing schemes - Reversal of reforms during economic crisis period
Post-2000	New Reform Period towards a More Open Economy	- Reduction of agricultural tariffs following WTO membership - Export taxes and quotas on key export products are gradually abolished or transitioned to MoUs (Memorandums of Understanding) - National Agricultural Fund (price regulation, production regulation, marketing, loans, etc.) is gradually reduced through minimum reference prices and state food purchases for market intervention. - Sugar production quota limit: until 2018 - Various subsidies like input subsidies, interest support, tax incentives - Lifting of restrictions on land purchases

Source: OECF Agriculture Policy Monitoring and Evaluation 2022

Additionally, two important matters related to Ukraine's current agricultural policy, namely, the WTO and DCFTA, are outlined below.

a) Membership in the World Trade Organization (WTO) in 2008

In May 2008, Ukraine joined the WTO and introduced import tariffs on a wide range of agricultural products, including perishables. The average Most Favored Nation (MFN) tariff for agricultural products is 9.1%, which is notably higher than the 3.7% average for non-agricultural goods. While most imports are subject to ad valorem tariffs, Ukraine also upholds a tariff quota specifically for raw sugar, a measure utilized only in 2011 and 2021—years marked by an oversupply of sugar in the local market. Additionally, export tariffs are imposed on certain commodities like oilseeds, live animals, and hides. However, these tariffs have been on a decline since Ukraine's accession to WTO.

[2] Free Trade Agreement Information Survey and Analysis Project: Survey and Analysis of Information Related to Agricultural Investment in Ukraine (2011).

b) Signature of the Deep and Comprehensive Free Trade Area (DCFTA) in 2014

The DCFTA between Ukraine and the European Union (EU) was ratified on June 27, 2014, having a significant impact on Ukraine's trade policy (provisionally applied from January 1, 2016, and officially in force from September 1, 2017). The agreement envisages a phased trade liberalization over 7 to 10 years, with the EU opening tariff rate quotas (TRQs) for essential Ukrainian agricultural exports like grains, meats, dairy, and sugar, alongside duty-free imports and unrestricted access for other goods. Conversely, Ukraine is set to lower import tariffs on various EU products. Immediately following the agreement's implementation, about 40% of agricultural-related import tariffs were eliminated, and it is anticipated that roughly half will be removed during the transition period. Ukraine applies quota tariffs to around 10% of product categories, including dairy, eggs, sugar, other food items, animal oils and fats, and feed. From January 1, 2016, a specified quantity of these goods can be imported without duty. Both parties have agreed not to use export subsidies for agricultural trade.

The DCFTA is viewed as a precursor to Ukraine's potential EU membership, signifying a shift towards integrating Ukrainian agriculture with European markets. However, this transition raises concerns about the impact of inexpensive foreign agricultural imports on domestic value-added sectors like horticulture.

(2) Recent Organizational Changes in Agriculture

The Ministry of Agrarian Policy and Food (MinAgro) leads Ukraine's agricultural development initiatives. Between September 2019 and January 2021, MinAgro was merged into the Ministry of Economic Development, Trade, and Agriculture (MEDTA). Following a Cabinet of Ministers of Ukraine (CMU) resolution in February 2021, MinAgro was reestablished as a standalone entity tasked with developing and executing state policies in agriculture, fisheries, food security, regional development, and land management.

2.1.3 Agricultural Development Strategy

For understanding the current direction of Ukraine’s agricultural development strategy and recovery plans from the conflicts with Russia, the following two documents can be referred to. An explanation of each is provided.

- Agricultural sector part mentioned in Ukraine’s National Recovery Plan 2022
- Strategy for Agriculture and Rural Development in Ukraine from 2023 to 2030: Ministry of Agrarian Policy and Food

(1) Ukraine's National Recovery Plan 2022

The National Recovery Plan for 2022 delineates a strategy for Ukraine's comprehensive recovery, emphasizing five core principles and methods for implementation:

(a) Start now, ramp up gradually

(b) Grow prosperity in an equitable way

(c) Integrate into EU

(d) Build back better for the future

(e) Enable private investment & entrepreneurship

The execution of this strategy is planned across three distinct stages: (1) the immediate "wartime economy (2022)," (2) the medium-term "post-war recovery (2023-2025)," and (3) the visionary "new economy (2026-2032)." This structured approach is illustrated in Figure B2.2.1 and detailed for the "15 national programs" identified in Table B2.1.1.

Within these 15 strategic initiatives, item 8 focuses on " Grow value-adding sectors of the economy," positioning the agricultural sector as a crucial component. Specifically, item 8 outlines 18 priority programs, numbered 8.1 to 8.18. It includes "7 priority projects (totalling 35 billion USD)" that are specifically aimed at bolstering the agricultural sector (refer to section 2.1.7 for further details, highlighted accordingly).

7 priority projects in Agriculture Sector

i. Develop agri processing (starch, corn syrup, gluten, lecithin, protein) in alignment with EU Green Deal principles.
ii. Build 1 million ha irrigation system in compliance with EU directives
iii. Develop high-value-add agri produce (vegetables, fruits, berries, seeds)
iv. Recultivation of damaged land
v. Increase meat and milk production and processing
vi. Promoting the transition of the agri-food sector to "green" growth (by enabling precision farming)
vii. Fast restoration after the war of 10.5k agricultural enterprises

In addition to the seven priority projects outlined in the National Recovery Plan 2022, the Ukrainian government's official 'Ukraine Recovery Plan' website (https://recovery.gov.ua/en) also lists the following six priority projects[3].

Additional Priority Projects

i. Bioenergy independence
ii. Maintaining the agricultural sector in the context of the seaport blockade
iii. Comprehensive planning of spatial development and land use in the communities
iv. Mapping Ukraine and implementation of the National Geospatial Data Infrastructure
v. Development of reclamation systems
vi. Development of seed production: construction of factories for the production of hybrid seeds

In addition to the aforementioned 15 national programs, the website also lists two prerequisites for implementing these programs: a) the need to strengthen institutional capabilities, and b) the introduction and reinforcement of a digital government.

[3] The National Recovery Plan 2022 was compiled in the year 2022. However, as of September 2023, the homepage of the "Ukraine Recovery Plan" operated by the Ukrainian national government (https://recovery.gov.ua/en) not only lists the previously mentioned "seven priority projects" but also includes an additional six projects marked as priority projects

(2) Draft Strategy for Agriculture and Rural Development in Ukraine from 2023 to 2030 Harmonized with the EU

This document, henceforth known as the "EU-Aligned Agricultural Strategy 2030," sets forth the ambition to align Ukraine's agricultural practices with the European Union's New Common Agricultural Policy for 2023-2027. This alignment is a step towards Ukraine's goal of EU integration. It details the national strategy and action plans for enhancing agriculture and rural development, emphasizing post-conflict rehabilitation. Initially, it presents "Challenges in Agriculture and Rural Areas" through six key points. This is followed by " Government Priorities During and After the War," a "13-point Post-war Recovery Plan," and "10 Key Strategies" for agriculture and rural development (for further information, refer to Annex 2.2.1)

Challenges:

- - Direct war-related losses are estimated at approximately USD 8 billion, and indirect war-related losses are estimated to exceed USD 3 billion.
- Although the EU's "Lane of Solidarity" and the Black Sea Grain Initiative (currently suspended as of March 2024) are promoting exports, high logistics costs and ever-changing export risks threaten farmers and agribusinesses,
- The ratio of agricultural machinery and commodity prices for producers negatively impacts farm liquidity, production, investment, and profits,
- Two million hectares of agricultural land are contaminated with landmines,
- Public support programs have sometimes been reduced or cancelled due to financial bottlenecks,
- Poverty raises concerns about food security.

When categorizing the 13 items of the "Post-war Recovery Plan" presented in this strategy into three major categories (facility renovation and restoration support (Hardware Support), technical training support (Software Support), and the prerequisites for such recovery) the following is observed:

Hardware Support i. Investment in irrigation infrastructure and systems in Ukraine to mitigate the damage from the war and the climate change ii. Diversification of domestic and export logistics (including sea, river, truck, and rail transport)
Software Support i. Promotion of high-value-added products in the agricultural sector, including fruits and vegetables ii. Encouragement of livestock production and processing to diversify farm sales iii. Incentives for investment in crop production and food processing to balance exports of raw materials and processed foods iv. Development of the domestic seed industry

Prerequisites for Recovery

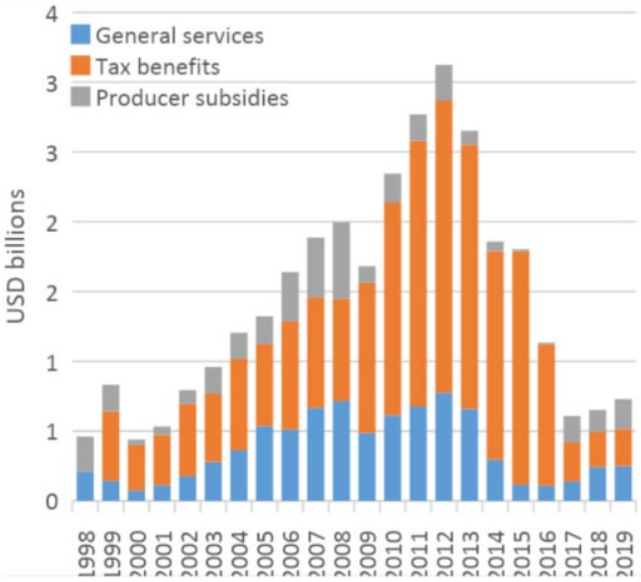
i. Update and complete the mapping infrastructure, make it available online, and decentralize land use planning
ii. Develop a green growth strategy and harmonize it with the EU
iii. Demining of farms, agricultural land, and household gardens in villages
iv. Support for domestic refugees through employment in horticulture and greenhouse farming
v. Investment in biogas based on corn and agricultural waste as a substitute for imported natural gas
vi. Restoration of assets lost due to the damage from war
vii. Implementation of health measures for plants and animals, food safety, and SPS measures aligned with the EU

2.1.4 Farmer Support System

It is said that the farmer support system in Ukraine experienced a substantial transformation circa 2017.

(1) Farmer Support System Before 2017

As depicted in the figure below, the bulk of agricultural support was previously derived from tax incentives (highlighted in orange in the diagram). This significant component has seen a considerable reduction from 2018 onwards. Before 2017, these tax incentives for farmers included a) the single tax (also known as the Fixed Agricultural Tax (FAT) until 2015), and b) a specialized value-added tax regime for the agricultural sector (AgVAT).



Source: How to Make Current Agricultural Fiscal Support More Efficient | VoxUkraine[4]

Figure A2.1.1 Agriculture Support Data

The single tax was a uniform tax that converted income tax into a land tax, with rates varying between 0.09% and 1.00% depending on the type and location of the agricultural land. However, according to 2010 data, the Fixed Agricultural Tax (FAT) collected an average of only about USD 0.75 per hectare of cultivated land, rendering the tax virtually non-existent. Yet, 2010 data reveals that the Fixed Agricultural Tax (FAT) amounted to merely around USD 0.75 per hectare of farmland, making it almost negligible. By 2015, adjustments in the standard land valuation significantly increased the FAT to approximately USD 9 per hectare. This figure, however, remained substantially lower than what would typically be paid under a conventional tax system.

Within the specialized value-added tax framework for agriculture (**AgVAT**), farmers had the advantage of keeping the VAT from their sales to counterbalance the VAT on inputs for upcoming cultivation. This provision also allowed for flexibility in using these funds for various production needs. Despite this, the effectiveness of these tax incentives in enhancing agricultural efficiency and productivity has been widely debated[5]. Facing criticism and pressure from international bodies like the IMF, the AgVAT system began to be dismantled between 2016 and 2017. Nevertheless, the FAT continues to be in effect (refer to Figure A2.1.1) and is anticipated to persist into the foreseeable future.

(2) Farmer Support System After 2017

In 2017, the AgVAT system transitioned to a "quasi-accumulation VAT" system, eliminating previous tax incentives. Under this new arrangement, agricultural entities, particularly those in livestock and horticulture, are granted budgetary subsidies that correlate with the VAT they contribute to the national budget. These subsidies' extents are determined by the "annual law On the State Budget of

[4] Source: https://voxukraine.org/en/how-to-make-current-agricultural-fiscal-support-more-efficien
[5] Ukraine: Agricultural Policy Review. Report No 83763, 2013

Ukraine," setting the parameters for agricultural subsidy policies. In 2021, the subsidy provision for agricultural producers rose to UAH 4.7 billion (USD 166 million), marking a notable increase from the UAH 4 billion allocated in both 2019 and 2020, when adjusted to the local currency.

Besides the single tax system, the "General Budget Program: Financial Support for Agricultural Producers" continues to support various agricultural endeavours. This includes subsidizing a portion of the costs for acquiring agricultural machinery, and equipment; and providing interest subsidies for bank loans. Livestock producers receive additional aids, such as interest support for breeding and reproduction loans; cost reimbursement for constructing or renovating animal farms; per capita payments for cattle; and subsidies for procuring high-quality livestock, semen, and embryos. Crop producers benefit from compensation aimed at supporting farm investments and facilitating debt repayments.

Agricultural operators currently have access to the several subsidies, with specifics detailed in Section 2.5.3, including:

- Preferential loans at 5-7-9%
- Partial risk guarantees for agricultural loans
- State subsidies for agricultural insurance

2.1.5 Other Legislation

(1) Laws Relating to Agricultural Land

Recent years have seen the implementation of various laws aimed at improving agricultural productivity and land mobility. Notably, a 2002 moratorium initially banned the sale of agricultural land, permitting only leasing for cultivation. This moratorium was annually renewed until 2019 and was not extended in 2020. On July 1, 2021, a groundbreaking law was passed, allowing Ukrainian individuals to own up to 100 hectares (ha) of land, thereby lifting the longstanding prohibition on land sales. Starting from January 1, 2024, not only Ukrainian nationals but also legal entities whose founders or ultimate beneficiaries are Ukrainians and who are not registered in foreign or offshore companies will be able to purchase up to 10,000 ha. The sale of land to foreigners is still prohibited, as is the sale of state and communal agricultural land.

An October 2020 Presidential Decree directed the Cabinet of Ministers of Ukraine (CMU) to facilitate the transition of state-owned agricultural land to communal ownership, support private farming initiatives, enhance land management practices, and liberalize land regulation through legislative reform.

Additional legislative measures concerning agricultural land include:

- **In April 2021**: The law "Acts of Ukraine on Improving the System of Management and Deregulation in the Sphere of Land Relations" was adopted and came into force in May 2021. This law transfers state-owned land outside of settlements to communal ownership by villages, settlements, and city councils. It also approves changes in the purpose of privately-owned land outside of settlements by local governments and guarantees state management of land use and protection by village, settlement, and city councils. Additionally, it streamlines administrative procedures concerning permits and land

management documents, thereby reducing the time and cost of land management procedures.

- **In July 2021**: The law "On Amendments to Certain Laws of Ukraine Concerning the Acquisition and Sale of Land Plots and Usage Rights through Electronic Auctions" was enacted. This law mandates the conduct of land auctions through a state-operated electronic trading system, introduces a minimum guaranteed fee for bidders, and outlines procedures for the operation and management of the electronic trading system.
- **In June 2021**: The Cabinet of Ministers of Ukraine (CMU) approved a resolution confirming the procedure for verifying that buyers or owners of agricultural land comply with Article 130 of Ukraine's Land Code. This resolution outlines the procedure for notarizing data about land buyers and marked the final stage in the preparations for opening the land market.
- **In September 2021**: The law "On Amendments to Certain Laws of Ukraine Concerning the Activation of Agricultural Land" was adopted by the parliament and came into force in October 2021. This law defines the composition of agricultural land and determines the recipients of state support. Newly established farms, family-operated farms, and farms in mountainous areas can receive state budget support for three years after their establishment. The law also provides financial support for family-operated farms that pay mandatory social insurance contributions and for farms operated by individuals under 35 years of age.
- **In June 2021**: The CMU approved a resolution on the "Functioning of the Agricultural Register," which authorizes the maintenance and management procedures for the State Agrarian Register. This register, established in November 2020, serves as a single state information system that integrates information about agricultural producers and their properties.
- **In November 2021**: The government resolution "On Approval of the Methodology of Normative Monetary Valuation of Land Plots" was adopted and came into force. This resolution establishes new rules for calculating the standard monetary value of land and unifies the three existing methods of land valuation (within settlements, outside of settlements for non-agricultural purposes, and for agricultural purposes).

(2) Laws Relating to Agricultural Finance and Insurance

In November 2021, the "Law on the Fund for Partial Guarantee of Loans in Agriculture" was enacted, inaugurating a novel, non-banking specialized financial institution dubbed the "Fund for Partial Credit Guarantee in Agriculture." This initiative is designed to strengthen credit support and offer repayment assurances to small and medium-sized agricultural enterprises managing up to 500 hectares of land. The legislation delineates the methodologies for establishing the fund's authorized capital; the assembly and decision-making processes of its governing bodies; and the qualification requisites for businesses to obtain partial credit guarantees.

Furthermore, in July 2021 saw the enactment of the "Law on Amendments to Certain Laws of Ukraine on Improving the Legal Regulation of Insurance of Agricultural Products with State Support" This law inaugurates governmental backing for agricultural insurance, compensating farmers for up to 60% of the insurance premium costs. It precisely demarcates the entitlements and commitments of parties in the insurance sector and sets forth the stipulations for the issuance of state-supported insurance policies.

(3) Laws Relating to Agricultural Cooperatives

In March 2021, the CMU announced the "Resolution on the Approval of Model Statutes of an Agricultural Cooperative." This new model statute stipulates the legal status, rights, and responsibilities of cooperatives and quasi-cooperative members, as well as the formation, management, and termination of economic activities of agricultural cooperatives.

2.1.6 Definition and Classification of Farmers

This section discusses the definition of a farmer in Ukraine, which is often complex and unclear. In conclusion, there is no connection between the definition in the Agricultural Law and the definition used in statistics published by the National Bank of Ukraine (NBU), and there is no unified definition of a farmer in Ukraine. This complicates the problem in understanding the overall picture of Ukrainian agricultural workers.

According to the report on agriculture and regional development published[6] by the European Commission in 2012, Ukraine's agricultural sector is characterized as having a dual structure due to the dismantling of collective farms after the country's independence. The collective farms of the former Soviet Union, which took the form of agricultural enterprises at the time of independence, gave rise to farming entities of various sizes through the process of land transfer and agricultural enterprise privatization, which eventually led to a division into two groups, i.e., the large-scale holding companies and the individual farmers. This dual structure has shaped Ukraine's agriculture to this day. When discussing farmers in Ukraine, it is necessary to categorize and organize each component of this dual structure by size, but as described below, except for those farmers other than holding companies and those which can be easily understood as corporate entities, there is no unified definition of the companies and the individual farmers that make up the agricultural sector, using the scale of farming operations such as cultivated area and number of livestock raised, and annual income. Therefore, from publicly available materials, it is difficult to classify the size of farms other than large-scale holding companies based on cultivated area, number of livestock, etc.

(1) Classification of farmers based on the Agriculture Act (2003)

According to the law "On Farm" (Law of Ukraine No. 973 of 2003), a farmer is a farming entity that produces agricultural products for sale in the market, and is divided into two categories, i.e., those who

[6] Joint Research Center “Farming and rural development in Ukraine; making dualization work” December 2012

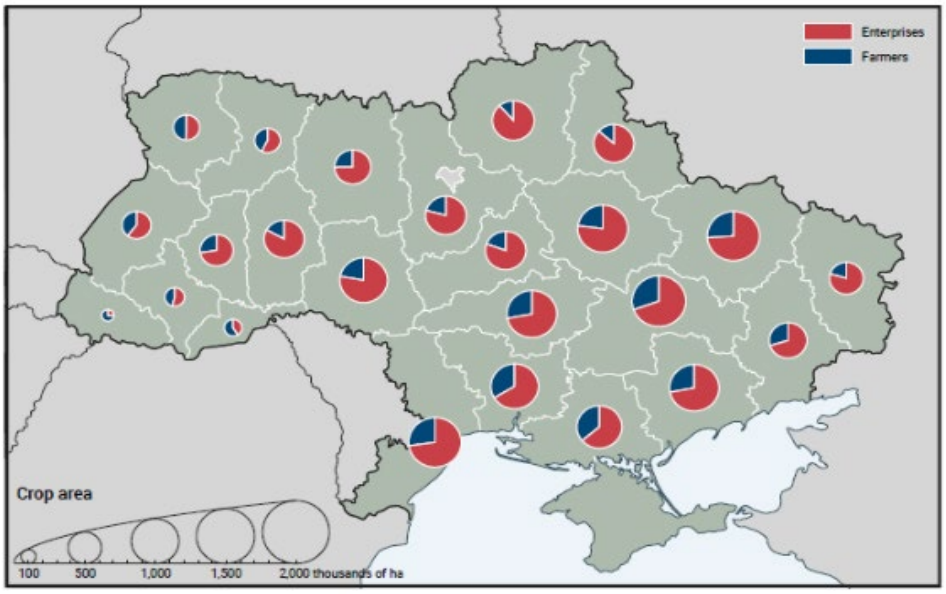
are registered and those who are not. Registered farmers are further divided into legal entities and individual entrepreneurs. From this, it is thought that registered individual farmers are recognized as economic entities as individual entrepreneurs. On the other hand, the law also allows individual or family farms not to be registered. In this case as well, the representative is an individual entrepreneur, but because he or she is not registered, he or she is not officially recognized as an economic entity and is not considered to be the object of statistics. Therefore, there are only two types of farmers under the Agricultural Law: corporations and individual farmers. In order to receive support from the Government of Ukraine, including the Ministry of Agricultural Policy and Food, even individual farmers must be registered[7]. Since the law does not include the classification of farmers based on the area of cultivated land, the size of a farm cannot be defined by the law using the area of cultivated land or the number of livestock raised.

On the other hand, in addition to the above-mentioned Law No. 973, Law No. 742 of 2003 also stipulates the term "Personal Peasant Farm." Peasant farms produce agricultural products primally for their own consumption and sell any surplus agricultural products, so selling in the market is not the primary purpose of agricultural production. Therefore, the law stipulates that products from peasant farms are not included in the statistics for registered farmers based on the Agricultural Law. The cultivation area of a peasant farm is basically 2 ha, which is distributed equally by the government, but it is also possible to own more than 2 ha through inheritance.

The statistics of State Statistics Services are based on economic entity according to the definition of the law “On Farm”. It is divided into “Business Entity” and “Peasant Household”. Only the former is known as agricultural statistics for Ukraine, that is, only those related to registered farmers under the Agricultural Law.

The following chart presents data from the statistical bureau on the land area ownership rates of the legal entities and the individual entrepreneurs in each oblast for the year 2019. While this is a useful resource for showing the distribution across oblasts (particularly, a high concentration of individual farmers in Zakarpattya and Chernivtsi), it's important to note that the data here only covers registered "individual farmers." It omits the area owned by "family farms," which are more prevalent in the central-western regions. According to this data, 27% of the total land area is said to be owned by "individual farmers." However, according to the later Table A2.3.1, the ownership rate of arable land by "individual farmers" + "family farms" is said to be 45%, showing a significant gap. Therefore, it can be inferred that the actual ownership rate of "individual farmers" + "family farms" is likely higher than what is represented in the chart below, especially in the central-western regions.

[7] See Q &A on the Business Development Fund website.



Source: Stawormir Matsuszak, (2021), The Breadbasket of the World Agricultural Development in Ukraine Center for Eastern Studies, Warsaw

Figure A2.1.2 Agri-Enterprises and Farmers

(2) Classification of farmers based on the Commercial Code

On the other hand, the Commercial Code classifies economic entities based on the number of employees and annual income. Table A2.1.2 shows the company classification based on the Commercial Code, and defines large, medium, small, and micro companies. In terms of the fact that those entities are legally registered, the same standards can be applied to the Commercial Code and the Agricultural Law.

Table A2.1.2 Corporate Classification under the Commercial Code

	Micro enterprises	Small enterprises	Medium enterprises	Large enterprises
Number of employees	10 people or less	50 people or less	Enterprises which belong to neither large nor small companies	250 people or more
annual income	Less than 2 million Euros	Less than 10 million Euros		50 million Euros or more

Source: Prepared by JICA Survey Team based on Article 55 of the Commercial Code of Ukraine, Law No. 18, 19, 20, 21, 22 of 2003

According to the classification in Table A2.1.2, corporate or individual farmers with an annual income of up to 2 million Euros are classified as micro-enterprises. Micro-enterprises are reminiscent of individual farms with small cultivating areas and a small number of livestock. However, according to calculations by the Kyiv University of Economics, the annual income of 500,000 to 2 million Euros, which is classified as a micro-enterprise, is excessive for farmers; such level of income corresponds to 700 to 3,000 ha of cultivated land for grain and 80 to 310ha for the vegetables, and in case of dairy farm, it corresponds to raise 300 to 1,200 dairy cows[8]. Furthermore, micro-enterprises with an annual income of less than 500,000 Euros, classified as the lowest income group, are, though unofficially, considered small in the agricultural sector; but it is said to be equivalent to grain and oil seeds cultivation of up to

[8]"Assessing the role of small farmers and households in agriculture and the rural economy and measures to support their sustainable development" Oleg Nivievskyi , Pavlo Iavorskyi , Oleksandr Donchenko , Kyiv School of Economics, February 2021, pp.13

600 to 700 ha or vegetable cultivation with 80 ha, and dairy farming of up to 300 dairy cows. Although it is said to be unofficial, the university's report describes that small-scale farms have the cultivated land of 150 to 200 ha, with a maximum of 500 ha, medium-sized farms with 200 (500) ha to 10,000 ha, and large-scale farms with 10,000 ha or more. It points out that there is a discrepancy between the definition under the Commercial Code, which classifies farmers based on their annual income, and that based on scale of farms, which defines them based on cultivated area and the number of livestock they raise. From this point on, the authors of the paper at Kyiv University of Economics classify small-scale farmers as (1) individual farmers – legal entities, (2) family farmers, physical person entrepreneurs (3) individual rural farmers - physical persons, and (4) other commercial farms. Although (3) individual rural farmers are defined as subsistence farmers as defined in Law No. 742, it is pointed out that it is difficult to clearly distinguish them from (2) family farmers.

(3) Farmer and Peasant Household

a) Farmer

Table A2.1.3 lists the number of farms with corporate status by business type and size. The following characteristics can be read from here.

- Large enterprises are engaged in grain cultivation, but also exist in pig and poultry farming. These are considered to be Agro-holdings.
- Small enterprises account for an overwhelming number of enterprises, and most of them are micro enterprises.
- Many medium and small enterprises produce grain, including individual farmers.
- Products other than grains, legumes and oilseeds are produced by small and medium-sized enterprises.

Table A2.1.3 Number of farms with Legal Status by Business Type and Size

Industry type	Total	Large companies	Medium company		Small business		Micro enterprise	
				Of which private companies		Of which private companies		Of which private companies
Total number of companies	3,837,106	610	17,811	309	1,937,827	1,585,105	1,880,858	1,576,209
Crop and animal production, hunting and related services	122,823	49	1,793	3	63,118	18,887	57,863	18,819
Of which growing of non-perennial crops		41	1,389	2	50,253	11,672	45,746	11,636
Cereals, Legumes, Oilseeds		41	1,335	2	48,027	10,451	43,647	10,417
Vegetables, melons, roots and tubers		-	44	-	1,646	870	1,541	868
Of which perennial crops		-	47	-	2,178	797	2,048	793
Grape		-	11	-	176		145	46
Pome fruits, stone fruits		-	27	-	827	227	770	225
Other tree and bush fruits, nuts		-	9	-	912	378	879	377
Of which animal production		7	289	-	3,726	1,855	3,386	1,851
Dairy cattle		-	182	-	729	209	626	209
Sheep and goats		-		-	193	75	186	75
Swine and pig		3	50	-	1,006	582	909	579
Poultry		4	40	-	870	443	784	442
Of which mixed farming			12	-	1,381	431	1,304	439
Percentage of the total number of companies of that size		8%	10%	1%	3%	1%	3%	1%
Percentage of total grain production, livestock, hunting and related service enterprises		0%	1%	0%	51%	15%	47%	15%

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

Table A2.1.4 lists the production scale of agricultural enterprises by the type of crops produced.

Table A2.1.4 Number of Companies by Crop and Size

Farm Area (ha)	Grain & Leguminous crops					Wheat					Corn				
	Num. of Com.	Ratio (%)	Yield (ton)	Ratio (%)	Median yield per ha	Num of Com	Ratio (%)	Yield (ton)	Ratio (%)	Median yield per ha	Num. of Com.	Ratio (%)	Yield (ton)	Ratio (%)	Median yield per ha
Total number	32,403	100	69,689	100	59.3	24,016	100	25,687	100	47.4	15667	100	36791	100	83.7
Up to 100ha	18,361	56.7	2,699	3.9	41.3	14,789	61.6	1,986	7.7	39.2	9,357	59.7	2,302	6.3	67.6
100 to 200	3,745	11.5	2,718	3.9	49.8	3,005	12.5	2,010	7.8	45.2	2,250	14.4	2,542	6.9	76.7
200 to 500	4,380	13.5	7,597	10.9	53.5	3,310	13.8	5,045	19.6	47.0	2,158	13.8	5,600	15.2	80.4
500 to 1,000	2,833	8.7	11,352	16.3	56.0	1,768	7.4	6,001	23.4	48.3	1,016	6.5	5,878	16.0	83.1
1,000 to 2,000	1,938	6	15,567	22.3	57.9	854	3.5	5,806	22.6	49.4	493	3.1	5,784	15.7	83.7
2,000 to 3,000	604	1.9	8,978	12.9	61.5	167	0.7	1,987	7.8	49.6	183	1.2	3,930	10.7	87.7
3000 or more	542	1.7	20,778	29.8	70.4	123	0.5	2,852	11.1	49.1	210	1.3	10,755	29.2	90.9
Farm area (ha)	Barley					Rapeseed					Forage beet				
	Num. of Com.	Ratio (%)	Yield (ton)	Ratio (%)	Median yield per ha	Num. of Com	Ratio (%)	Yield (ton)	Ratio (%)	Median yield per ha	Num. of Com.	Ratio (%)	Yield (ton)	Ratio (%)	Median yield per ha
Total Num.	13,858	100	5,593	100	42.3	4,740	100	2,907	100	29.3	553	100	10,354	100	486.6
Up to 100ha	10,546	76.1	1,157	20.7	36.0	2,420	51.0	311	10.7	27.2	273	49.4	562	5.4	512.0
100 to 200	1,640	11.8	1,019	18.2	42.5	961	20.3	410	14.1	28.6	89	16.1	695	6.7	550.1
200 to 500	1,225	8.9	1,654	29.6	43.6	900	19.0	838	28.8	29.5	96	17.4	1,534	14.8	503.6
500 to 1,000	348	2.5	1,071	19.1	45.5	307	6.5	633	21.8	29.7	45	8.1	1,519	14.7	495.6
1,000 or more	99	0.7	692	12.4	47.3	152	3.2	716	24.6	30.3	50	9.0	6,043	58.4	472.0

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

Looking at those tables, the majority of enterprises have cultivated land of less than 100 ha for all crops, and the production volume is the smallest except for barley and soya beans. It is judged that agricultural enterprises of this size include the enterprises owned by individual. On the other hand, the cultivated area of grains with the highest yields varies depending on the crop; for corn and fodder beets, their cultivated land areas are 3,000 ha and 1,000 ha or more respectively, while for wheat, it is 500 to 1,000 ha and for barley, rapeseed and oily and soybeans, they are 200 ha to 500 ha. As a result, there is a large number of companies with cultivated areas of approximately 200 ha or less, and the yields of these companies are lower than those with other cultivated areas, making them less competitive than companies with other cultivated areas.

b) Peasant Household

Tables A2.1.5 to A2.1.11 are data on home farms published by the State Statistical Services. The following characteristics of peasant households can be gleaned from these data.

- The average cultivated land area is small at 1.24 ha, but more than half of the cultivated land is less than 0.5 ha.
- More than 20% of peasant households have cultivated land area above average, and the majority are 1 to 5 ha in size, but there are some with cultivated land area of over 10 ha.
- An average of 3 ha of land is leased, and most of the leased land is peasant farms with 1 hectare or more of cultivated land.
- The head of the family of a peasant farm is an elderly person.

Table A2.1.5 Number of Peasant Household and Land Erea owned

Item	All household	Land area		
		0.5 ha and less	0.51–1.00ha	1.01 ha or more
Average land area of the household (ha)	1.24	0.27	0.70	4.16
Per cent of land shares and rented plots to total land area of households	48.0	0.2	1.0	65.2
Average total size of land shares and rented plots (ha)	3.0	0.1	0.40	3.1
Share of female-head households	52.7	55.5	54.6	43.8
Share of male-head households	47.3	44.5	45.4	56.2
Average age of households' heads (year)	59	58	61	60
Female	62	60	63	64
Male	57	56	58	58

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

Table A2.1.6 Average Arable Land Area of Peasant Household and Characteristics of Family Head

Item	January 1, 2022	Reference: January 1, 2021
Number of households (1000)	3,921.5	3,954.8
The land area (1000 ha)	6,120.0	6,125.7
including the intended purpose		
for construction and maintenance of residential house, commercial buildings and structures	777.1	787.0
for personal peasant farming	2,544.2	2,517.7
for agricultural commodity production	2,735.3	2,772.6
of which is rented	367.1	350.9

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

- Grains and craft crops are grown on just over half of the cultivated area of peasant households, with fruits and berries also grown on the side.
- For registered farmers with 1 hectare or more of cultivated land, they lease the land for Agro-holdings who grow export grains such as sunflowers, wheat and barley.
- Peasant households also raise livestock, and the proportion of livestock raised increases as the size of cultivated area increases.
- More than 20% of peasant households own agricultural machinery, with tractors, tillers, and trucks being most commonly owned by farmers with cultivated areas of 1 ha or more.

Table A2.1.7 Cultivated Land Area of Peasant Household (unit:%)

Item	Distribution of rural households by land area in their size
Households with land area (ha):	-
0.5 and less	**51.3**
of which-	
to 0.25	26.5
0.26 – 0.50	24.8
0.51 – 1.00	**26.9**
1.01 and more	**21.8**
of which-	
1.01 – 5.00	18.3
5.01 – 10.00	2.1
10.01 and more	1.4

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

Table A2.1.8 Cultivated Land Area for Perennial Food Production in Peasant Household (Percent)

Item	All household	Household with land area		
		0.5ha and less	0.51–1.00ha	1.01ha or more
Agricultural land – total	100.0	100.0	100.0	100.0
Including				
arable land	89.4	88.1	86.4	90.2
perennial plantations	1.4	5.4	2.5	0.7
of which				
Gardens	1.2	4.5	2.2	0.6
Vineyards	0.1	0.5	0.1	0.0
Berries	0.1	0.4	0.2	0.1
hayfields and pastures	8.4	6.1	10.2	8.3
fallow land	0.8	0.4	0.9	0.8

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

Table A2.1.9 Cultivated Land Area for Grains and Craft Crops in Peasant Household (Percent)

Item	All households	Households with land area		
		0.5 ha and less	0.51–1.00 ha	1.01 ha and more
Share of the sown area of grain and leguminous crops in the total sown area	55.7	25.6	40.0	61.9
Share of crop area in total crop area of grain and leguminous crops, by crops:				
Wheat	50.1	29.5	44.7	51.6
Barley	24.3	10.7	17.2	25.8
Rye	0.4	0.4	0.4	0.4
Maize	21.5	49.5	30.6	19.1
Share of the sown area of industrial crops in the total sown area	19.2	0.5	1.7	24.4
Share of crop area in total crop area of industrial crops, by crops:				
Soybeans	19.9	59.2	79.1	19.1
Sunflower	77.9	40.8	20.7	78.7
Share of the sown area under:				
potatoes	10.8	41.9	24.8	4.8
vegetables of open ground and Cucurbitaceae	3.0	14.2	6.2	1.1
fodder crops	11.3	17.8	27.3	7.8
Reference: share of non-sown arable area in 2021	8.2	8.3	9.1	8.0

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

Table A2.1.10 Breakdown of Livestock on Peasant Household (Percent)

Item	All households	Households with land area		
		0.5 ha and less	0.51–1.00ha	1.01 ha and more
Share of households keeping of agricultural animals in the total number of households (%)	61.2	47.7	71.4	80.4
Cattle	26.2	16.1	26.4	40.2
Cows	25.4	15.2	25.7	39.4
pigs and hogs	37.2	25.2	37.3	53.7
Sheep	0.6	0.3	0.4	1.2
Goats	4.3	4.3	5.3	3.3
Horses	4.0	1.4	3.6	8.1
Rabbits	5.7	4.9	6.1	6.4
Poultry	96.1	95.2	96.9	96.5
Bees	1.4	0.7	1.2	2.6
Availability of agricultural animals per 10 households, heads				
Cattle	2.5	1.0	2.9	5.4
Cows	1.9	0.8	2.2	4.1
pigs and hogs	4.2	1.7	4.8	9.1
Availability of poultry per household, heads	12.9	9.5	14.5	18.9
Share of agricultural animals kept in households, by size of land area of households (%)				
Cattle	100.0	21.1	31.3	47.6
Cows	100.0	21.1	31.6	47.3
pigs and hogs	100.0	21.3	30.7	48.0
Poultry	100.0	37.9	30.2	31.9

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

Table A2.1.11 Agricultural Machinery owned by Peasant Household (Percent)

Item	All households	Households with land area		
		0.5 ha and less	0.51–1.00ha	1.01 ha and more
Share of households, which have machinery and equipment, in the total number of households	22.6	16.4	22.2	37.7
Share of households, which have machinery and equipment, by type of machinery and equipment:				
Plough	25.0	8.5	18.3	46.8
seeding machine	11.5	2.2	6.4	24.6
Harrow	20.8	5.7	15.9	39.6
Cultivator	13.7	3.2	9.8	27.1
Tractor	19.1	6.2	10.9	38.2
Combine	1.4	0.0	0.2	3.6
Separator	9.5	6.1	8.8	13.4
peeling mill	20.6	20.1	18.2	22.9
Truck	2.5	1.4	1.4	4.5

Source: Prepared by JICA Survey Team from State Statistics Service of Ukraine

2.1.7 Analysis: Agricultural Policy and Strategy

i. Section 2.1.6 points out that there is no established definition or classification for farmers. However, the "small-scale farmers" targeted for support in the survey can be considered as: (1) "Micro-enterprises" among registered "legal entities," (2) registered "individual entrepreneurs," and (3) "peasant households." Yet, it is important to note that peasant households are not registered and are therefore not included in national agricultural statistics. Also, the definition of micro-enterprises includes companies with annual revenues of less than 2 million Euros, which may be larger than

generally assumed.

ii. As indicated in Section 2.1.3, two post-war reconstruction plans/strategies for the agricultural sector are outlined (National Reconstruction Plan 2022, Agricultural and Rural Development Strategy 2030). Within these, 13 priority projects and 13 post-war reconstruction plans are specified. The following key terms, which will be important in the survey, are summarized from these plans:

"Construction of irrigation systems [A]," "Restoration of irrigation infrastructure [B] "

- "Maintaining agricultural production activities related to port blockades A," "Diversification of domestic and export logistics B"
- "Development of high-value agricultural products (vegetables/fruits/berries/seeds) [A]," "Promotion of high-value products [B]"
- "Regeneration of damaged land [A]," "Mine removal from farms, agricultural land, and village gardens [B]"
- "Comprehensive planning for village development and land use within communities [A]"

(Note: Labels in the upper right indicate A: National Reconstruction Plan 2022, B: Agricultural and Rural Development Strategy 2030)

iii. Due to the current conflict with Russia, Ukraine will strengthen its ties with EU countries. Ukraine aims for future EU membership and has laid the groundwork by signing the "Deep and Comprehensive Free Trade Agreement (DCFTA)," which came into effect in 2016. While this is a tailwind for promoting the export of domestic agricultural products for large agricultural companies with strong international competitiveness, this also means an increase in the inflow of cheap foreign agricultural products, which has negative implications for promoting the added value of domestic horticulture.

iv. Similar to the above point 3, the same can be said for the irrigation sector discussed in the next chapter. According to the "EU Water Framework Directive" (refer to 2.2.1(3)), which was also signed and introduced in Ukraine in 2016, the country is obligated to adopt European standards in various public life sectors, including water management, water conservation, and water pollution prevention.

v. Decoupling from Russia post-war and strengthening ties with the EU are essential trends for Ukraine's post-war reconstruction. To achieve quick post-war recovery, technical assistance is also needed to overcome these more stringent EU standards and unfavourable conditions.

2.2 Irrigation

2.2.1 Overview and History of the Irrigation Sector[9]

Irrigated area in Ukraine accounts for only 1% of the country's land but contributes to the rural economy in certain crops/regions, such as potatoes (15%), most tomatoes and rice (14%), and certain other crops, such as Kherson Oblast (14%).

The irrigation and drainage system in Ukraine was developed in the 1960s, 70s, and 80s, when the country was part of the Soviet Union and agriculture was conducted by large state and collective farms. The State Water Agency of Water Resources, under various names and regimes, had been responsible for supplying irrigation water to these large-scale farms and collecting drainage water from them. At its peak, about 2.2 million ha were irrigated and more than 3 million ha were drained, mainly in the northwestern part of the Country with heavier precipitation than other areas of the Country.

The collapse of these large-scale farming systems was triggered by the Soviet Union's dissolution and Ukraine's swift economic and political shifts, creating a vacuum without clear responsibility for the management of the regional irrigation systems. As a result, buried metal pipelines, equipment of pumping stations, and secondary canal lining materials were stolen.

Irrigation systems developed during the Soviet Union were almost entirely financed by the state through budget allocations to state agencies, intentionally low electricity prices and post payments, and payments by state-controlled farms. After independence, Ukraine faced a severe budget crisis, with the budget of state agencies unable to sustain the rapid increases in electricity and other prices, and payments from new private farms unable to make up the shortfall. Since then, these agencies' budgets have been almost exclusively devoted to day-to-day personnel and administrative costs, with little for preventive maintenance of facilities and almost complete withdrawal from areas with severely deteriorating systems.

Meanwhile, the development of new private farms was most rapid in the southern part of the Country, especially in Kherson, Mykolaiv, and Zaporizhzhia Oblasts, where new entrepreneurs were highly motivated to manage most of the irrigation systems in this region. By 2013, the total irrigated area over the Country amounted to 300,000-400,000 ha, with less than 20% of the peak, and was almost entirely concentrated in this region. The approximate operational irrigated areas as of 2021 are 540,000 ha.

Given these conditions, it is clear that the irrigation, drainage, and water resources management sectors in Ukraine were already at a turning point before the war, necessitating sectoral reforms to overcome existing challenges .

2.2.2 Policies in Irrigation Sector

(1) World Bank, Irrigation and Drainage Strategy 2018.

This Strategy provides a vision for the restoration and modernization of irrigation and drainage systems in Ukraine and how they should be managed; it comes at a time when the EU Water Framework

9 Irrigation and Drainage Strategy of Ukraine, World Bank

Directive is being transposed into national law and water resource management system in Ukraine is undergoing significant change. The strategy is fully supportive of the direction taken by Ukrainian agriculture.

The primary goal of Ukrainian agriculture is to bring wealth to the country, and the objective of this strategy is to support that goal by establishing an effective and efficient irrigation and drainage sector that serves the needs of its farmers. This will achieve increased water productivity, higher crop yields, increased agricultural production, and increased exports.

This Strategy is fully consistent with (i) the "Ukraine 2020" Strategy for Sustainable Development, (ii) the Draft Comprehensive Strategy for Agriculture and Rural Development 2015-2020, (iii) the Key Principles (Strategy) for Ukraine's National Ecological Policy to 2020, (iv) the Sustainable Development Goals to 2030, and the Association Agreement with the EU and (v) the National Strategy for Regional Development until 2020, which is fully consistent with a number of key national strategies. The implementation of this Strategy has required the drafting and adoption of new laws and other regulatory instruments as well as changes and amendments to existing legislation.

Reforms to achieve these objectives and adequately address each phase of the irrigation and drainage system include,

Reform 1: Improve the Nation's ability to manage water resources
Reform 2: Improve mass water supply and drainage
Reform 3: Transfer management of irrigation and drainage systems to local stakeholders through water users' associations
Reform 4: Ensure financial sustainability
Reform 5: Stimulate profitable investment

These reforms will be implemented in two phases. Phase 1 will reorganize the internal state institutions into the Water Resources and Water Works Departments and commence the process of establishing water user associations. Phase 2 will then complete the process of transferring the Water Division's responsibilities to the new stakeholder-operated regional irrigation and drainage water users' association and transferring the management of the tertiary system, consisting of units of tertiary canals branching off from the main and branch lines (secondary canals), to WUA.

(2) Ministry of Agrarian Policy and Food, "Irrigation and Drainage Strategy to 2030"

Irrigation and drainage strategy in Ukraine until 2030 is a nationwide cross-sectoral policy document is aimed at application of irrigation and drainage arrangements with a view of increase of crop yields two to three times, compared to rainy conditions, irrespectively of existing weather conditions. In the current circumstances, irrigation and drainage restoration is a key tool development of the agrarian sector of economy and increase of export potential of Ukraine, minimizing the impact of climate on the processes of socio-economic development of the regions.

The purpose of this Strategy is to determine the strategic direction of public policy on irrigation and drainage and to ensure the development of sustainable and environmentally sound agriculture in Ukraine. The Strategy also intends to restore the potential of irrigation and drainage systems and further expand

irrigation and water use areas in order to maximize the efficiency and environmental safety of agricultural production.

The problems currently faced are: (a) the inability of irrigation/drainage systems to function as a resource and to ensure national food security in years of adverse weather conditions due to very low utilization of available capacity; (b) incomplete laws on water management and agricultural land reclamation, inadequate management and development system for water users to achieve a gradual transition to self-financing of irrigation and drainage, and the unresolved matters to determine the conditions and opportunities for sustainable decentralized management and operation; (c) water management and reclamation systems characterized by a high degree of centralization, lack of water user's participation in irrigation/drainage system management and tariff setting, and incomplete system for expansion of irrigated areas and water quality control areas; and (d) lack of clear rules for the operation of irrigation systems that supply water to farms.

The scope of the Strategy is to be achieved through application of the following arrangements: (a) reforming the public administration system for irrigation and drainage through application of integrated water management based on the basin principle, accounting and separation of the function of water management (in particular implementation of public policy, water use planning and water distribution) from the function of water infrastructure management; (b) preservation and restoration of soil fertility, protection of territories and settlements from the harmful effects of water, achievement and maintenance of the good status of the river water basins; (c) restoration and expansion of the areas of irrigated lands, drainage systems; (d) promotion of the mechanism of public-private partnership; (e) stakeholder involvement in decision-making in the relevant field of public policy; (f) creating prerequisites for enhancing national competitiveness of agricultural production on the world market; (g) improving the quality of irrigation and drainage services and transparency of tariffs formation; and (h) support of scientific research, training of qualified personnel.

(3) EU Water Framework Directive

Directive 2000/60/EC of the European Parliament and of the Council dated 23 October 2000 aims (hereinafter referred to as the Water Framework Directive) to establish a framework for Community action in the field of water policy, and to lay down the main provisions for EU countries to achieve good water quality in their water areas. The Water Framework Directive is the main document in the field of EU water policy. All surface, groundwater, transitional and coastal waters within each river basin are covered by the Directive.

The basic principle of the Water Framework Directive is to recognize the river basin as a fundamental hydrographic unit for water resources management, an integrated natural hydrographic entity that is not limited by administrative or national boundaries.

An Association Agreement signed in 2014 between Ukraine and the European Union and its member states obliges Ukraine to adopt European standards in various areas of public life, including water management, water conservation, and water pollution prevention.

The implementation of the Water Framework Directive in Ukraine was adopted and started on October 04, 2016. The Law "On Amendments to Certain Legislative Acts of Ukraine on the

Implementation of the Integrated Approach to Water Resources Management Based on the Basin Principles" (hereinafter - Law No. 1641). Pursuant to Law No. 1641, a number of legislative acts, including the Law on Water of Ukraine, were amended in order to introduce the practice of water resources management based on watershed principles in Ukraine, in particular a) defining the concept of "watershed management principles"; b) establishing zoning for waterways and water management on the territory of Ukraine; c) planning, approval, and implementation of river basin management; d) establishment of the legal status of watershed councils; and e) development, approval, and implementation of water management, five of which are regulated by laws.

2.2.3 Irrigation Laws and Institutions

A summary of irrigation-related laws and regulations is presented in Table A2.2.1.

Table A2.2.1 Laws, Regulations on Irrigation in Ukraine

Law Code	Name of Law	Purpose/Outline of Law
No. 1389	Law about land reclamation lands	This Law determines basics legal regulation public relations that arise in the process carrying out land reclamation land, use reclaimed land and reclamation systems, and powers bodies executive authorities and bodies local government in the field land reclamation lands and directed on software ecological security ameliorative systems and protection public interests.
No. 2079	The Law of Ukraine “On organizations of water users and stimulation of hydrotechnical land reclamation”	This Law defines the legal status of water user organizations, the procedure for their creation, operation and termination, the procedure and conditions for their acquisition of rights to the engineering infrastructure objects of inter-farm and on-farm melioration systems, features of operation of water user organization melioration networks, rights and obligations of members of water user organizations.
No. 7577	Law on Amendments to Certain Legislative Acts on Improving the Management System of Engineering Infrastructure Objects of State-Owned Land Reclamation System	This law provides for proper operation and maintenance of irrigation systems that do not transfer ownership of irrigation facilities to water users' associations. It aims to establish a non-profit organization to operate and maintain state-owned irrigation systems, create a mechanism for various water users to participate in irrigation project management, promote transparency in the use of government subsidies, and clarify the method of setting service fees.
No. 476	On an approval of the Procedure for Conducting Land Inventory	This Procedure defines requirements for conducting land inventory, including state inventory of lands and land plots, in the course of land management and preparation of technical documentation on land management for conducting land inventory, including state inventory of lands and land plots.
No. 962	Model Charter of the organization of water users.	Pursuant to Law No. 2019, prescribes a model charter for water users' associations.
No. 77	Procedures for the use of funds provided in the state budget for the financial support of agricultural producers	This defines the mechanisms for the use of funds provided under the "Financial Support to Agricultural Producers" program in the State Budget of the Ministry of Agricultural Policy and Food. The objectives of the budget use are to expand agricultural production, increase agricultural productivity, promote agricultural market development, and ensure food security.
No. 1070	Procedures for the use of funds provided for in the state budget for the provision of state support to agricultural commodity procedures who use reclaimed land and water user organizations.	This defines the mechanisms for the use of funds allocated for state support to agricultural producers and water users associations that use reclaimed land in the State Budget of the Ministry of Agricultural Policy and Food "Program of Financial Support to Agricultural Producers". To increase agricultural efficiency in response to climate change, increase the area of reclaimed land, and increase total agricultural production, budget is allocated for state support to agricultural producers using reclaimed land, as well as to water users' associations for the rehabilitation of pumping stations that are not in operation or whose ownership has been transferred.

Law Code	Name of Law	Purpose/Outline of Law
No. 974	Determination of the levels of performance indicators of the upmping station, which has been transferred to the ownership of the organization of water users.	If the effective rate of the pump is lower than the standard, financial assistance may be obtained from the State.

Source: Websites of Ukrainian Government

2.2.4 Organizations in Irrigation Sector

(1) Government agencies

The central administrative bodies responsible for the formulation and implementation of national policies in the field of water resources/irrigation policy are:

1) The Ministry of Environmental Protection and Natural Resources of Ukraine (hereinafter referred to as the "Ministry of Environmental Protection") is the central administrative body that ensures the formation and implementation of state policies in the field of environmental protection, ecology, and biological and genetic safety within the powers provided by law, as well as in the field of water resources development, management, use and reuse of surface water resources.

2) The Ministry of Agrarian Policy and Food of Ukraine is a central administrative body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine and is the leading body in the system of central administrative bodies, ensuring the formation and implementation of state policies in the field of agricultural land development, multipurpose national water management facilities, and operation of inter-farm irrigation and drainage systems.

3) The State Water Resources Agency of Ukraine is a central administrative body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Environmental Protection and Natural Resources, and which implements state policy in the field of water resources development, management, and use and reuse of surface water resources.

4) The State Agency of Melioration and Fisheries of Ukraine is a central administrative body whose activities are directed and coordinated by the Cabinet of Ministers of Ukraine through the Minister of Agrarian Policy and Food, and which implements state policies in the areas of fisheries and fishery, protection, utilization and re-production of aquatic biological resources, regulation of fishing, agricultural land development, operation of multipurpose national water management facilities and inter-farm irrigation systems.

(2) State Agency of Melioration and Fisheries of Ukraine

a) Description of duties

The following is a summary of the duties of the State Agency of Melioration and Fisheries of Ukraine

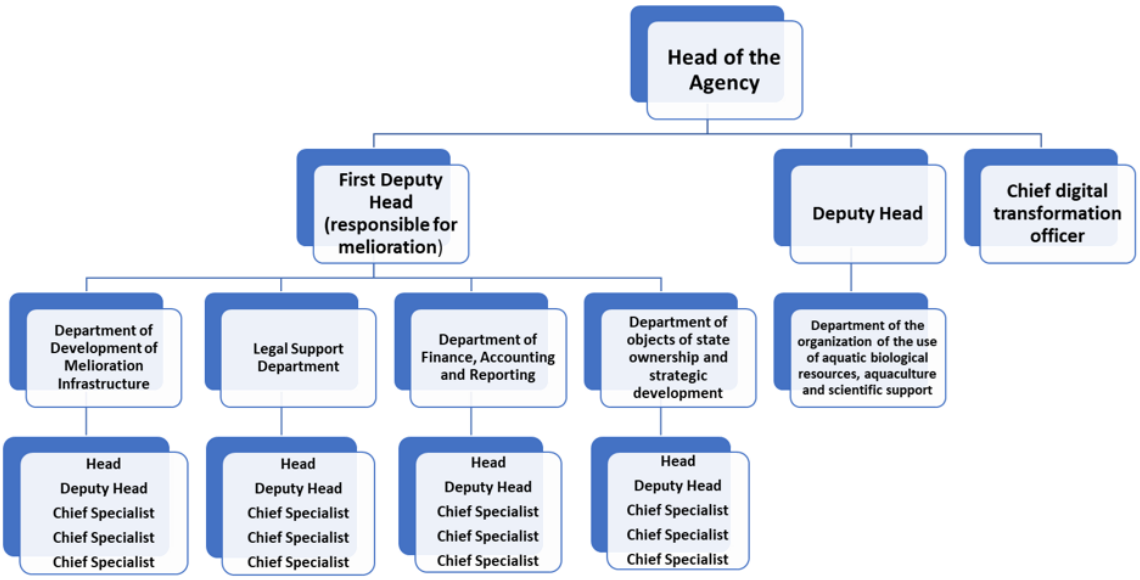
1) Implementation of state policies in the field of melioration and operation of multi-purpose state, water management facilities of the inter-farm irrigation and drainage system

2) Submission of proposals to the Minister of Agricultural Policy and Food to ensure the formation of national policies in the field of melioration and operation of multi-purpose state of the art water management facilities, inter-farm irrigation and drainage systems.

Details of the tasks of the Melioration and Fisheries Agency are provided in Annex 2.2.1.

b) Organization

The organizational structure of the Stare Agency of Melioration and Fisheries is shown in Figure A2.2.1.



Source: State Agency of Melioration and Fisheries

Figure A2.2.1 Organization of the State Agency of Melioration and Fisheries

(a) Headquarters

The management positions of the Agency for Land Reclamation and Fisheries are Director General, First Deputy Director General, Deputy Director General, and Deputy Director General for Digital Development, Digital Transformation and Digitalization. The Agency has specialized departments: a) Department of Development of Melioration Infrastructure, and b) Department of Water Resources Utilization, Aquaculture, and Scientific Support Associations. Several specialists are assigned in each department. Other administrative departments include a) the Legal Support Department, b) the Finance, Accounting and Reporting Department, and c) the National Property Management and Strategic Development Department. In total, the Agency has approximately 90 central government employees.

i) Department of Development of Melioration Infrastructure

Main tasks

- Implementation of national policies in the areas of agricultural land development, including irrigation and drainage facilities, operation of multi-purpose national water management facilities, and inter-farm irrigation and drainage systems.
- Preparation and submission of proposals for the formation of national policies in the field of agricultural land development including irrigation and drainage facilities, operation of multi-purpose national water management facilities, inter-farm irrigation and drainage systems.
- Coordination of the activities of enterprises, institutions and associations under the control of the Agency and implementation of national policies in the field of agricultural land development, including irrigation and drainage facilities, and operation of multipurpose national water management facilities and inter-farm irrigation and drainage systems.

ii) Legal Support Department

Main tasks

- Legal support for the implementation by the Agency of state policies in the field of fisheries and fishery, protection, use and rehabilitation of aquatic biological resources, fisheries regulation, agricultural land development, operation of multipurpose water management facilities, inter-farm irrigation and drainage systems.
- Preparation of proposals to summarize the practice of applying the law on issues within the competence of the national agency and to improve the legislation, the laws of the President of Ukraine and the Cabinet of Ministers of Ukraine, and the regulations of the ministries.
- Participation in the implementation of state policy in areas where Ukrainian legislation needs to be adapted to EU legislation.

iii) Finance, Accounting and Reporting Department

Main tasks.

- Implementation of national budgetary policies in the field of fishery, protection, utilization and rehabilitation of aquatic biological resources, regulation of fisheries, safe navigation of fishing fleet vessels, land reclamation, operation of multi-purpose national water management facilities, and participation in inter-farm irrigation and drainage systems.
- Participation in the development of key directions of investment, budgetary, tax, financial and credit policies in the field of fishing and fisheries, protection, use and rehabilitation of aquatic biological resources, regulation of fishing, safe navigation

of fishing fleet vessels, land reclamation, operation of multi-purpose national water management facilities, and inter-farm irrigation and drainage systems.

- Ensuring compliance with fiscal and budgetary discipline by regional organizations and budgetary bodies under the control of state agencies.

iv) National Property Management and Strategic Development Department

Main tasks.

- Implementation of state policies in the sphere of management of state property and use of state property, within the scope of the powers granted to state agencies.
- Participation in the preparation of proposals to ensure the formation and implementation of state policies in the field of fisheries and agricultural land development.
- Participation in the economic analysis of the state of the fisheries industry and development trends, in the formulation of the balance of supply and demand for fish and fish products, and in the development of priority areas, strategies and mechanisms for the development of the fisheries industry and agricultural land development.

(b) Regional Office

The regional offices under the State Agency are located in Vinnytsia, Volyn, Dnipropetrovsk, Donetsk, Zhytomyr, Zakarpattia, Zaporizhzhia, Ivano-Frankivsk, Kyiv and Kyiv, Kirovohrad, Luhansk Lviv, Mykolaiv, Odesa, Poltava, Rivne, Sumy, Ternopil, Kharkiv, Kherson, Khmelnytskyi, Cherkasy, Chernivtsi, Chernihiv Regions, Azov and the Black Sea Coast region.

The main tasks of the regional offices are the protection, utilization and reproduction of fishery resources, the regulation of fisheries, land reclamation and the exercise of the authority of the Agricultural Land Reclamation and Fisheries Agency in the operation of multipurpose national water management facilities, inter-farm irrigation and drainage systems. The number of employees per local organization is approximately 70.

(3) Water Users' Association (WUA)

A water users' association is a non-profit association established by the owners and/or users of agricultural land parcels in accordance with Law No. 2079 enacted in February 2022 (hereinafter referred to as the Water Users' Association Law) to provide services for irrigation water allocation within the association service area and to ensure the use, operation and maintenance of the water facilities comprising the irrigation system.

A summary of water users' association establishment and organization is summarized in Table A2.2.2. Details are provided in Annex 2.2.2.

Table A2.2.2 Establishment and Organization Water Users' Association

No.	Category	Description
1	WUA as a Legal Entity	WUA is a non-profit corporation established in accordance with Law No. 2079-IX, "Law on the Promotion of Water Users' Association Organization and Irrigated Agricultural Land Reclamation.
2	Preparation for establishment of WUA	Preparatory work for the establishment of WUA requires a list of agricultural land parcels and their owners (users) in the service area of WUA. Initiators (initiator) sends a notice to the water users to hold a meeting to establish WUA.
3	Requirements for Establishing WUA	A majority of the votes cast by the landowners (users) at the founding general meeting must be in favor of the total number of votes cast by the landowners (users).
4	Joining WUA	Those who vote in favor at the founding general meeting for WUA have the right to become full members. Those who voted against or were absent from the meeting may join WUA as associate members.
5	Resolutions on important agenda at the general meetings of WUA	A majority of the votes cast for the total number of votes held by the landowners (users) is required to approve the proposal.
6	Constitution of WUA	Any enactment or amendment of constitution of WUA shall require the approval of the general meeting.
7	Rights and bligations of members of WUA	Members exercise their rights and fulfil their obligations in accordance with the constitution of WUA.
8	Administrative organization of WUA	The general meeting of the association is the highest decision-making body. The executive committee, headed by the president, and the Audit Committee are established with the approval of the general meeting.

Source: Law No. 2079 compiled by JICA Survey Team

The total number of votes cast at the general meeting for the foundation of the association and at the general meeting of WUA is the basic vote plus additional votes. Each member has one basic vote, and additional votes are allocated proportionally according to the area of land parcels owned (used) by each member. For example, if there are 100 members, the total number of votes cast is 200. The basic vote is 100, and the additional 100 votes are allocated proportionally according to the area owned (used) by each member.

2.2.5 Operation and Maintenance of Irrigation Systems

(1) Responsibility for irrigation system management

Before the irrigation sector reform, the responsibility structure for operation and maintenance of irrigation systems is shown in Table A2.2.3. Irrigation systems were operated and maintained by government agencies.

Table A2.2.3 Operation/Maintenance Structure of Irrigation Systems Before Irrigation Sector Reform

Category	Investment to Irrigation and Drainage Infrastructures	Operation and Maintenance to Irrigation and Drainage Infrastructures	Cost bearing for Operation and Maintenance to Irrigation and Drainage Infrastructure
Main system (Pumping Station, Main Canal/Pipeline)	Government	Government	Government
Secondary Canals/Pipelines	Government	Government	Government
Tertiary Canals equipped with booster pump stations	UTC	UTC	UTC
Equipment for Irrigation (Sprinkler /Drip Irrigation System)	Farmers	Farmers	Farmers

*UTC: Regional Committee

Source: State Agency of Melioration and Fisheries

The responsibility structure for operation and maintenance of the irrigation system when the operation/maintenance of irrigation facilities is transferred to WUA in accordance with WUA Act is shown in Table A2.2.4.

Table A2.2.4Operation/Maintenance Structure of Irrigation System After Transfer to Water Users' Association

Category	Investment to Irrigation and Drainage Infrastructures	Operation and Maintenance to Irrigation and Drainage Infrastructures	Cost bearing for Operation and Maintenance to Irrigation and Drainage Infrastructure
Main system (Pumping Station, Main Canal/Pipeline)	WUA	WUA	WUA
Secondary Canals/Pipelines	WUA	WUA	WUA
Tertiary Canals equipped with booster pump stations	WUA	WUA	WUA
Equipment for Irrigation (Sprinkler /Drip Irrigation System)	Farmers	Farmers	Farmers

Source: State Agency of Melioration and Fisheries

After the transfer of ownership of irrigation system, the government will provide technical guidance and financial support to the WUA. The establishment of WUAs and the transfer of ownership of irrigation systems to WUAs will be subject to approval by the government based on farmers' applications. Therefore, the operation and maintenance of irrigation systems for which this procedure is not taken will continue to be carried out by government agencies as in the past.

The change that is expected to have the greatest impact on the irrigation system management after the transfer of the ownership is that all investment, maintenance, and cost burden for the "main irrigation system" will be transferred to the WUA, instead of being borne by the government. Although the transfer of management of irrigation systems to the private sector is a trend seen in other countries as well, in many cases, considering the human and financial acceptability of WUAs, up to the secondary canals are

transferred and the main irrigation system is managed by government agencies. In Asian countries in particular, there are many cases where the main system was once transferred to the WUA, but this proved to be impossible in practice, and the main system is now managed by the government. In the case of Ukraine, it remains to be seen how much organizational and financial strength the WUA will have, but it is important to be very careful.

(2) Irrigation system management by WUA

A summary of the operation and maintenance of the irrigation system by WUA is shown in Table A2.2.5. Details are given in Annex 2.2.3.

Table A2.2.5 Operation/Maintenance of Irrigation System by Water users' Associations

No.	Category	Description
1	Irrigation water distribution	WUA and its members enter into a service agreement and distribute water according to the terms of the agreement.
2	Preparation and implementation of operation and maintenance plans	Annual budget and maintenance plan to be approved at the general meeting and implemented.
3	Assets and financial resources of WUA	Admission fees, contributions, service fees from members, and water facilities are assets and financial resources of WUA.
4	Service fee collection system	Members of WUA shall pay water usage fees for operation and management of WUA and facility maintenance in accordance with the terms of service agreement.
5	Penalties for violators	If a member fails to pay the service charge by the specified date, WUA may suspend water supply service. It may also stipulate its own penalties in its rules and regulations.
6	Mutual coordination and cooperation with related agencies, including water use adjustment during drought	The law allows for shortfalls in water withdrawals to be adjusted to a certain percentage of water allocation based on the area of agricultural land owned (used) by each member.
7	Transfer of ownership of irrigation facilities to water users' association	WUA shall send an application for ownership transfer to the competent government agency for approval, attaching information on farmland and irrigation facilities.
8	Public financial support system	A system of government contributions to WUA is available. In addition, if the performance of the pumps is not up to standards, there are subsidy programs for their repair, etc.

Source: Low No. 2079 compiled by JICA Survey Team

The most significant change is that maintenance of irrigation facilities, which had been the responsibility of government agencies, will be transferred to WUAs.

2.2.6 Current Status of Irrigation Systems

(1) Current status at the national level

The number of irrigation systems, area equipped with irrigation system, and operational irrigated area per Oblast in 2021 are shown in Table A2.2.6.

As this table shows, as of 2021, only about 25% (563.8 / 2,173.9 thousand ha) of the total irrigated area was operational. Originally, most of the public irrigation and drainage systems were designed and built during the Soviet era, when irrigated agricultural production was planned and operated in a centralized manner. However, after Ukraine's independence, the operation and management of these systems became difficult, and the irrigation facilities have fallen into disrepair. The following three points can be cited as the causes of the deterioration of irrigation facilities.

- Due to the lack of state funding, Ukraine has not invested in irrigation facilities for many years[10].
- The moratorium on land reform has long prohibited the sale and purchase of agricultural land, leaving large farms dependent on land leases. This has resulted in little private investment in irrigation and drainage systems, as agricultural enterprises have little motivation to develop their own privately financed systems, and even if they did, access to financing has been limited (see 2.1.5 (1) for more on the moratorium). (For more information on the moratorium, see 2.1.5 (1) Laws on Agricultural Land).
- The government agency was responsible for irrigation system management (see Table A2.2.3), but lack of financial and human resources prevented proper management.

Table A2.2.6 Summary of National Irrigation Systems in 2021

Oblast	Nos. of Irrigation System	Area Equipped with Irrigation Facilities (1000 ha)	Operational Irrigation Area (1000 ha)
Crimea	N.A.	401.6	n/a
Vinnytsya	25	23.8	4.4
Volyn	N.A.	0.5	0.5
Dnipropetrovsk	31	198.7	29.4
Donetsk	16	122.3	4.7
Zhytomyr	N.A.	0.8	0.7
Zakarpattya	N.A.	0.9	0.8
Zaporizhzhya	17	240.7	66.8
Ivano-Frankivsk	N.A.	0.1	0.1
Kyiv	6	43.9	9.9
Kirovohrad	18	40.7	2.7
Luhansk	22	54.1	1.4
Lviv	N.A.	0.2	0.2
Mikolaiv	22	190.3	34.6
Odesa	55	226.9	41
Poltava	11	50.8	8.8
Rivne	N.A.	N.A	N.A
Sumy	N.A.	1.2	0.2
Ternopil	N.A.	1	0.9
Kharkiv	39	82.4	25
Kherson	12	427.1	309
Khmelnytskiy	N.A.	1.3	0.3
Cherkasy	51	63.2	20.5
Chernivtsi	N.A.	0.9	0.9
Chernihiv	N.A.	0.5	N.A
Ukraine		**2,173.9**	**562.8**

Source: State Water Resources Agency

According to the State Agency for Water Resources, in 2021, Ukraine had about 2.17 million ha of agricultural land equipped with adequate irrigation infrastructure (reservoirs, trunk and distribution channels, protective dams, pumping stations, pipelines, regulating reservoirs, drainage networks, and other hydrotechnical structures). About 600,000 ha of agricultural land was actually irrigated in 2021. This represents 1.3% of Ukraine's total agricultural land of 413,000 km2 (from World/Data Atlas/Land Use 2021).

[10] "Irrigation and Drainage Strategy of Ukraine", World Bank (https://documents.worldbank.org/en/publication/documents-reports)

An inventory data from the Ministry of Agrarian Policy and Food indicates that the inter-farm irrigation system includes 423 major intake structures, 1,730 pumping stations, and 96 reservoirs with an effective capacity of 463 million m3. The permanent irrigation system has 7,300 km long channels, with 3,300 km of open canals and 4,000 km of pipelines.

The list of irrigation systems throughout the country is established by Resolution of the Cabinet of Ministers of Ukraine dated September 27, 2022 No. 1077. The list of systems is shown in Annex 2.2.4.

(2) Outline of Major Irrigation Systems

Table A2.2.7 provides an overview of the major irrigation systems in 26 locations in Ukraine, as mentioned in the World Bank "Irrigation and Drainage Strategy 2018". Details are provided in Annex 2.2.5.

Table A2.2.7 Major Irrigation Systems in Ukraine

No.	Name of Irrigation Systems	Oblast	Area equipped with irrigation infrastructure (Estimates)	Area operational (Estimates)	Rate of Irrigation	Water resources	Type of Irrigation	Number of beneficiaries (Estimates)
1	Yaryshivska	Vinnytsia	1400 ha	930 ha	(66%)	Dniester river	Sprinkler	1
2	Kilchensk	Dnipropetrovsk	36,500 ha	35,300 ha	(97%)	Dnipro Reservoir	Sprinkler	43
3	Magdalinovska	Dnipropetrovsk	25,700 ha	5,060 ha	(20%)	Dnipro-Donbas channel	Sprinkler	9
4	Tsarychanska	Dnipropetrovsk	12,830 ha	3,320 ha	(26%)	Dnipro-Donbas channel	Sprinkler/Drip	9
5	Slavic language	Donetsk	10,074 ha	2,400 ha	(24%)	Siversk Deanery River	Sprinkler/Drip	11
6	Priazovska *	Donetsk/ Zaporizhzhia	280,000 ha	96,800 ha	(35%)	Kakhov reservoir	Sprinkler/Drip	89 ***
7	Vilnius **	Zaporizhzhia	20,021 ha	7,350 ha	(37%)	Dnipro Reservoir	Sprinkler/Drip	29
8	Severochoraghachitska *	Zaporizhzhia	164,000 ha	109,300 ha	(67%)	Kakhov reservoir	Sprinkler	64 ***
9	October	Zaporizhzhia	13,500 ha	12,671 ha	(94%)	Dnipro Reservoir	Sprinkler	11
10	Syrogozka *	Zaporizhzhya/ Kherson	116,400 ha	41,600 ha	(36%)	Kakhov reservoir	Sprinkler/Drip	44 ***
11	Kakhovskaya *	Zaporizhzhya/ Kherson	780,000 ha	262,000 ha	(34%)	Kakhov reservoir	Sprinkler/Drip	113 ***
12	Peredilska *	Luhansk	1,800 ha	864 ha	(48%)	Siversk Deanery River	Sprinkler/Drip	6 ***
13	Inguletska	Mykolayivska	60,800 ha	23,900 ha	(39%)	Ingulets River	Sprinkler	54
14	Spaska	Mykolayivska	10,200 ha	4,700 ha	(46%)	Lyubyn reservoir	Sprinkler	23
15	Yavkinska	Mykolayivska	50,300 ha	2,800 ha	(6%)	Ingulets River	Sprinkler	28
16	Yuzhno-Buzka	Mykolayivska	12,200 ha	4,168 ha	(34%)	Pivdenniy Bug River	Sprinkler	16
17	Kiliya rice	Odesa	4,832 ha	0 ha	(0%)	Danube River	Gravity	9
18	Danube-Dniester	Odesa	48,325 ha	0 ha	(0%)	Lake Sasyk	Sprinkler	0
19	Suvorivska	Odesa	10,300 ha	1,680 ha	(16%)	Lake Katlabukh	Sprinkler/Drip	8
20	Belgorod-Dnistrovska	Odesa	14,584 ha	11,937 ha	(82%)	Dniester River	Sprinkler/Drip	29
21	Nizhny-Dniester	Odesa	37,000 ha	12,000 ha	(32%)	Dniester River	Sprinkler/Drip	56
22	Tatarbunarska	Odesa	31,700 ha	12,714 ha	(40%)	Danube River	Sprinkler/Drip	38
23	Lymanetska	Kherson	1,700 ha	1,500 ha	(88%)	Dnipro River	Sprinkler	18
24	Krasnoznamyansk *	Kherson	96,700 ha	72,000 ha	(74%)	North Crimean Canal	Sprinkler/Drip	63 ***
25	Kalanchak *	Kherson	18,080 ha	14,675 ha	(81%)	Kakhov reservoir	Sprinkler/Drip	28 ***
26	Chaplinska *	Kherson	50,330 ha	38,564 ha	(76%)	Kakhov reservoir	Sprinkler/Drip	47 ***

*Located in the occupied territory, **located close to the war zone, *** The number of members before the war
Source: Ministry of Agrarian Policy and Food

The majority of the water sources for the main irrigation system are reservoirs constructed on the rivers, such as the Dnipro, Dniester, and Ingulet. The average rate of operational irrigation rate is about 40%, but this rate is not directly related to the scale of the irrigation system. All systems are irrigated with sprinklers, among which 14 systems are partially irrigated with drip irrigation systems.

(3) Reservoirs

The reservoir cascade constructed on the Dnipro River, an important source of irrigation water, consists of six reservoirs as indicated in Table 2.2.8.

Table A2.2.8 Reservoirs Constructed on the Dnipro River

	Name of Reservoir	Year of Construction	Length	Width	Area of Reservoir	Total Storage Capacity
1	Kyiv	1966	110km	12km	922km^2	3.73 km^3
2	Kaniv	1978	120km	8km (Max.)	675km^2	2.73 km^3
3	Kremenchuk	1961	149km	28km (Max.)	2,252km^2	13.5km^3
4	Dniprodzerzhinsk	1964	114km	16km	567km^2	2.45km^3
5	Dniplro	1932	129km	3.2km (Ave.)	410km^2	3.3 km^3
6	Kakhovka	1958	230km	25km (Max.)	2,155km^2	18.2km^3

Source: https://web.archive.org/web/20130109082749/http://geografica.net.ua/publ/galuzi_geografiji/fizichna_geografija_ukrajini/vodojmi_ukrajini_ozera_limani_vodoskhovishha_bolota_i_kanali/39-1-0-533)

(4) Major channel networks

As presented in Table A2.2.9, Channels in Ukraine are constructed primarily in the Dnipro River, Siversky Donets River, and partially in the Danube River basins. Their main purpose is water supply, irrigation, and drainage, and some are also used for aquaculture and recreation.

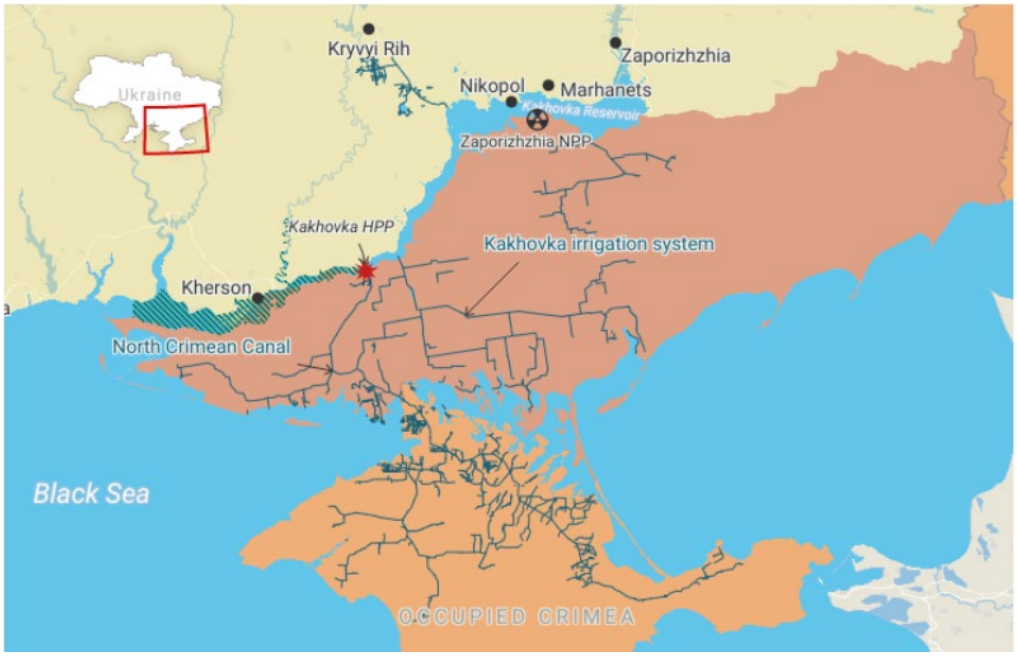
Table A2.2.9 Major Channel Networks

	Name of Canal	Year of Construction	Water Resoureces	Length
1	North Cremia	1976	Kakhovka Reservoir	400km
2	Dnipro-Donba	1981	Dniprodzerzhinsk Reservoir	263km
3	Kakhovka	1979	Kakhovka Reservoir	130km
4	Dnipro-Kryvyi	1961	Kakhovka Reservoir	40km

Source: https://web.archive.org/web/20130109082749/http://geografica.net.ua/publ/galuzi_geografiji/fizichna_geografija_ukrajini/vodojmi_ukrajini_ozera_limani_vodoskhovishha_bolota_i_kanali/39-1-0-533)

(5) Status of Irrigation system (case study of Kakhovka irrigation system)

The Kakhovka main canal is a 130 km long canal constructed in 1979 to irrigate farmland and supply water to rural communities in Kherson and Zaporizhzhia Oblasts. The water source is the Kakhovka Reservoir, and irrigation water is pumped from a pumping station with a capacity of 530 m3/s (head is 24.3 m) and supplied to the main canal. A map of the Kakhovka irrigation system, photographs of the pumping station, and the main canal are shown in Figures 2.2.2 through 2.2.4.



Source: https://Euromaidanpress.com/2023/07/03/russias-destruction-of-kakhovka-dam-five-blows-to-economy-environment-of-world-and-ukraine/

Figure A2.2.2 Location Map of the Kakhovka Irrigation System

Source:https://www.ukrinform.net/rubric-ato/3625907-base-pump-station-within-kakhovka-main-canal-flooded-due-to-enemy-shelling-khlan.html

Figure A2.2.3 Kakhovka pumping station

Source:https://www.wikidata.org/wiki/Q4217790#/media/File:%D0%9A%D0%B0%D1%85%D0%BE%D0%B2%D1%81%D1%8C%D0%BA%D0%B8%D0%B9_%D0%BA%D0%B0%D0%BD%D0%B0%D0%BB_%D0%9B%D1%8E%D0%B1%D0%B8%D0%BC%D1%96%D0%B2%D0%BA%D0%B0.jpg

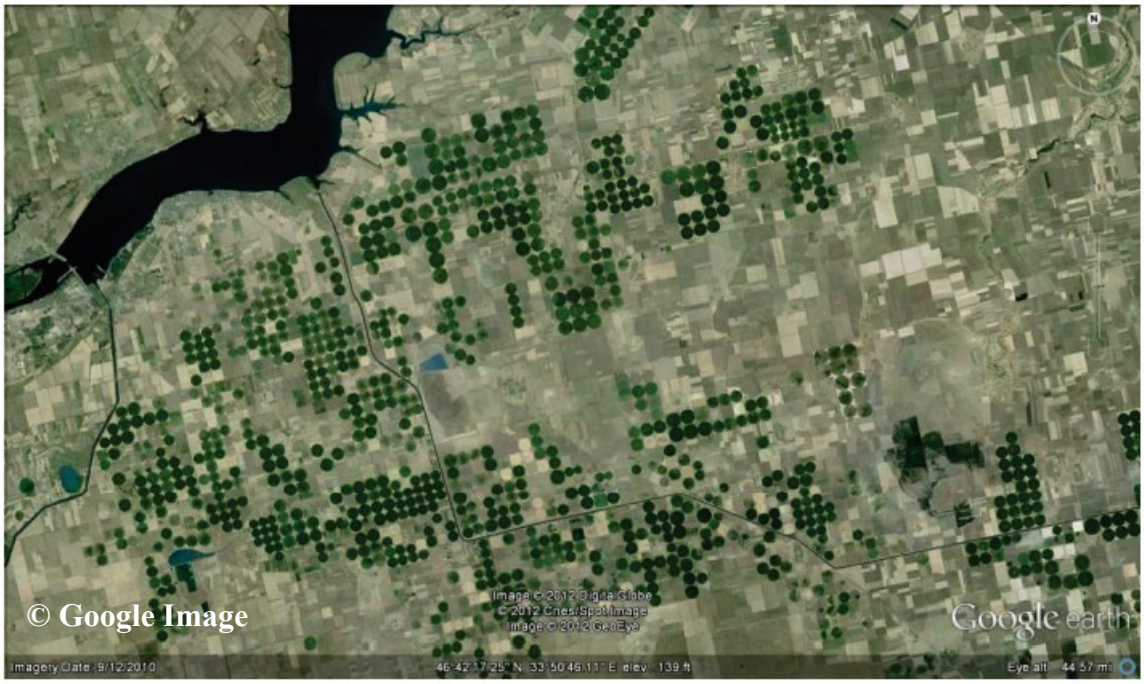
Figure A2.2.4 Kakhovka trunk canal

4 water level regulators 12 diversion facilities to inter-farm canals, one railroad bridge, 12 road bridges, and one pedestrian bridge, were constructed on the main canal. From the Kakhovka canal branch the main secondary canals that make up the irrigation system, including Priazovska, Syrogozka, Henicheska, Kalanchatka, and Perekop. Through this irrigation network, 348,000 ha of irrigated area is developed, with 261,000 ha irrigated in 2013. At the first diversion point on the Kakhovka main canal, another pumping station has been constructed, pumping 18 meters, and diverting water to secondary canal R1. All other secondary channels are gravity fed.

The R1 secondary canal provides irrigation water to 17,500 ha of farmland. 95% of the area is managed by 30 large farmers, with the remaining 5% operated by an unspecified number of small

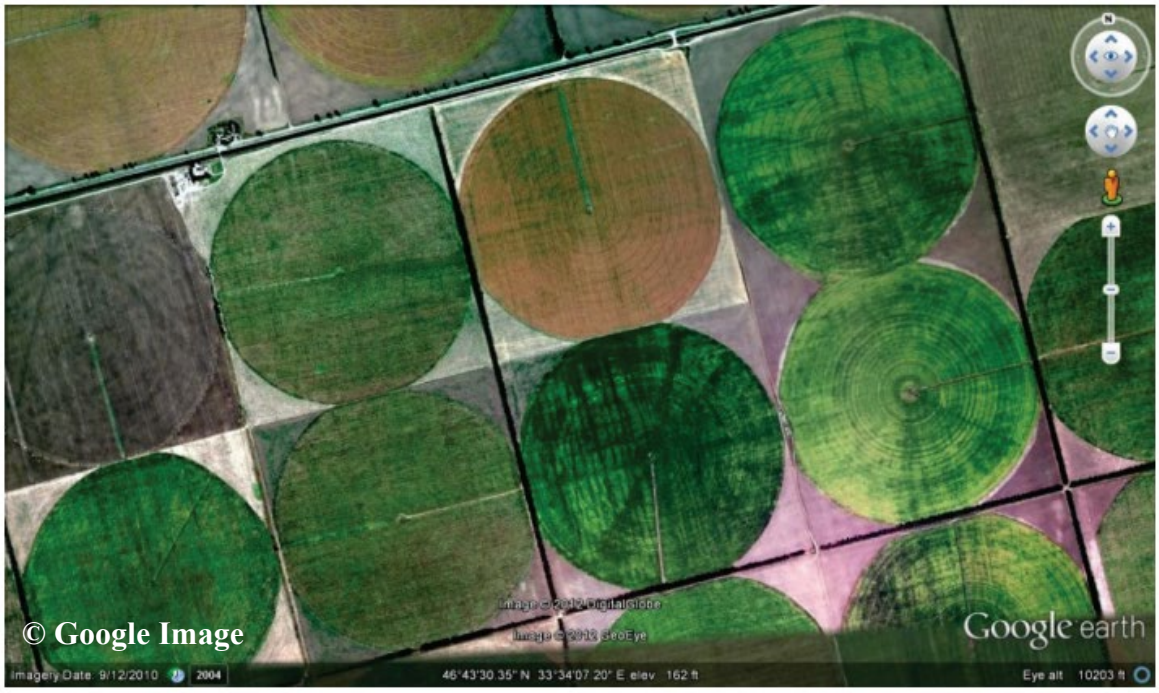
farmers. The main irrigated crops are soybeans, corn, and vegetables, with wheat added when crop rotation is required or when the system capacity is insufficient to meet peak demand for soybeans and corn throughout the region.

The secondary canal R1 is 27 km long and has 17 pressure pumping stations along the canal route. Each with 4 to 6 electric pumps applies approximately 10 atmospheres of pressure to deliver water to an irrigation network consisting of buried metal pipelines. Each pumping station supplies irrigation water to about 1,000 ha of 2-3 large farmers and an average of 50 ha of small farmers (usually growing vegetables with drip irrigation). Each pipeline has 12 to 24 hydrants, and each hydrant is serviced by one irrigation unit (usually a large center-pivot sprinkler covering about 65 ha of fields of almost 1 km square). These sprinkler systems were installed in the late 1970s and 1980s, during the period of the former Soviet Union.



Source: Google Image (CURRENT STATE OF IRRIGATION IN THE KHERSON, STEPPE ZONE OF UKRAINE AND IN KUJAWSKO-POMORSKIE PROVINCE IN POLAND, Valery S. Reznik, Olena S. Morozova, Olexiy V. Morozov, Iwona Jaskulska, Jarosław Kamieniarz) (URL: http://bestplacesofworld.com/node/43)

Figure A2.2.5 Aerial View of Kakhovka Irrigation System (1/2)



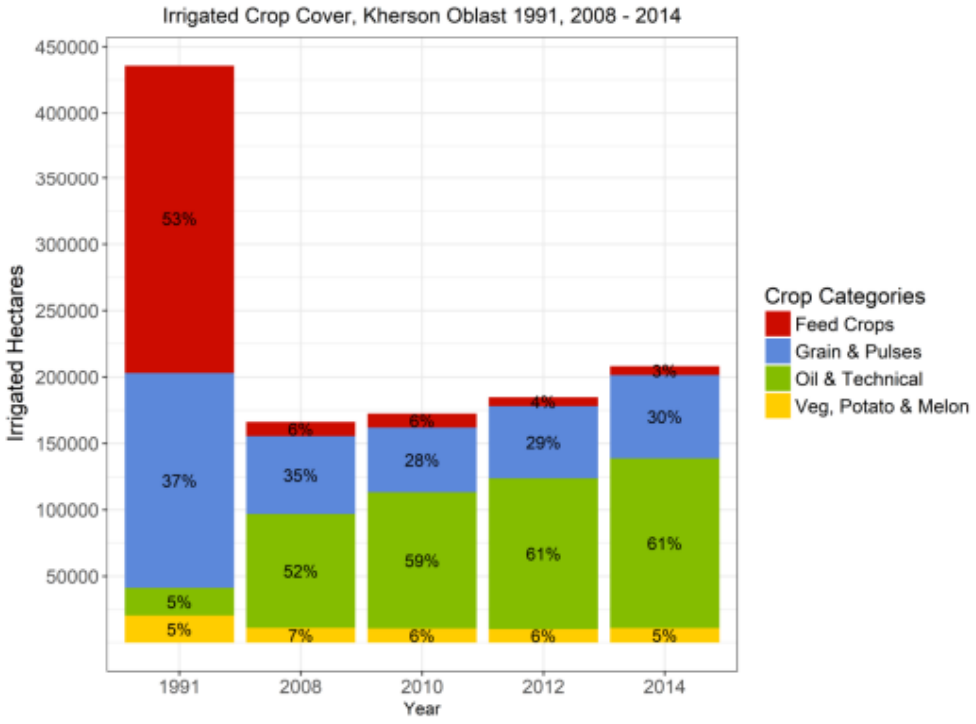
Source: Google Image (CURRENT STATE OF IRRIGATION IN THE KHERSON, STEPPE ZONE OF UKRAINE AND IN KUJAWSKO-POMORSKIE PROVINCE IN POLAND, Valery S. Reznik, Olena S. Morozova, Olexiy V. Morozov, Iwona Jaskulska, Jarosław Kamieniarz) (URL: http://bestplacesofworld.com/node/43)

Figure A2.2.6 Aerial View of Kakhovka Irrigation System (2/2)

- The efficiency and profitability of this irrigation system can be improved in several ways.
- Replacing pressure pumps and sprinklers with modern, low-pressure equipment can almost halve the final pumping cost.
- Rehabilitating or replacing pressure pumps, pipes, and sprinklers can reduce breakdown of the system and yield losses, and can increase the percentage of more profitable crops, such as soybeans, in the overall crop rotation because the total amount of water available to the field is increased.
- Replacing sprinklers with drip irrigation can significantly increase yields with the same amount of water, although at a higher capital and recurring cost.
- Converting from composite crops to vegetables can change the economics, significantly increasing the value of production, and increasing profits to if handling and marketing challenges can be overcome.
- Reorganizing operation system in the secondary canal and pressure pump station could result in significant labor cost savings and job creation.

(6) Situation of irrigation in Kherson Oblast

Crops grown on irrigated farmland in Kherson Oblast are shown in Figure A2.2.7.



Source: *Derzhavna Sluzhba Statystyky* (2009, 2011, 2013, 2015) and *Ministerstvo Statistiki Ukrainy* (1991). Note: The main feed crops grown in 1991, by far, were maize for silage and annual and perennial grasses.

Figure A2.2.7 Irrigated Area by Crop in Kherson Oblast

During the Soviet era, irrigation was mostly for pasture and grains, but after the independence, the ratio of profitable oil crops increased (rapeseed, sunflower, soybeans, etc.). Meanwhile, as land productivity increased, disputes between landowners and land users over the share of profits increased, and in some cases the government is said to have intervened.

Irrigation performance in Kherson Oblast is shown in Table A2.2.10.

Table A2.2.10 Status of Kakhovka Irrigation System

Region	Average area available for irrigation per year ha	Actually (2015) irrigated area ha	Water supply thousands of m^3	Rate of water m^3/ha
Velikolepetikha	6,590	2,360	2,701	1,144
Verhnerogachik	2,709	0	0	0
Genichesk	28,294	21,900	45,051	2,057
Gornostaivka	16,721	17,290	66,854	3,867
Ivanivka	19,767	15,330	50,873	3,319
Kakhovka	59,426	64,700	112,384	1,737
Nizhnesirogozy	2,829	1,820	6,131	3,369
Novotroitsk	72,730	53,530	119,152	2,226
Chaplinka	50,330	38,200	122,070	3,196
Nova Kakhovka	2,910	3,450	4,300	1,246
Total	262,306	218,580	529,516	2,423

Source: CURRENT STATE OF IRRIGATION IN THE KHERSON, STEPPE ZONE OF UKRAINE AND IN KUJAWSKO-POMORSKIE PROVINCE IN POLAND, Valery S. Reznik, Olena S. Morozova, Olexiy V. Morozov, Iwona Jaskulska, Jarosław Kamieniarz

The actual irrigated area in 2015 was 218,000 ha with regional variation for rate of water distribution. As a result, there are water shortages and over-irrigation in some areas. Therefore, from the viewpoint of irrigation technology, it is necessary to develop and implement a water allocation plan that takes into

account the growing period of each crop type. As shown in Table A2.2.11, the actual irrigated area in recent years has remained at about 80% of the total area.

Table A2.2.11 Irrigation Performance in Kherson Oblast

Year	Possibilities of irrigation thousands of ha	Irrigated area thousands of ha	Utilization（%）
1980	185	171.6	92.8
1990	267.9	259.1	96.7
2000	275.8	156.2	56.6
2001	262.7	71.8	27.3
2005	261.7	184.5	70.5
2010	262.3	199.2	76
2011	262.2	200.6	76.5
2012	262.2	201.3	76.8
2013	262.2	203.9	77.8
2015	262.3	218.6	83.3

Source: CURRENT STATE OF IRRIGATION IN THE KHERSON, STEPPE ZONE OF UKRAINE AND IN KUJAWSKO-POMORSKIE PROVINCE IN POLAND, Valery S. Reznik, Olena S. Morozova, Olexiy V. Morozov, Iwona Jaskulska, Jarosław Kamieniarz

2.2.7 Current Activities

(1) Irrigation system rehabilitation and improvement by USAID AGRO

a) Overview of Pilot Program

1) Background

The Agricultural Growth and Rural Opportunities Activity in Ukraine (AGRO) is a seven-year (2019-2026) project funded by USAID and implemented by a contracted consultant.

The objective of AGRO is to encourage the integration of more productive, modern, and profitable small, medium, and micro (MSME) agricultural enterprises into competitive enterprises and to accelerate economic development in rural Ukraine, where the needs are greatest, through a better managed agricultural sector. Activities are outlined as strengthening food security globally and in Ukraine, maintaining and restoring the profitability of agricultural small and medium-sized enterprises (SMEs), and increasing access to financing for agricultural SMEs.

2) Purpose

The objectives of the pilot program are to promote the land reform process, facilitate the creation of water user associations, promote innovation in irrigation, encourage investment in irrigation, and help expand the rights and opportunities of land and water users. WUA will install the latest irrigation technology, procure and install energy and water conservation equipment, and automate irrigation and irrigation control systems to reduce irrigation water loss and reduce energy use. It is hoped that other water user associations will further develop the experiences and lessons learned from these activities.

b) Activities of Pilot Program

This activity envisages the development and implementation of multiple irrigation projects in areas of Ukraine that are not currently being fought and where irrigation systems need to be rehabilitated, modernized, or irrigated areas within the water users' service area need to be expanded. The irrigated benefited area of each project must be at least 200 hectares.

AGRO will contract with Ukrainian water users' associations that are legal entities, sole proprietors, or already registered in the Unified State Register. In addition, these associations will be required to contribute at least 30% of the total project budget as co-financing.

The activities envisaged in the pilot program include:

i. upgrading of pumping stations whose ownership has been transferred from the State to WUAs
ii. procurement and upgrading of irrigation machinery and equipment.
iii. provision of drip irrigation system
iv. installation of water metering system.
v. replacement of irrigation pipelines.
vi. infiltration control measures in irrigation canals.
vii. procurement of equipment for maintenance of irrigation systems.
viii. deployment of remote irrigation control system
ix. installation of soil moisture monitoring system;
x. installation of irrigation systems for greenhouses
xi. provision of sprinkler irrigation system for home vegetable garden.

c) Amount provided, etc.

A maximum of UAH 18,285,000 will be granted to each WUA. The final amount will be determined by the activity and final negotiations and may be lower or higher than that amount. The duration of the activity shall not exceed 24 months.

d) Application guidelines/qualifications, etc.

AGRO encourages applications from WUA that meet the following eligibility criteria:

- The applicant is a duly registered WUA.
- WUA must have all land parcels within its service area registered in the State Land Register (specify cadastral number) and its title to those land parcels must be registered in the State Register of Real Rights.
- WUA enters information on agricultural producers operating in the service area of WUA (in particular, the name of the legal entity and/or the full name of the individual entrepreneur) in the State Agricultural Register in accordance with the procedure established by Ukrainian legislation.
- The members of WUA have no outstanding irrigation service fee debts to WUA.

- The members of WUA have at least 3 years of experience in the agricultural sector, including irrigated agriculture.
- The applicant must propose candidates and submit resumes for four key positions (project manager, irrigation technician, agricultural specialist, and economic specialist or accountant). The official should have at least 3 years of experience in similar activities and a comprehensive understanding of the main challenges facing the irrigation sector in Ukraine.
- Applicants should be able to contribute at least 30% of the total budget proposed for this activity.

e) Expected outputs

The expected benefits of the pilot project are as follows.

- Establishment of effective WUA.
- Improvement of access to irrigation water for members of WUA.
- Increased irrigated area/rehabilitation of irrigation canal network (top priority).
- Reduction of costs associated with operating irrigation systems, including water tariff, energy costs, and routine maintenance costs.
- Increased agricultural production by members of WUA after implementation of the activity.
- Strengthening of operational capacity of WUA.

f) Progress of activities to date

In the first batch, 2 irrigation systems were selected and are currently implementing the activities described in the next section. The second batch of two irrigation systems was started in May 2023, and the selection process should be completed in August 2023.

In addition to the above local activities, AGRO has prepared a guidelines for the establishment of WUAs and held several forums for interested parties to disseminate its activities.

g) Summary and current status of irrigation project areas adopted in Batch 1.

Table A2.2.12 provides a summary of the 2 pilot project areas adopted in the first batch.

Table A2.2.12 Outline of Irrigation Project Areas Adopted in Batch 1

Description	System 1	System 2
Name of Irrigation System	Trush Irrigation System (Pump Station 1)	Suvorov Irrigation System
Oblast	Cherkasy	Odesa
Raion, village	Cherkasy, Borovytsika	Izmail, Suvorov
Water Resource	Kremenchug Reservoir (Dnipro River)	Katlabukh reservoir
Current irrigated area	436 ha	1,685 ha
Irrigated area after restoration	996 ha	8,900 ha
Type of Irrigation	Gravity, Sprinkler	Sprinkler
Name of WUA	Druzhba	AGRO Partner 777 LLC
Date of Registration of WUA	09th December 2022	14th December 2022
Number of WUA's Member	1	9
Crops	Maize, Soybeans, Sunflower	Maize, Wheat

Description	System 1	System 2
Facilities/equipment to be rehabilitated/restores	Pump and power units of pumping station, pipeline equipment, sprinkler system, and drip irrigation equipment	Pump and power units of pumping station, pipeline equipment, sprinkler system, and drip irrigation equipment
Current Situation	Inventory survey is being conducted for transferring the whole system to the WUA	Inventory survey is being conducted for transferring the whole system to the WUA

Source: Interview from the WUA

The rehabilitation plan and project cost will be finalized in the above areas in the near future. At the same time, procedures for transferring ownership of the irrigation facilities to the WUAs are underway. After the transfer of ownership is completed, the rehabilitation of the irrigation facilities will begin. A training plan for the WUAs will be developed in the future. According to the interviews with the leaders of the WUAs, they were interested in the operation of labor-saving and low-cost irrigation systems, the calculation of water tariff, and the introduction of advanced irrigation system operation and management case studies from other countries.

(2) Status of establishment of WUA

As of May 23, 2023, 25 groups have held general meetings for the establishment of WUAs, of which 18 WUAs have been registered. A summary of the WUAs established is shown in Table A2.2.13.

Table A2.2.13 Outline of Water Users' Associations Established

Oblast	Irrigation System	Name of WUA	Service Area
Vinnytsia	Yaroshivska ZS	Yaroshiv irrigation system	930 ha. In the future , the irrigation area will increase to 1,400 ha
Zhytomyr	Tesnivsk drainage system	Forest springs	4,197 ha
Dnipropetrovsk	Kilchevsk ZS	Dnipro water	26,500 ha
	Kalinivska ZS	Kalinivska	750 ha. In the future, the irrigation area will increase to 1,500 ha
Odesa	Suvorivska ZS	Water of life	1,680 ha. In the future, the irrigation area will increase to 6,900 ha
	Kiliysko-Mayakskaya ZS	First Kiliya OVC	1,020 ha
	Belgorod-Dnistrovska ZS	Generous land	1,640 ha
	Oryol Military Academy	Oryol County	400 ha. In the future, the irrigation area will increase to 1,200 ha
	Nahirnyansk Armed Forces	Nahirnyansky Lan	400 ha. In the future, the irrigation area will increase to 1,200 ha
	Sour rice system	Bessarabian rice systems	1,600 ha
Poltava	Karpivska ZS	Aqua Life	496 ha
	Hradiska ZS	Hradiska	5,627 ha. In the future, the irrigation area will increase to 8,188 ha
	Police station on the territory of the Omelnytskyi TG of the Kremengug district	Flowering deer	910 ha
Cherkassy	Trushivska ZS	The first	406 ha. In the future, the area will increase by 200 ha
	Ratsivska ZS	Ratsivska	670 ha
	Khudyakivska ZS	Khudyakiv meliorative irrigation system	1560 ha
	Topilivska ZS	Topilivska	1050 ha
	Lyashivska ZS	Flower spring	980 ha

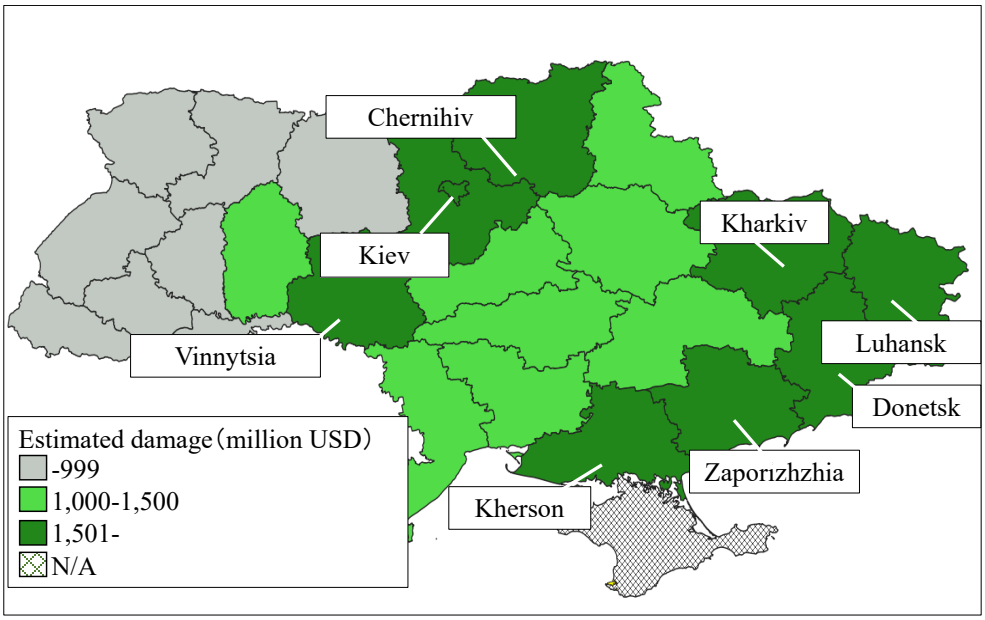
Source: State Department of Melioration and Fisheries

2.2.8 Current Status of Irrigation Damage

(1) World Bank Report

The Rapid Damage and Needs Assessment 2 published by the World Bank in February 2023, reported that damages in the water resources and irrigation and drainage sectors were estimated at USD380.5 million.

As shown in the figure below, damage to agricultural facilities due to the conflict following the Russian invasion was mainly concentrated in the areas surrounding Kiev and in the south and east of the country, including Kherson, Zaporizhzhia, Donetsk, Luhansk, and Kharkiv, where the need to repair and restore irrigation and storage facilities is greatest. The need for the rehabilitation and restoration is highest in this region. The cost of rehabilitation and reconstruction of physical damage to these irrigation water source facilities is calculated to be approximately USD 200 million, even for urgent short-term measures alone.



Classification		Estimated damage (million USD)	
		Agriculture	Irrigation/Water resource
Physical damage		2,239.0	154.4
Economic damage		28,280.0	75.7
Restoration & Rehabilitation costs	Short term	10,039.0 (52%)	19.9 (1%)
	Mid term	8,693.1 (48%)	7,521.3 (99%)
	Total	18,732.1(100%)	7,541.2 (100%)

Source: World Bank (2022) Ukraine Rapid Damage and Needs Assessment

Figure A2.2.8 Post-conflict Irrigation and Other Damage

According to the Rapid Damage and Needs Assessment 2 released by the World Bank in February 2023, damages in the water resources and irrigation and drainage sectors are estimated at USD380.5 million. This includes damage to farm infrastructure, irrigation canals, levees, buildings, and institutional facilities. It represents (i) areas that were not under the government control and have

recently been returned to the control of the Ukrainian authorities, (ii) areas damaged by bombing, and (iii) areas flooded due to protection against the invasion. The main descriptions are as follows.

- - Northern river basins in Ukraine were inundated to protect them from the invasion, which prevented the cultivation of crops and made agricultural production in 2022 and 2023 impossible in these areas, resulting in losses due to flooding.
- - Some areas along the national border (military areas) were blasted by landmine, excluding these areas from agricultural production, and resulting in operational losses.
- - Some areas have damaged or limited power infrastructure and are unable to pump water from drainage areas or provide water for irrigation, forcing a shift to rainfed agriculture, uncontrolled flooding, limited production, and a 20-30% decrease in profits.
- - In some areas, irrigation and drainage infrastructure has been destroyed and pipelines dismantled, resulting in operational losses. Damage has also been observed in the Oskilske reservoir (Kharkiv Oblast) and the Karachunivske reservoir (Dnipropetrovsk Oblast).

(2) Damage to Kakhovka Pumping Station

UKRINFORM dated December 1, 2022, reported that Russian forces damaged the main pumping station of the irrigation canal. During November 2022, Russian occupation forces attacked against the pumping station at Kakhovka and other locations. As a result of the bombardment, the sealing of the pumping station was compromised, and the engine room flooded. The ventilation system, drainage pumps, all 10 main pumping units (two of them with electric motors), and the elevator shaft were submerged. The control panel was also damaged, and power was not supplied.

(3) Impact of Kakhovka Dam destruction

The Kakhovka dam was destroyed in June 2023. A forum held by the Ministry of Agrarian Policy and Food shortly thereafter stated that, in effect, 94% of the irrigation system in Kherson Oblast, 74% in Zaporizhzhia Oblast, and 30% in Dnipropetrovsk Oblast were not operational. If irrigation cannot be restored quickly in these areas, Ukraine expects to lose 14% of its agricultural production and its export potential will be seriously declined.

Experts attending the Forum added, "As an emergency measure, it is necessary to install temporary pumping stations along the Dnipro River to irrigate the surrounding fields. In fact, prior to the construction of the Kakhovka Reservoir, water was taken directly from the Dnipro River without using a large-scale irrigation canal network to irrigate farmland. Depending on the topography, farmland within a distance of 4-5 km from the river could be irrigated using the above method".

2.2.9 Analysis of Damage to Irrigated Area

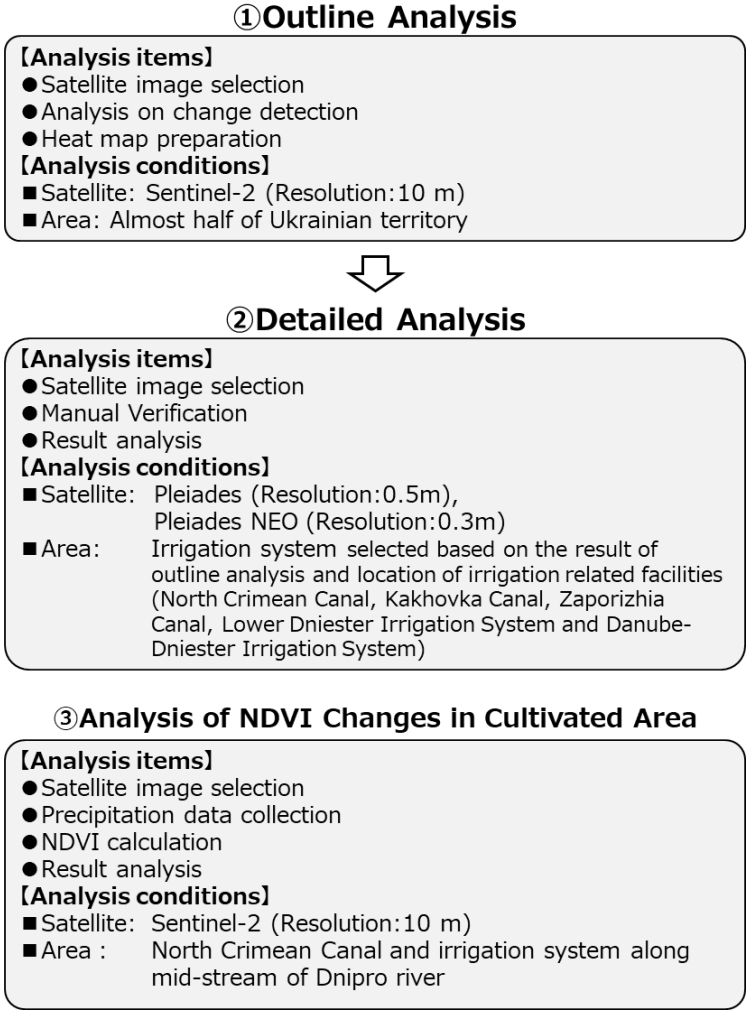
JICA Survey Team carried out satellite image analysis to analyse the damage to irrigated land. The details are detailed in Annex 2.2.6 to Annex 2.2.10, and only the summary and results are excerpted here.

(1) Method

In order to assess the damage to irrigation facilities, "outline analysis" was carried out for 300,000 km^2, almost half of Ukraine's land area. Based on the result of "outline analysis" and other collected information related to the damage to irrigation facilities, "detailed analysis" was conducted for the area where the damage to irrigation facilities was judged to be serious or need to be verified.

In addition to the above, analysis of NDVI changes in cultivated area with/without irrigation was conducted in a part of North Crimean Canal, in which JICA Survey Team evaluated whether NDVI changes in cultivated area could be useful to assume the damage to irrigation facilities.

The workflow of satellite image analysis is shown in Figure A2.2.9.



Source: JICA Survey Team

Figure A2.2.9 The Workflow of Satellite Image Analysis

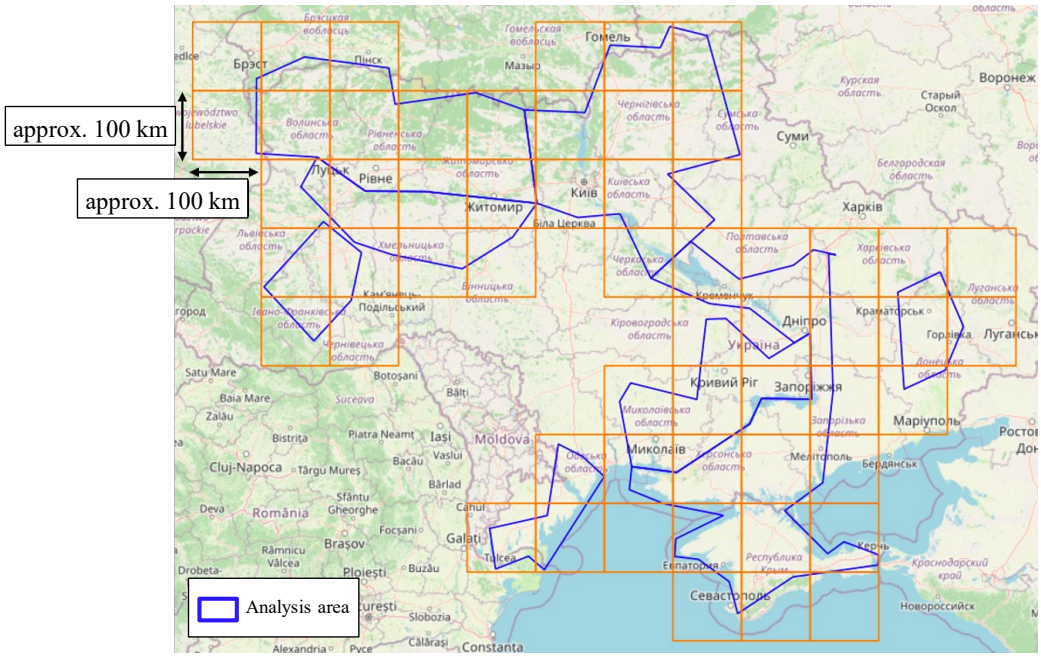
(2) Outline Analysis

a) Overall

In order to assess the damage to irrigation facilities, outline analysis was carried out by three processes: i) satellite image selection, ii) analysis on change detection, and iii) heat map creation (For the detail, refer to Annex 2.2.6). The analysis area (approximately 300,000 km^2) of the outline

analysis was selected with reference to the irrigation area map published by the Food and Agriculture Organization of the United Nations (FAO). Figure A2.2.10 shows the analysis area for the outline analysis.

It should be noted that "change" of change detection is defined as colour change in land cover, and that outline analysis is a method to detect the damage by Russian invasion by colour change. There is a possibility that other natural/ social phenomena can be detected as “change” such as demolition of buildings, deforestation, flooding. However, JICA Survey Team finally selected this method since this method can quickly analysis the vast area of Ukraine territory.



Source: JICA Survey Team

Figure A2.2.10 Analysis Area for Outline Analysis

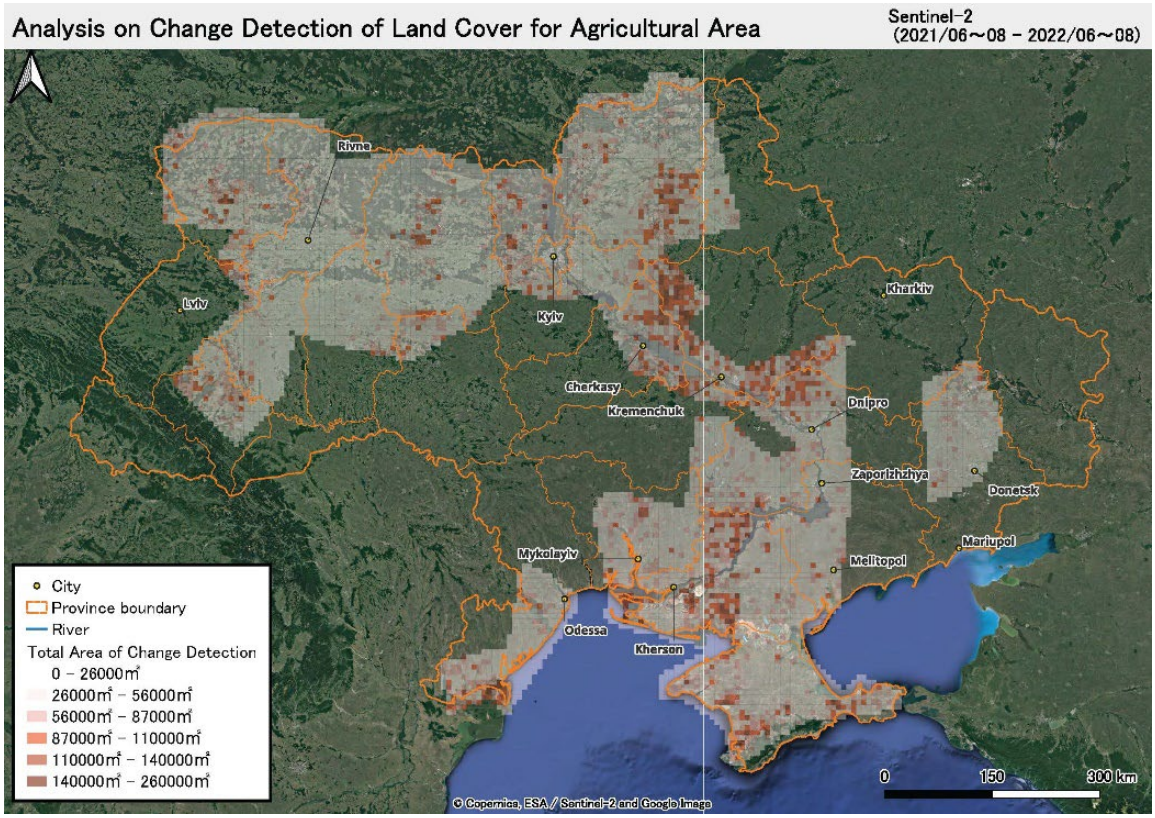
b) Heat Map Creation and Result

For the result of change detection, heat maps were prepared converting the common extracted area into colour strength in order to easily grasp the spatial distribution of the results over Ukraine overall area (Figure A2.2.11).

The heat map results show that most of the common extracted area were often observed in the mid-stream of Dnipro River (around Cherkasy and Kremenchug), on the opposite site of Dnipro River near Zaporizhzhia province, and in the south of Kherson (around North Crimean Canal and Kakhovka Canal). It should be noted, however, that the common extracted areas were also observed in areas where there was no invasion (western Ukraine).

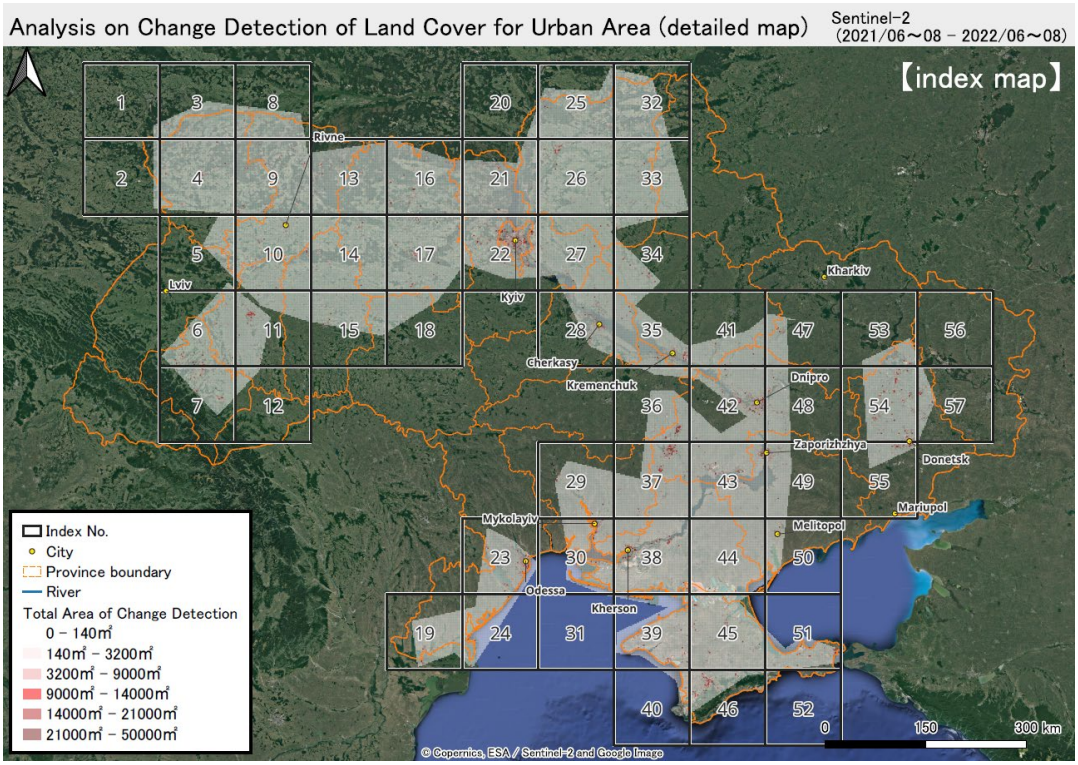
It was technically difficult to determine whether the areas were actually damaged by the invasion based on outline analysis only. In the areas where the common extracted areas were often observed, JICA Survey Team checked whether the common extracted area were actually attacked by the Russian invasion through detailed analysis (for the detail, refer the next page).

The Ukraine overall area map and the detailed map were prepared in both of agricultural area and urban area as shown in Annex 2.2.7, Annex 2.2.8. As shown in Figure A2.2.12 and Figure A2.2.13, the detailed maps were prepared 57 sheets in grid-wise, which is approximate 100 km square (corresponding to zoom level 8 of tile coordinate).



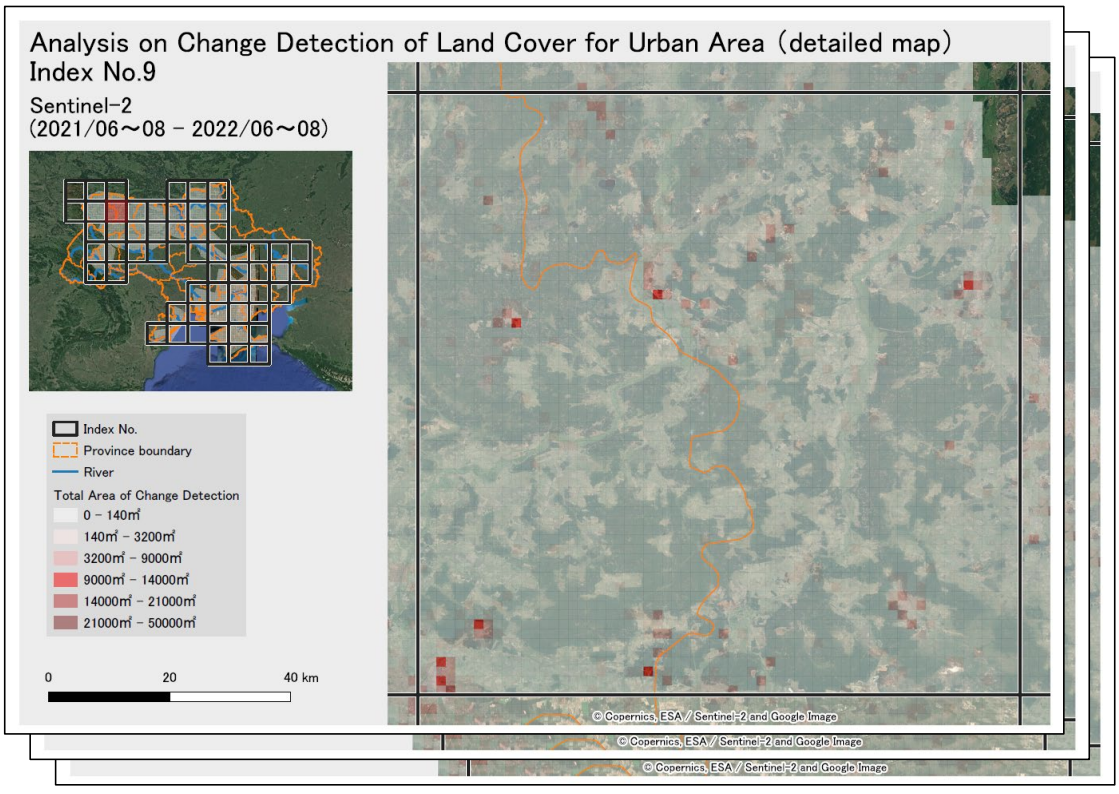
Source: JICA Survey Team based on Open Street Map

Figure A2.2.11 Heat Map of Ukraine Overall Area (Agricultural Area)



Source: JICA Survey Team based on Copernics, ESA/ Sentinel-2 and Google Image

Figure A2.2.12 Sample Images of Heat Map (Index for Detailed Map)



Source: JICA Survey Team based on Copernics, ESA/ Sentinel-2 and Google Image

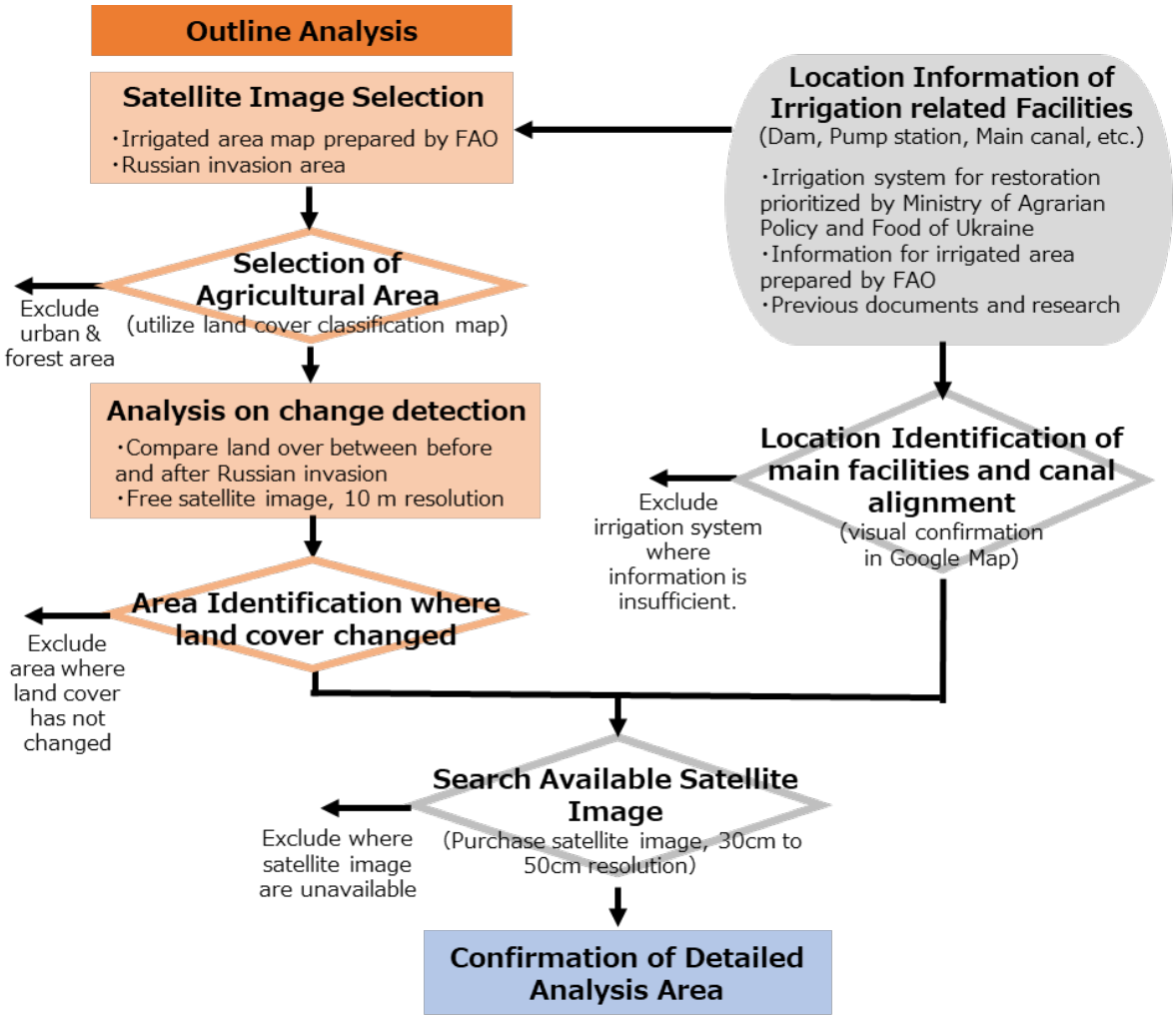
Figure A2.2.13 Sample Images of Heat Map (Detailed Map)

(3) Detailed Analysis

a) Overall

In order to assess the damage to irrigation facilities more precisely, the detailed analysis was carried out by three processes: i) satellite image selection, ii) manual verification, and iii) result analysis. The manual verification was selected for the detailed analysis to check the damage to irrigation facilities quickly and precisely.

The analysis areas for the detailed analysis were selected based on the information such as location of irrigation related facilities, and the result of outline analysis. The workflow of satellite image selection is shown in Figure A2.2.14.



Source: JICA Survey Team

Figure A2.2.14 The Workflow of Satellite Image Selection for Detailed Analysis

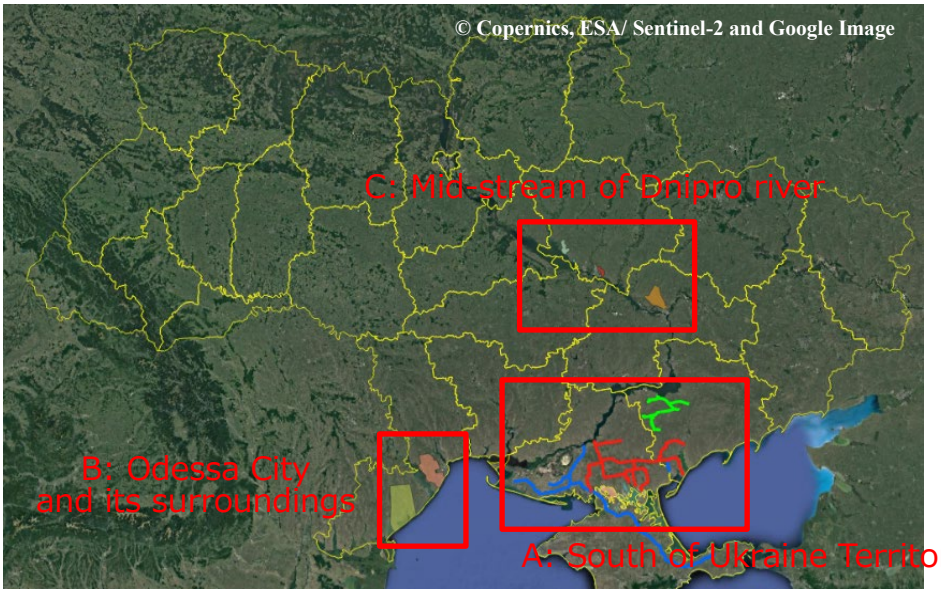
As shown in the figure in the next page, candidates of irrigation system were selected based on the result of outline analysis, the collected information, and the prioritised irrigation system list, which Ukraine prepared for early rehabilitation and restoration (namely, "Projects on Irrigation systems restoration" dated on 28th May 2022, prepared by Ministry of Agrarian Policy and Food).

The irrigation systems, which were selected finally for the detailed analysis, are five in total: North Crimean Canal, Kakhovka Canal, Zaporizhzhia Canal, Lower Dniester Irrigation System, Danube-Dniester Irrigation System. The remaining four systems (Hardyzka Irrigation System, Maxymivska Irrigation System, Karpivska Irrigation System, Kilchenska Irrigation System) were analysed in "Analysis of NDVI Changes in Cultivated Area" (refer to section (4)).

Table A2.2.14 Selection of Irrigation System for Detailed Analysis

Item	Location	Availability of Satellite Image	Detailed Analysis
1. Irrigation scheme selected based on the result of outline analysis, and collected information			
North Crimean Canal	A	✓	✓
Kakhovka Canal	A	✓	✓
Zaporizhzhia Canal	A	✓	✓
2. Irrigation system, which Ukraine selected for rehabilitation and restoration*			
Lower Dniester Irrigation System	B	✓	✓
Danube-Dniester Irrigation System	B	✓	✓
Hardyzka Irrigation System	C	-	-
Maxymivska Irrigation System	C	-	-
Karpivska Irrigation System	C	-	-
Kilchenska Irrigation System	C	-	-

Ukraine Overall Area Map



* "Projects on Irrigation systems restoration" dated on 28th May 2022, prepared by Ministry of Agrarian Policy and Food Projects

Source: JICA Survey Team based on Copernics, ESA/ Sentinel-2 and Google Image

The areas of purchased satellite image in each irrigation system are shown in Table A2.2.15. The area maps of the purchased satellite image are shown in Figures 11 up to 15 in Annex 6. The satellite image locations in each irrigation scheme and the map numbers of each satellite image are shown in Annex 2.2.9.

Table A2.2.15 Summary of Areas of Purchased Satellite Image for Detailed Analysis

S/N	Irrigation System	Purchase Area (km^2)	
		Pre-invasion	After-invasion
1	North Crimean Canal	0	107
2	Kakhovka Canal	0	233
3	Zaporizhzhia Canal	0	47
4	Lower Dniester Irrigation System	60	78
5	Danube-Dniester Irrigation System (August 2022)	130	210
6	Danube-Dniester Irrigation System (December 2022)	180	233
Total		370	521

* In case of unavailable of pre-invasion satellite image, the satellite image of Goole map was used for manual verification.

Source: JICA Survey Team

b) Manual Verification and Result

The following facilities were manually observed to confirm the damage is visible or not in the purchased satellite image:

- Main irrigation facilities such as headworks, pumping station, etc.,
- Main canal (inclusive of bridge and access road),
- Other visible structure such as booster pump used for center pivot irrigation, and
- Farmland (inclusive of artillery shell marks and tank moving truck): It should be noted that the analysis area was selected as a representative area from the irrigation systems due to the time limitation for the analysis.

The summary of the result of manual verification are shown in the table below. The detailed results of manual verification are shown in Annex 2.2.10.

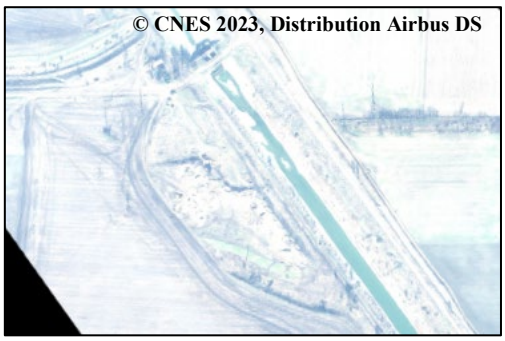
Table A2.2.16 Summary of Result of Manual Verification

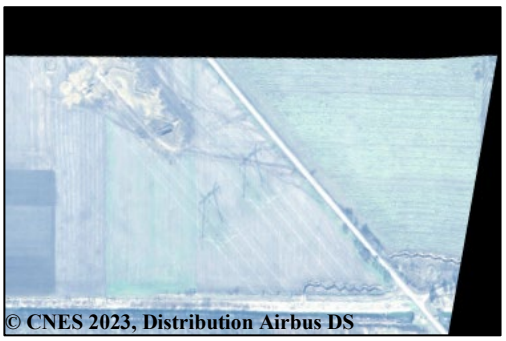
Irrigation System	Result of Manual Verification
North Crimean Canal	There was visually no obvious damage to irrigation facilities by the invasion, but there were some unusual signs in the farmland (expected vehicle tracks and trenches).
Kakhovka Canal	
Zaporizhzhia Canal	
Lower Dniester Irrigation System	There was visually no obvious damage to irrigation facilities by the invasion.
Danube-Dniester Irrigation System (August 2022)	There was visually no obvious damage to irrigation facilities by the invasion.
Danube-Dniester Irrigation System (December 2022)	There was visually no obvious damage to irrigation facilities by the invasion.

Source: JICA Survey Team

In all irrigation systems, there was rarely found visible physical damage to main facilities or main canals (one bridge over downstream of main canal of the North Crimean Canal was observed to have been destroyed). The evidence of shelling or other attacks were not found in the analysed area. However, in the areas where the Russian invasion took place (surroundings of North Crimea

Canal, Kakhovka Canal, and Zaporizhzhia Canal), some traces were found in farmland, expected to be Russian invasion, as shown in the figure below. These traces were mostly observed in farmlands near large urban areas.





Source: CNES 2023, Distribution Airbus DS (Pleaides and Pleiades NEO operated by Airbus)

Figure A2.2.15 Satellite Image along Main Canal of Zaporizhzhia Canal (9th March 2023)

Under the detailed analysis, some traces expected to be Russian invasion were found in farmland near large urban areas. There is a high possibility that the damages are concentrated in irrigation facilities and farmland (e.g., unexploded shell, landmine) near large urban areas. It could be one idea to focus on urban area in the further satellite image analysis.

Even if there are not visible changes in the appearance of irrigation facilities, the machinery and internal facilities could be damaged or not well- maintained, so it is recommended to have a field survey on the actual damage of the irrigation facilities.

(4) Analysis of NDVI Changes in Cultivated Area

a) Overall

The analysis of NDVI changes in cultivated area with/without irrigation was conducted in a part of North Crimean Canal, in which JICA Survey Team evaluated whether NDVI changes in cultivated area could be useful to assume the damage of irrigation facilities.

As shown in the table below, JICA Survey Team expected that NDVI would show different trends in irrigated and non-irrigated areas. In this analysis, NDVI were compared between irrigated and non-irrigated areas. NDVI represents the amount and vitality of vegetation, and it is said to have a strong correlation with the amount of precipitation.

Table A2.2.17 Expected Trend of NDVI in Irrigated and Non-irrigated Areas

Area	Normal Year	Dry Year	Wet year
Irrigated Area	High	Equivalent to average year	Equivalent to average year or more
Non-irrigated Area	-	-	-
(High yield)	High	Lower than average year	Equivalent to average year or more
(Low yield)	Low	Significantly lower than average year	Significantly higher than average year

Source: JICA Survey Team

This analysis was carried out by four processes: i) satellite image selection, ii) precipitation data collection, iii) NDVI calculation, and iv) result analysis. In this section, only the results of iv) are excerpted and explained, the contents of i), ii), iii) are explained in Annex 2.2.6.

In order to compare NDVI between irrigated and non-irrigated areas, the analysed areas were selected from the northern and southern parts of the North Crimean Canal, where irrigation status is clearly identified. The north and south parts of the canal are clearly divided into irrigated and non-irrigated areas after the annexation of Crimean Peninsula by Russia in 2014.

Table A2.2.18 Irrigation Status after Annexation of Crimean Peninsula by Russia in 2014

Location	Status
Northern parts of North Crimean Canal	Irrigation water is available from North Crimean Canal
Southern parts of North Crimean Canal (Crimean Peninsula)	Water distribution to North Crimean Canal suspended by Ukrainian government

Source: JICA Survey Team

In Kherson and Simferopol, the following years were designated as dry and wet years respectively since both precipitation trends were the same. In addition, the year 2018 were compared also since precipitation trends were dry in Herson and wet in Simferopol.

A the year of 2017: dry year (heavy rain in April)

B the year of 2021: wet year

C the year of 2018: dry year in Kherson, wet year in Simferopol

In Lubny, the following years were designated as dry and wet years respectively.

D the year of 2019: dry year

E the year of 2018: wet year

b) Result and Discussion

In the northern part of the North Crimean Canal, as shown in Figure A2.2.16, the strongest NDVI appeared differently between the circular plots with center pivot irrigation, and the rectangular plots (the dark green colour shows NDVI higher).

In the northern part of the North Crimean Canal, NDVI was strongest in the circular plots with center pivots from June to August each year. On the other hand, rectangular plots had the highest NDVI from April to May each year, with the values decreasing after May.

As shown in Figure A2.2.17, in the southern part of North Crimean Canal, no circular plots with center pivots were found, and NDVI was generally highest around April and May each year, followed by a decrease in values. On the other hand, the area circled in red (right of Figure A2.2.18) maintained a high NDVI despite 2017 being a dry year.

Initially, JICA Survey Team assumed that NDVI trends would be generally the same in both of northern and southern parts of North Crimean Canal, but it is likely that the cropping pattern and harvesting time might differ (or the different crops could be planted in both areas).

- North Crimean Canal

  (circular plots): possibility to be harvested in August or later (spring wheat?)

  (rectangular plots): possibility to be harvested in June and July (winter wheat?)

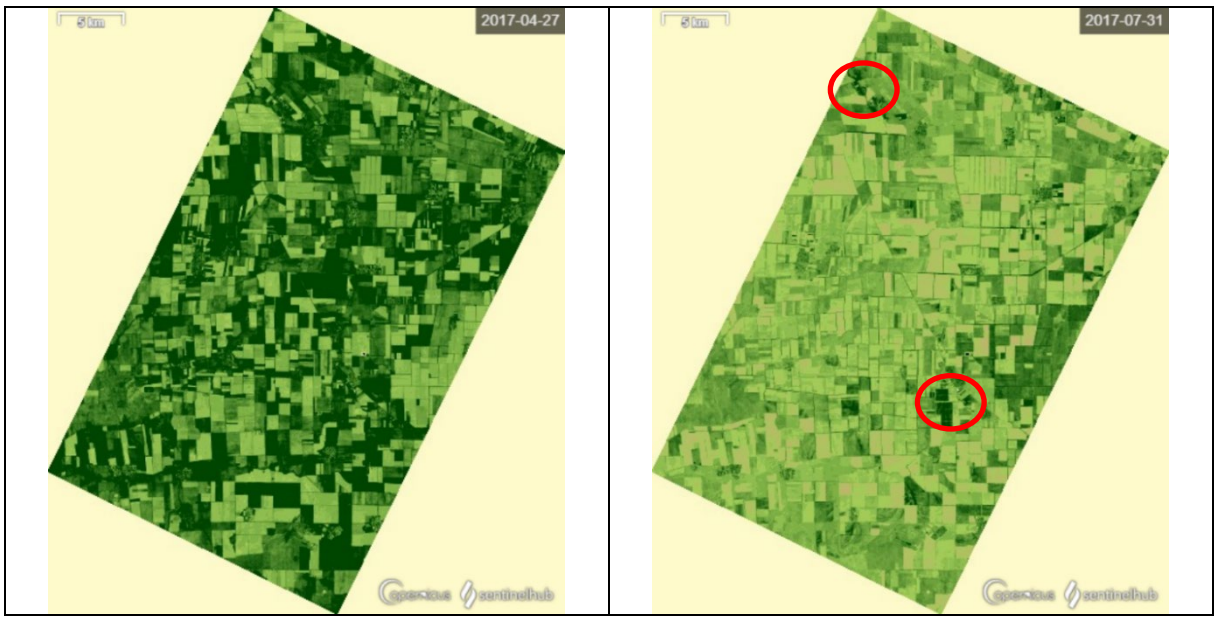
- Southern part of the North Crimean Canal

  (round plots): possibility to be harvested in June (winter wheat?)

Besides, in the southern part of North Crimean Canal, there were areas where NDVI remained high even in dry year. It is suggested that irrigated cultivation was conducted by using water sources other than North Crimean Canal.

Source: EO Browser (https://www.sentinel-hub.com/explore/eobrowser/)

Figure A2.2.16 Dissemination of NDVI in Northern Parts of North Crimean Canal in Dry Year 2021 (Left:27th April 2017, Right 31st July 2017)

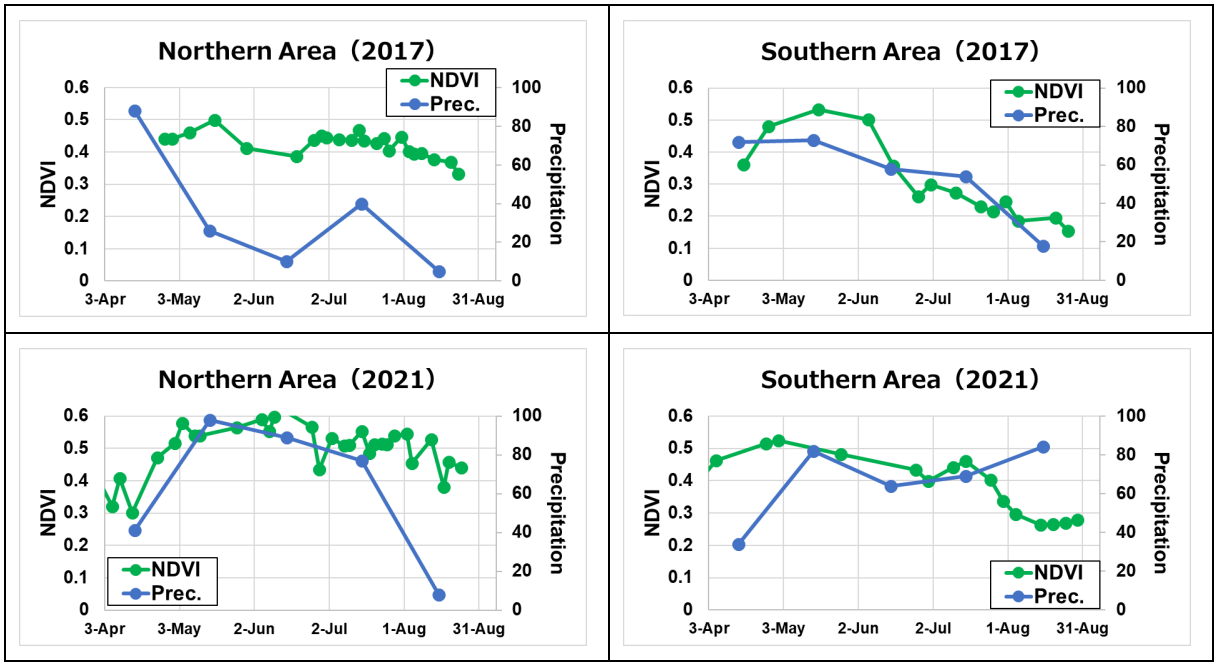


Source: EO Browser (https://www.sentinel-hub.com/explore/eobrowser/)

Figure A2.2.17 Dissemination of NDVI in Southern parts of North Crimean Canal in Dry Year 2021 (Left:27th April 2017, Right 31st July 2017)

The temporal changes of area average NDVI and the amount of precipitation for each month in the northern and southern parts of the North Crimean Canal are shown in the figure below. In the northern part of the North Crimean Canal, the area average NDVI were high from April to August, regardless of dry or wet years. On the other hand, in the southern part of the North Crimean Canal, the area average NDVI tended to decrease from May and June.

Those results are supposed to be due to the difference in cropping pattern between the northern and southern parts of the North Crimean Canal, which resulted in inconsistent crop growth conditions. Therefore, it is not possible to determine the presence or absence of irrigation simply by comparing the area average NDVI. As a conclusion in this analysis, it was difficult to identify differences in area average NDVI between irrigated and unirrigated areas.



Source: JICA Survey Team

Figure A2.2.18 Temporal Change of Area Average NDVI in North Crimean Canal

2.2.10 Candidates Rehabilitation and Improvement of Irrigation System

The candidate irrigation systems for rehabilitation and improvement of facilities obtained from the Ministry of Agriculture Policy and Food are shown in Table A2.2.19. Details are shown in Annex 2.2.11.

Table A2.2.19 Candidate Irrigation Systems of Rehabilitation/Improvement of Irrigation Facilities

No.	Name of Irrigation Systems	Oblast	Area currently irrigated (Estimates)	Area after restoration (Estimates)	Water resources	Number of beneficiaries (Estimates)
1	Kilchenska Irrigation System	Dnipro	26,500 ha	35,500 ha	Samara River	43
2	Kalynivska Irrigation System	Dnipro	750 ha	1,300 ha	Dnipro	6
3	Hardyz'ka Irrigation System	Poltavska	5,627 ha	8,188 ha	Kremenchugh Reservoir	10
4	Maxymivska Irrigation System	Poltavska	Currently mothballed.	1,086 ha	Kremenchugh Reservoir	0
5	Karpivsaka Irrigation System	Poltavska	496 ha	3,745 ha	Kamisnske Reservoir	1
6	Bolgrad-Reni-Izmail irrigation systems					
a	Nahirnyanska IS	Odesa	1074	1,203 ha	Kagul Lake	Unknown
b	Kotlovynska IS	Odesa	745	781 ha	Yalpug Lake	6
c	Banivska IS	Odesa	315	1,231 ha	Katlabuh Lake	2
d	Belgorod-Dnistrovska IS	Odesa	4309	11,937 ha	Dnister River	43
e	Kiliyska IS	Odesa	3200	4,832 ha	Danube River	7
f	Tashbunarska	Odesa	372	1,398 ha	Katlabuh Lake	2
g	Banivska IS	Odesa	84	1,546 ha	Katlabuh Lake/ Banivske reservoir	4
h	Michurinska IS	Odesa	425	1,016 ha	Danube River	3
i	Liskivska rice IS	Odesa	2027	3,859 ha	Danube River	3
j	Suvorovskaya IS	Odesa	2538	10,290 ha	Katlabuh Lake	Unknown
k	Izmailsk IS	Odesa	920	4,080 ha	Katlabuh Lake	6
l	Troitsko-Gradenitska IS	Odesa	Not in use since 2013	5,175 ha	Turunchuk River	Unknown
7	Danube-Dniester Irrigation System (DDIS)	Odesa	No irrigation since 2005	18,860 ha	Sasyk (Kunduk) Lake	0
8	Lower Dniester Irrigation Systems	Odesa	15	37,600 ha	Dniester River	68
9	Reni irrigation system	Odesa	Not in use since 1995	818 ha	Danube River, grounwater	Unknown
10	Tatarbunary irrigation system	Odesa	5,968 ha	19,535 ha	Danube River	66

Source: Ministry of Agrarian Policy and Food

As the table above shows, it should be noted that the number of beneficiaries is extremely small compared to the area of irrigated farmland. Thus, when the area of farmland per beneficiary is several hundred hectares, the funds invested in the improvement of irrigation facilities may be perceived as being allocated to a specific individual or company, and the appropriateness of such a situation should be thoroughly considered to implement the restoration of the irrigation systems.

2.2.11 Analysis: Irrigation

i. As described in Section 2.2.6, the operational irrigated area in Ukraine is only about 25% (563.8 / 2,173,900 ha) of the total irrigated area as of 2021, which is about 1% of the total agricultural land in Ukraine. While most of the agricultural products are grown with rainwater, despite such a low irrigation rate, it should be noted that the agricultural sector makes a significant contribution to the country's economy, especially in certain crops/regions, as will be discussed in Section 2.3.

ii. On the other hand, irrigation systems in the country were not always underutilized, and during the Soviet era, 2,174,000 ha, or about four times the current area, was being developed and operated under irrigation. Therefore, if the devastated irrigation systems could be restored after

the war, and if the new irrigated area could be greatly expanded, agricultural income would increase significantly, and this would undoubtedly have a strong impact domestically and internationally as a major driving force for Build Back Better in the postwar reconstruction. The significance of this support is great. Particularly, in light of the early postwar reconstruction roadmap, there is no shorter way to contribute to the smooth and rapid promotion of Ukraine's industries and exports than to restore and develop irrigated agriculture, which was once widespread and familiar to farmers in the Soviet era, rather than to introduce completely new technologies.

iii. It is important to analyse how and why irrigation systems, which were smoothly maintained and operated during the Soviet era, gradually fell into disrepair and reached their current state, and to prevent a repetition of such a situation in the future. As described in Sections 2.2.5 and 2.2.6, the deterioration of irrigation facilities is caused by (1) land ownership issues and (2) problems in the management of irrigation systems. However, with regard to (1), the land ownership moratorium was lifted in July 2021, allowing the general public to own land. As for (2), the Water Users Association Law enacted in February 2022 renewed the management system for irrigation systems, and with the enactment and enforcement of these laws, it can be said that the main causes of the deterioration of the irrigation systems seen up to now have been eliminated. Therefore, now is an opportune time to provide assistance to restore the irrigation systems.

iv. There would be concerns of the future irrigation system management. In particular, careful consideration must be given to the management of the irrigation systems by WUAs under the Water Users' Association Law (see Section 2.2.5 (1)). In particular, the change that is likely to have the greatest impact on the system management after the transfer of ownership is that all investment, maintenance, and cost burden for the "main irrigation system" will be transferred to the WUA from the previous government burden. Generally, in developing countries, the main irrigation system is often managed directly by government agencies, while the secondary canals being transferred to the WUAs in consideration of their human and financial capacity. Although there should be the circumstances from country to country, it is expected that a trial period will be conducted to determine whether the change in the transfer rule will actually allow WUA to function in managing the main irrigation system.

v. USAID is currently conducting the strengthening of WUAs to improve management of the irrigation systems through the AGRO program, and some pilot projects are being implemented as part of the program (see Section 2.2.7). However, this is still in the trial stage, and there are many issues to be addressed, such as the issues pointed out in the previous section and the requirement for the WUA to contribute at least 30% of the total budget for the pilot project as a co-financing.

vi. In the case that the Japanese government considers financial assistance for the restoration of irrigation system, it should also be fully aware that, as shown in Table A2.2.20, the number of beneficiaries per irrigation system is an order of magnitude lower than that of developing

countries usually supported by Japan. When deciding on the plan for the restoration of irrigation systems, its appropriateness should be confirmed through sufficient consultations among Japanese government officials.

vii. An additional concern is the energy issue. Until now, operations of pumps under the irrigation systems have relied on inexpensive Russian crude oil, but there is also concern that decoupling from Russia will make it less easy to secure inexpensive energy sources in the future. This is the background for the development of biomass energy in the National Recovery Plan 2022 and postwar reconstruction strategy, and there are still many issues to be resolved for the sustainable management of irrigation systems.

2.3 Agricultural Value Chain

2.3.1 Overviews

Ukraine is divided into three climate zones, namely cool, temperate and steppe. The northern and western regions are covered with natural vegetation of the Carpathian Mountains under a cool humid continental climate (Dfb) with annual precipitation of 1,200 to 1,600 mm. The southern region including the Crimean Peninsula falls in a relatively warm humid subtropical climate (Cfa) with rainfall of 400mm to 700mm during the growing season of major crops from May to August. Blessed with sufficient sunlight and fertile black soils, namely *Chernozem*, this zone developed as one of the largest granaries in Europe. The southern and southeastern regions belong partly to a steppe climate (BS). To the limited extent, the southern part of the Crimean Peninsula is semi-arid with an annual rainfall of 300 mm.

Agricultural land in Ukraine is widely distributed across the country with 413,100 km^2 (41,310,000 ha), which covers about 70% of the total national land of 604,000 km^2. The diversity of agricultural activities is operated in Ukraine reflecting the natural conditions mentioned above.

Since the dissolution of the Soviet Union in 1991, Ukraine has developed legal systems such as agricultural land reform and corporate privatization, which have accelerated the growth of the agricultural sector. The production of both grains and oilseeds has drastically increased and made Ukraine one of the world's top producers. The nominal G[11]DP in 2021 accounts for USD199.77 billion or USD4,828 per capita, of which 10.63% are generated by the agriculture, forestry and fisheries sectors. In addition, it provides employment opportunities to some 4 million or 20% of the working population of 20.46 million (2021), and supports the livelihoods of about 13 million people, or 30% of the total population of 43.79 million.

2.3.2 Agroecology

Agroecological zones of Ukraine are based on similarities in natural conditions such as climate, soils and vegetation, which influence to the prevailing agriculture by zone especially crop selection. Referring to the study on Vulnerability of Ukrainian Forests to Climate Change (Prof. Anatoly Shvidenko, et.al, 2017), the agroecological zones are defined in the present JICA Survey as illustrated

[11] World Bank「World Bank Open Data」(https://data.worldbank.org/)

in Figure A2.3.1 on the next page. The national land of Ukraine is divided into five (5) regions, namely Central, Northern, Eastern, Southern and Western regions.

Central
Vinnytsia・Dnipropetrovsk・Kirovohrad・Poltava・Cherkasy
Northern
Zhytomyr・Kyiv・Sumy・Chernihiv
Eastern
Donetsk・Luhansk・ Kharkiv
Southern
Zaporizhzhia・Mykolaiv・Odesa・Kherson
Western
Volyn・Zakarpattia・Ivano–Frankish・Lviv・Rivne・Ternopil・Khmelnytskyi・Chernivtsi

Figure A2.3.1 Agro-ecological Classification of Ukraine

2.3.3 Categories of Producers

In Ukraine, the structure of production is multi-layered, consisting of both enterprises and individuals, a result of the dismantling and privatization of former Soviet state-run farms that occurred after independence. Large-scale agricultural enterprises primarily located in the east and south are engaged in large-scale production of export crops through the use of heavy machinery. On the other hand, individual farmers and household garden farmers produce over 90% of the country's vegetables and potatoes, as well as 76% of its fruit, and are also involved in livestock and poultry farming[12].

According to data as of 2018, following the enactment of the Land Law in 2001, more than 40,000 agricultural enterprises are registered. While there are large corporations (oligarchs) managing more than 50,000 ha of arable land, the majority of agricultural land is managed by individual farmers and household garden farmers with an average managed area of about 4 ha. The breakdown of the number of enterprises/farmers, scale of management, area of land occupied, and the main crops produced, across the four types of farming modes including individual and household farms, is shown in Table A2.3.1.

Table A2.3.1 Categories of Agricultural Producers

Category	Numbers	Land holding size (ha)	Proportional extent (%)	Major produces	Markets
Agro-holdings	70	70,000	14	wheat, corn, soybeans, rapeseeds, chicken meet	export

[12] State Statistics Service of Ukraine

Category	Numbers	Land holding size (ha)	Proportional extent (%)	Major produces	Markets
Agro-holdings cooperative	6,000	1,600	28	wheat, corn, soybeans, rapeseeds, sunflower, fruits, berries, pastures, potatoes	domestic and foreign markets
Agricultural enterprises	35,000	130	13		
Individual farmers and home gardens	4,000,000	4	45	vegetable, poultry, potatoes, pastures, fruits, berries	home consumption and sake for local markets

Source: Irrigation and Drainage Strategy of Ukraine (Dec. 2018)

According to the Agricultural Statistics Yearbook of 2018, it is stated that these 'individual farmers and household garden farms' account for 41.2% of the total agricultural GDP. This suggests that nearly half of the overall agricultural production is being carried out by these small-scale individual and household operations.

Table A2.3.2 Share of Agricultural GDP

Item	Total Agricultural Crop Production Share (%)	Main crops	Consumption/Sales Destination
Corporate Farms	58.8%	Grains	Time-bases Consumption / Export
Individual + Household	**41.2%**	Vegetables (Lobar-intensive)	Local Markets, Self-Consumption

Source: Statistical Year Book of Ukraine (2018)

2.3.4 Crop Production

(1) Overview

Ukraine is one of the leading agricultural countries in Europe with an annual crop production as large as 110 million tons of which 60 to 70 million tons are accounted for three representative crops, namely wheat, barley, and corn. The domestic demand of three crops amounts to 27 to 28 million tons or 30 to 40% of total production, of which 14 million tons are allocated to animal feed and seed reserve.

Ukraine exports 50 to 60 million tons of grains annually, which contribute substantially to foreign exchange earning of the country. Moreover, the global food security of Asia and Africa countries has been significantly supported by Ukraine’s cereals. The crop production of Ukraine in 2017 to 2021 are summarized in Table A2.3.3.

While grains are widely cultivated throughout the country, as mentioned later, wheat and barley are primarily produced in the southern and eastern regions, and corn has high production volumes in the central and eastern areas.

Table A2.3.3 Crop Production in Ukraine (2017-2021)

Crop	Averages in 2017 to 2021			World rank in production in 2021
	Harvested area (1,000ha)	Production (1.000ton)	Unit Yield (ton/ha)	
Cereals				
Wheat	6,697	27,266	4.1	6
Barley	2,488	8,325	3.3	5
Corn	4,981	33,750	6.8	5
Oat	191	458	2.4	-
Ray	149	457	3.1	-
Millet	90	159	1.8	-
Sorghum	50	173	3.6	-
Rice	11	60	5.2	-
Oil seeds				
Sunflower	6,266	14,232	2.3	1
Soybeans	1,602	3,670	2.3	9
Rapeseeds	1,044	2,744	2.6	8
Industrial crops				
Potato	1,312	10,718	8.2	6
Sugar beet	251	11,812	46.8	9
Vegetables				
Tomato	74.2	2,302	31.0	-
Cabbage	66.0	1,708	25.9	-
Carrot	43.1	855	19.8	-
Eggplant	5.2	67.4	13.0	-
Onion	2.2	27.9	12.5	-
Cauliflower	1.8	28.4	15.4	-
Fruits				
Apple	88.0	1,217	13.8	-
Strawberries	7.9	59.5	7.5	-
Other fruits	0.3	3.8	1.2	-

Source: State Statistics Service supplemented by FAOSTAT

Grains are widely planted throughout the country. The main producing zone of wheat and barley in the southern region of the country, while corn widely planted in the central region. In general, grains are produced under the highly mechanized farming systems in large farm plots. Oilseeds and industrial crops also contribute to growth of the agro-processing industry. Ukraine is the world's largest producer of sunflower oil. Rapeseed oil has a large share in the international market.

Potatoes are often categorized into industrial crop for the chips and starch processing factories as well as staple food called "second bread" in Ukraine since annual per capita consumption of potatoes is as high as 135 kg pr annum. Ukraine is the sixth largest potato producer in the world after Germany. Potatoes are produced nationwide, but the cool northwest region is known as a special production area. The main varieties of seed potatoes are Glico Ukraine, Norika, Solana, and Europlan, all of which are produced in Western Europe such as the Netherlands, and the share of local varieties is said to be about 3%.

Vegetable and fruit production by the private sector has increased in response to the government policies. Horticultural crops are planted nationwide. Individual farms and home gardens produce a diversity of vegetables and fruits for their consumption and income sources. Surplus over home-consumption is sold in local markets. In recent years, agribusiness enterprises embark on large-scale production of export-oriented fruits production especially berries. Berries require intensive crop

maintenance which has attracted new entry from small-scale individual farmers with opportunities for women farmers.

(2) Cereals and oilseeds

The production volume of major crops by province is shown in Table A2.3.4 on the next page. In order to grasp synoptic patterns of the regional characteristics of the crop production in Ukraine, the crop production of each oblast was aggregated by region, and the regional share was calculated as shown in the bottom limes of Table A2.3.4. The following points are observed from this analysis.

i. Wheat and barley are planted nationwide. The total production of both the southern and the central accounts for nearly 60% of the national total. Wheat production is particularly larger in such oblasts as Kharkiv, Zaporizhzhia, and Odesa, which are currently under crucial conditions by the war.
ii. Corn is grown throughout the country, but the central oblasts such as Poltava and Cherkassy are main producers contributing to nearly 50% of the national total.
iii. The regional share of wheat and barley production is lower in the northern region.
iv. The central and southern regions produce 60% of sunflower seeds of the national total.
v. The western and northern regions produce 70% of soybeans in its national total. On the other hand, production in the southern and eastern regions is limited.
vi. Distribution patterns of planed area of potatoes and sugar beets are almost same. The production areas spread from the western region to the central region.
vii. In the western region, production of grains and oilseeds generally is lower, but the reginal production of potatoes, sugar beets and soybeans are high.

The regional distribution of cereals, oilseeds and industrial crops is also shown in Figure A2.3.2 in the following page. The details of special distribution of crop production can be referred to Annex 2.3.1, which is prepared referring to crop production by oblast stipulated in the census in 2021 and 2022 published by State Statistics Service of Ukraine. The impact of the war to each oblast can be seen although further analysis is required.

Table A2.3.4 Production of Grains, Oilseeds and Industrial Crops by Oblast and Region (2021)

No.	Oblast	Wheat	Barley	Corn	Sunflower	Soybean	Rapeseed	Sugarbeet	Potato
	Ukraine	32,151	5,778	26,527	16,393	3,492	2,930	10,778	10,678
1	Vinnytsya	1,767	309	2,272	985	231	202	2,307	798
2	Volyn	718	140	408	101	103	155	381	604
3	Donipropetrovsk	2,469	591	845	1,416	10	200	32	353
4	Donetsk	1,549	129	73	778			11	231
5	Zhytomyr	754	122	1,093	371	310	108	445	940
6	Zakarpattya	82	7	216	7	27			241
7	Zaporizhzhya	2,717	49	19	1,070	41	179		111
8	Ivano–Frankivsk	236	141	404	91	119	68	23	512
9	Kyiv	1,054	200	1,786	596	232	102	967	759
10	Kirovohrad	1,869	450	1,873	1,596	144	68	449	266
11	Luhansk	1,081	0	0	809		1		101
12	Lviv	824	189	641	102	264	177	849	841
13	Mikolayiv	2,030	535	282	1,160	11	163		156
14	Odesa	2,643	833	325	966	11	303		162
15	Poltava	1,204	349	4,284	996	248	34	1,043	541
16	Rivne	539	173	558	108	140	88	803	649
17	Sumy	929	153	2,153	782	142	71		398
18	Ternopil	1,139	393	1,136	278	256	262	894	523
19	Kharkiv	2,831	220	436	1,420	42	8	253	332
20	Kherson	2,073	0	0	673	281	244		213
21	Khmelnytskiy	1,317	415	1,980	511	428	299	1,609	585
22	Cherkasy	1,229	229	2,640	810	194	55	485	452
23	Chernivtsi	174	72	436	63	155	32		318
24	Chernihiv	924	79	2,668	707	105	113	229	594

Reginal Total Production of Cereals, Oilseeds, Industrial Crops (Amount) (Unit: 1000 ton)

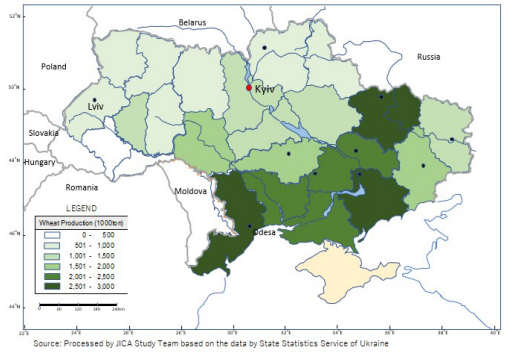
No.	Oblast	Wheat	Barley	Corn	Sunflower	Soybean	Rapeseed	Sugarbeet	Potato
1	Central	8,538	1,928	11,914	5,804	826	559	4,315	2,410
2	Northern	3,661	553	7,700	2,455	789	394	1,642	2,691
3	Eastern	5,460	349	509	3,007	42	9	264	663
4	Southern	9,463	1,417	626	3,868	343	889	0	642
5	Western	5,029	1,530	5,779	1,259	1,492	1,080	4,558	4,273
	Total	32,151	5,778	26,527	16,393	3,492	2,930	10,778	10,678

Reginal Total Production of Cereals, Oilseeds, Industrial Crops (Proportional Extent) (Unit:%)

No.	Oblast	Wheat	Barley	Corn	Sunflower	Soybean	Rapeseed	Sugarbeet	Potato
1	Central	27	33	45	35	24	19	40	23
2	Northern	11	10	29	15	23	13	15	25
3	Eastern	17	6	2	18	1	0	2	6
4	Southern	29	25	2	24	10	30	0	6
5	Western	16	26	22	8	43	37	42	40
	Total	100	100	100	100	100	100	100	100

Source: State Statistics Service of Ukraine

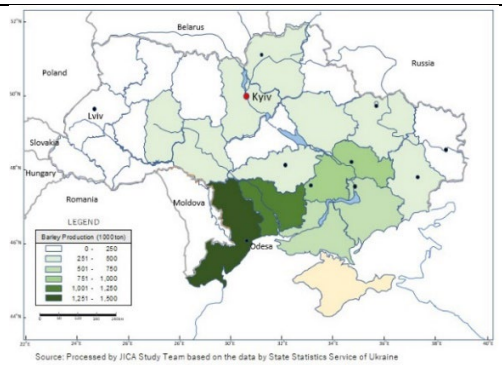
The regional distribution of cereals, oilseeds and industrial crops is shown in Figure A2.3.2.



Source: Processed by JICA Study Team based on the data by State Statistics Service of Ukraine

Figure 1.1 Wheat Production by Oblast in 2021

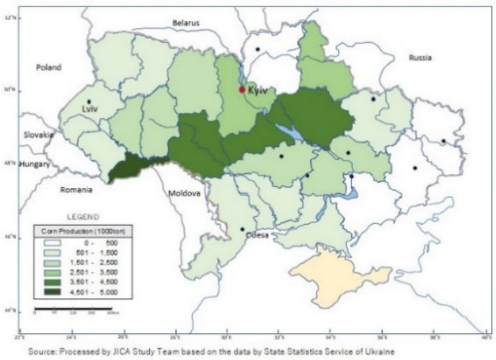
Wheat



Source: Processed by JICA Study Team based on the data by State Statistics Service of Ukraine

Figure 2.1 Barley Production by Oblast in 2021

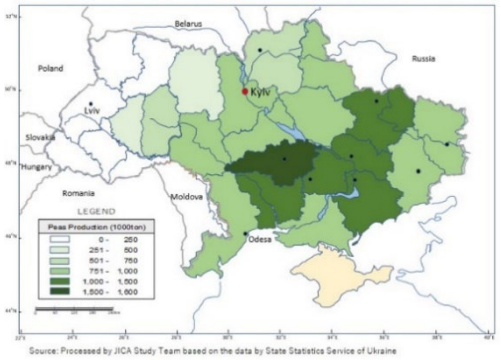
Barley



Source: Processed by JICA Study Team based on the data by State Statistics Service of Ukraine

Figure 3.1 Corn Production by Oblast in 2021

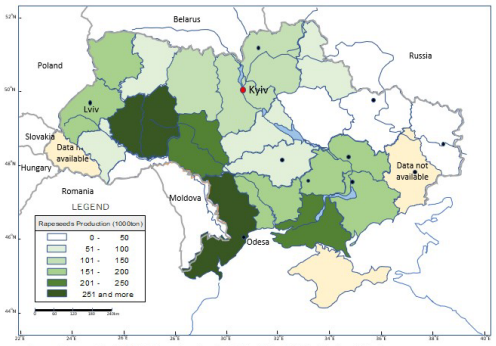
Corn



Source: Processed by JICA Study Team based on the data by State Statistics Service of Ukraine

Figure 6.1 Sunflower Production by Oblast in 2021

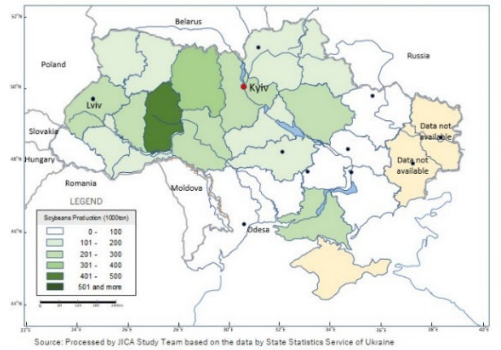
Sunflower



Source: Processed by JICA Study Team based on the data by State Statistics Service of Ukraine

Figure 7.1 Rapeseeds Production by Oblast in 2021

Rapeseed



Source: Processed by JICA Study Team based on the data by State Statistics Service of Ukraine

Figure 5.1 Soybeans Production by Oblast in 2021

Soybean

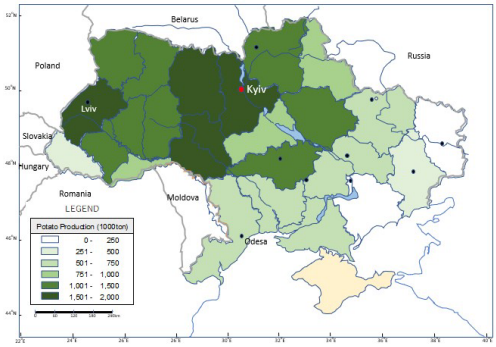
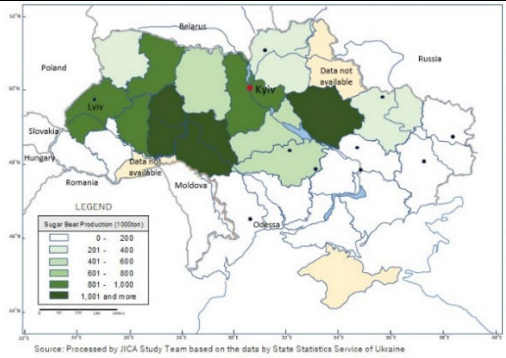


Figure 1 Potato Production by Oblast in 2021

Potato



Source: Processed by JICA Study Team based on the data by State Statistics Service of Ukraine

Figure 8.1 Sugar Beet Production by Oblast in 2021

Sugar beet

Source: Prepared by JICA Survey Team based on the data of State Statistics Service of Ukraine

Figure A2.3.2 Distribution Patterns of Cereals, Oilseeds and Industrial Crops

(3) Vegetables and fruits

Ukraine is one of the top three vegetable and fruit producing countries in Eastern Europe. In 2021, the harvested area of vegetables and fruits expanded to 1.7 million ha[13]. The total production amounted to 231.7 million tons. The products were exported to many countries of EU, Asia, and Africa although the export amount was limited to 498,000 tons with the total value of USD 196.6 million. The main products were tomatoes and onions. However, vegetable production in 2022 was seriously declined by 16.3% compared to the previous years due to shortages of agricultural materials, disruption of logistics, and damage to agricultural infrastructure due to the war. Apples have by far the highest cultivation area and production. In recent years, the planted area of berries has been increasing.

The crop production by oblast is presented in Table A2.3.5. The bottom lines of Table A2.3.5 show the regional share of vegetable and fruit production by oblast. The characteristics of the regional distribution of vegetables and fruits are summarized below.

i. Vegetables and fruits are produced nationwide. Dnipropetrovsk and Kherson Oblasts are the leading producers of vegetable and fruit production.
ii. The central region is relatively higher in vegetable and fruit production. The western region produces almost all vegetables and fruits except tomatoes and grapes.
iii. Tomatoes are regional specialties of both Kherson and Mykolaiv Oblasts, and grapes are regional specialties of Odesa Oblast. Production is overwhelmingly high in the southern region.
iv. Vinnitsa and Khmelnitsky Oblasts produce large quantities of apple, representative fruit of Ukraine.
v. The production of raspberries is high in each oblast bordering Moldova.
vi. Vegetable and fruit production in the northern and eastern regions is lower than in other regions.

Ukraine is ans exporter of vegetables as well as an importer. In 2021 the country imported more vegetables than exported. To compensate for domestic shortages, imports of potatoes and raw tomatoes for processing increased.

Compared to grains and oilseeds, the decline in vegetable exports is likely to be the cause of deteriorating business conditions for small and medium-sized enterprises and individual farmers, as can be seen from the OCHA report. However, potato, which is one of the most important in Ukraine's vegetable market, are mainly produced in the northwestern regions of Vinnytsia and Lviv Oblasts. Conflict damage is assumed to be in a different situation than that of grains and oilseeds and should be fully taken into consideration when considering the phased plan of the recovery assistance.

The regional distribution of vegetables and fruits is shown in Figure A2.3.3 on the following page and its further details of special distribution can be referred to Annex 2.3.2.

[13] "Agrarian sector in proximity to conflict - 24 Feb. to 30 May 2022: Risk to vegetables production", OCHA

Table A2.3.5 Production of Vegetables and Fruits by Oblast and Region (2021)

No.	Oblast	Tomato	Cabagge	Cucumber	Onion	Carrot	Apple	Grape	Plum	Pear	Strawberry	Raspberry
	Ukraine	2,445	1,741	1,080	1,025	864	1,279	264	188	163	62	37
1	Vinnytsya	75	65	49	79	61	237	4	7	4	3	3
2	Volyn	17	53	14	20	84	24	0	2	4	3	1
3	Donipropetrovsk	186	175	107	71	53	67	8	11	20	3	3
4	Donetsk	53	49	36	31	16	27	5	12	11	4	4
5	Zhytomyr	41	83	33	44	44	25	0	2	4	8	2
6	Zakarpattya	58	90	45	12	11	87	30	8	1	2	1
7	Zaporizhzhya	55	18	58	29	8	18	4	6	6	2	2
8	Ivano–Frankivsk	11	61	17	14	24	39	1	6	6	1	1
9	Kyiv	104	98	74	97	83	49	3	6	8	7	3
10	Kirovohrad	48	18	26	37	18	3	3	2	3	1	1
11	Luhansk	42	24	13	18	8	18	3	8	7	2	2
12	Lviv	24	382	95	63	86	81	1	11	13	3	1
13	Mikolayiv	432	15	30	47	20	9	18	3	3	0	0
14	Odesa	61	15	26	58	13	21	169	13	7	1	1
15	Poltava	129	72	65	52	40	50	3	13	15	3	2
16	Rivne	25	78	26	24	37	32	0	13	10	3	2
17	Sumy	45	27	20	19	19	9	0	2	1	1	1
18	Ternopil	35	64	36	30	30	80	0	5	3	3	1
19	Kharkiv	147	103	78	66	38	22	1	6	4	1	2
20	Kherson	677	93	120	89	61	16	9	4	1	3	1
21	Khmelnytskiy	21	39	21	25	32	152	1	30	10	2	2
22	Cherkasy	68	49	49	48	37	11	1	2	2	2	2
23	Chernivtsi	54	35	19	33	26	196	1	13	21	3	1
24	Chernihiv	38	35	25	21	15	9	0	3	1	2	1

Reginal Total Production of Vegetables and Fruits (Amount, 1000 ton)

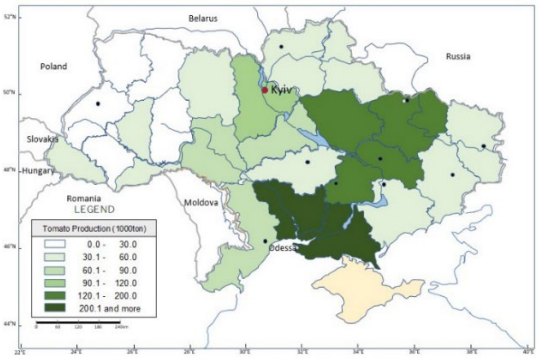
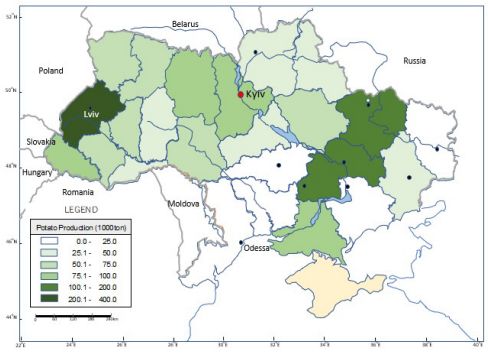
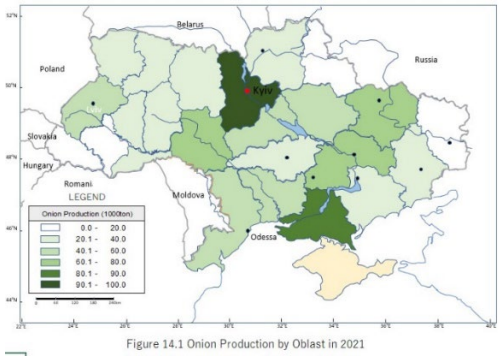
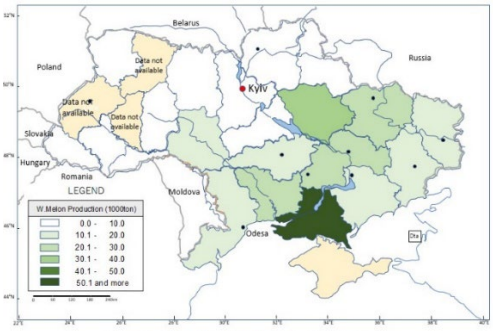
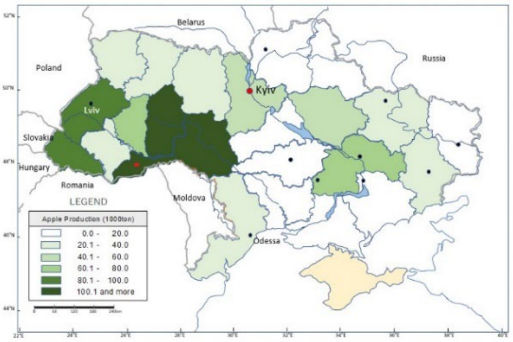
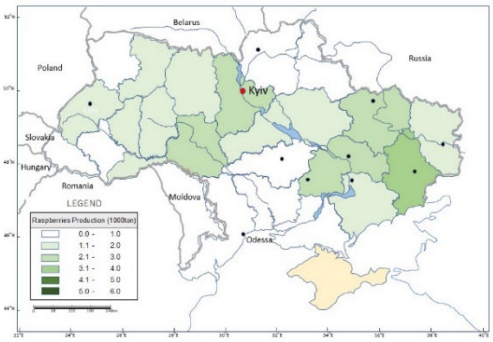
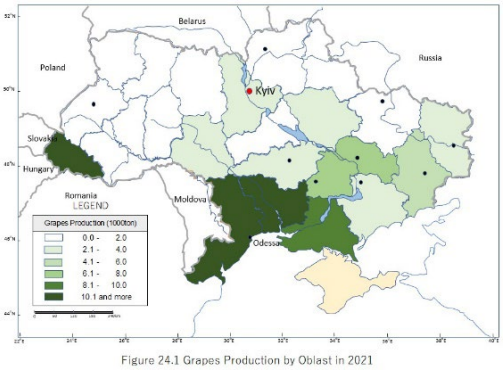
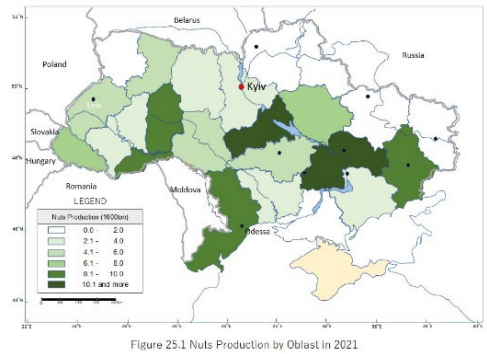
No.	Oblast	Tomato	Cabagge	Cucumber	Onion	Carrot	Apple	Grape	Plum	Pear	Strawberry	Raspberry
1	Central	506	379	295	286	209	368	18	36	44	12	10
2	Northern	227	243	152	181	161	92	3	12	14	18	6
3	Eastern	242	176	128	115	62	67	8	25	21	7	8
4	Southern	1,224	141	234	222	102	63	200	26	17	7	4
5	Western	245	802	272	221	329	690	35	89	67	19	10
	Total	2,445	1,741	1,080	1,025	864	1,279	264	188	163	62	37

Reginal Total Production of Vegetables and Fruits (Proportional Extent,%)

No.	Oblast	Tomato	Cabagge	Cucumber	Onion	Carrot	Apple	Grape	Plum	Pear	Strawberry	Raspberry
1	Central	21	22	27	28	24	29	7	19	27	19	27
2	Northern	9	14	14	18	19	7	1	7	9	28	16
3	Eastern	10	10	12	11	7	5	3	13	13	12	22
4	Southern	50	8	22	22	12	5	76	14	10	11	10
5	Western	10	46	25	22	38	54	13	47	41	30	26
	Total	100	100	100	100	100	100	100	100	100	100	100

Source: State Statistics Service of Ukraine

The regional distribution of vegetables and fruits is shown in Figure A2.3.3.

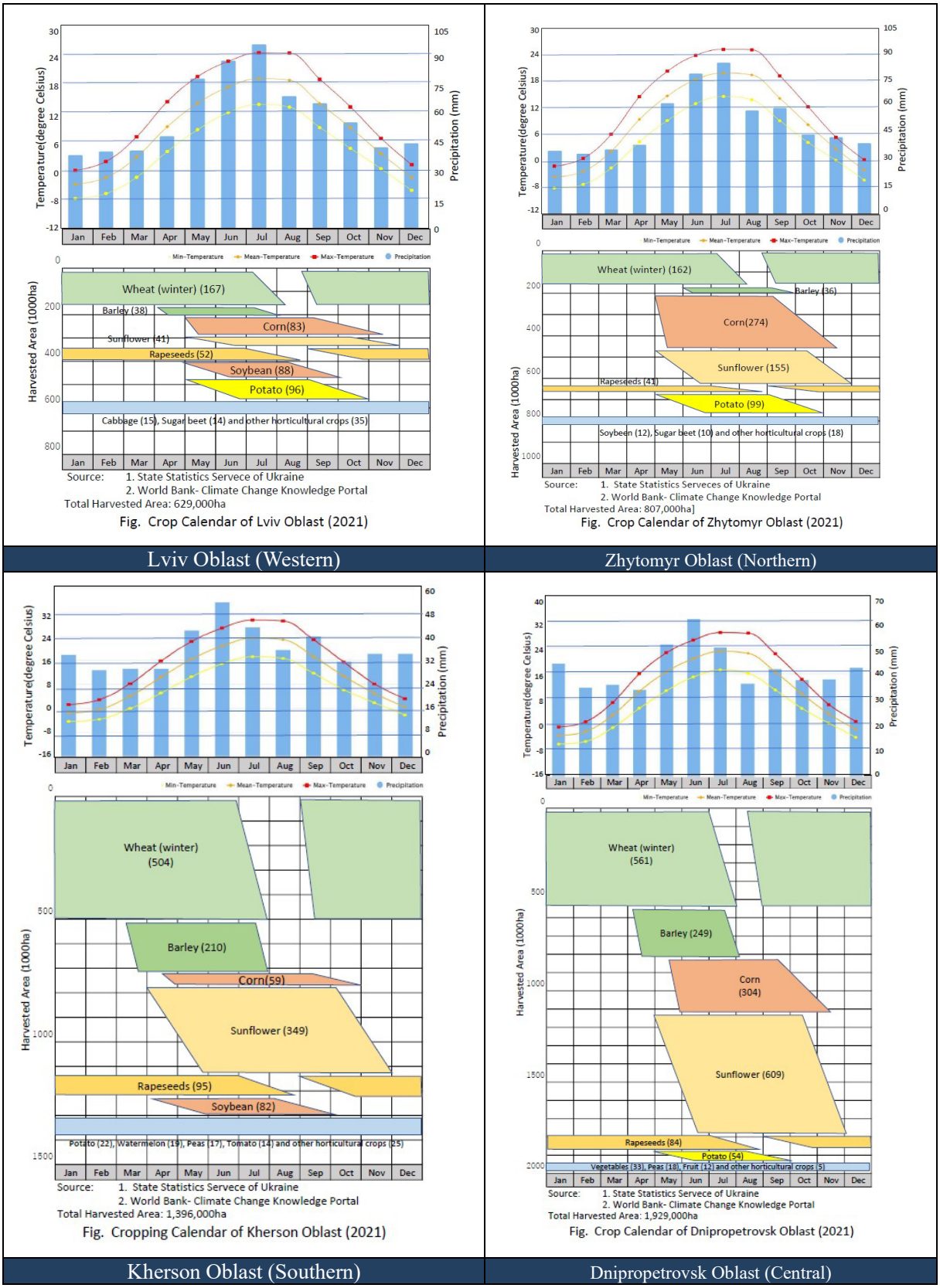
 Figure 13.1 Tomato Production by Oblast in 2021	 Figure 10.1 Cabbage Production by Oblast in 2021
Tomato	Cabbage
 Figure 14.1 Onion Production by Oblast in 2021	 Figure 16.1 Water Melon Production by Oblast in 2021
Onion	Watermelon
 Figure 18.1 Apple Production by Oblast in 2021	 Figure 22.1 Rasberries Production by Oblast in 2021
Apple	Raspberry
 Figure 24.1 Grapes Production by Oblast in 2021	 Figure 25.1 Nuts Production by Oblast in 2021
Grape	Nuts

Source: Prepared by JICA Survey Team based on the data of State Statistics Service of Ukraine

Figure A2.3.3 Regional Distribution Patterns of Vegetables and Fruits

(4) Cropping seasons

The cropping seasons of some oblasts are illustrated in Figure A2.3.4.



Source: Prepared by JICA Survey Team based on the data of State Statistics Service of Ukraine

Figure A2.3.4 Cropping Season in Ukraine

The temperature in Ukraine drops to near zero degree centigrade in December to February. In Ukraine, the single cropping is broadly practiced nationwide with exception in the southern oblasts. Wheat, barley, and rapeseed are generally sown from the end of August to the end of September, and after overwintering, they are harvested from July to early August of the following year. Other crops are planted in May and harvested by October followed by the fallow period from November to April. Precipitation during the planting period from May to August amount to 400 to 700 mm in most of oblasts. Only in some southern oblasts such as Kherson, the double cropping is introduced to the limited extent from early spring where irrigation water is available.

(5) Costs and profits of crop production

The production costs and profits of major crops in Ukraine are presented in Table A2.3.6.

Table A2.3.6 Costs and Profits of Crop Production under Rainfed Farming Conditions

Crop	Unit Yield ton/ha	Producer Price UAH/ton	Gross Profit UAH/ha	Production Cost UAH/ha	Net Profit UAH/ha	Profit Rate %
Wheat	3.00	6,000	18,000	13,101	4,899	27.2
Barley	2.50	4,850	12,125	10,928	1,198	9.9
Oat	2.00	5,000	10,000	9,100	900	9.0
Millet	2.00	6,800	13,600	9,034	4,566	33.6
Corn	4.00	5,100	20,400	17,172	3,228	15.8
Peas	1.50	6,900	10,350	7,055	3,296	31.8
Sugar beets	5.00	3,650	18,250	14,810	3,440	18.8
Tomato	15.00	4,500	67,500	45,450	22,050	32.7
Sunflower	1.20	10,500	12,600	10,930	1,670	13.3
Soybeans	1.50	11,300	16,950	14,400	2,550	15.0
Rapeseeds	1.20	10,350	12,420	10,170	2,250	18.1
Potato	6.50	6,000	39,000	29,426	9,925	49.7

Source: Prepared by JICA Survey Team based on the data of State Statistics Service of Ukraine

The proportional compositions of production costs are presented in Table A2.3.7.

Table A2.3.7 Composition of Production Costs

Crop	Total	Direct Cost (%)					Indirect Cost (%)		
		Seeds	Fertilizers	Fuel	Others	Subtotal	Hired labor	Others	Subtotal
Wheat	100.0	7.6	21.9	8.5	14.7	50.9	6.5	42.6	49.1
Barley	100.0	8.1	19.3	9.5	14.8	51.7	7.2	41.1	48.3
Oat	100.0	10.5	15.7	12.3	12.1	50.6	9.4	40	49.4
Millet	100.0	5.5	12.8	11.0	17.3	46.6	7.7	45.7	53.4
Corn	100.0	13.0	15.4	7.5	12.3	48.2	5.5	46.3	51.8
Peas	100.0	15.0	11.7	9.3	17.2	53.2	7.3	39.5	46.8
Sugar beets	100.0	9.4	16.4	9.2	22.0	57.0	5.3	37.7	43.0
Tomato	100.0	6.2	5.6	1.4	38.9	52.1	19.2	28.7	47.9
Sunflower	100.0	10.8	15.3	9.1	15.4	50.6	6.4	43.0	49.4
Soybeans	100.0	9.6	10.5	7.4	17.6	45.1	6.4	48.5	54.9
Rapeseeds	100.0	6.3	24.2	8.2	19.6	58.3	5.2	36.5	41.7
Potato	100.0	30.7	13.9	4.5	16.8	65.9	6.6	27.5	34.1

Source : Prepared by JICA Survey Team based on the data of State Statistics Service of Ukraine

The details of the indirect costs shown in Table A2.3.7 have not yet been studied in-depth. There is a notation by State Statistics Service that the other indirect costs include deductions on the social purposes, depreciation of fixed assets, payment of services and jobs of other organizations, other direct and indirect costs.

2.3.5 Exports of Agricultural Products

(1) Export-oriented crops

The balance of major crops was calculated in the basis of domestic production, imported and exported amounts. The results are shown in Table A2.3.8.

Table A2.3.8 Demand and Supply Balance of Major Crops in 2017-2021 (Unit：1000ton)

Crop	Domestic Production (1)	Imported (2)	Total Supply (3)=(1)+(2)	Exported (4)	Balance (5)=(3)-(4)	Exported/ Production (6)=(4)/(1)
Corn	33,750	31	33,781	25,134	8,647	74%
Wheat	27,266	8	27,274	18,232	9,042	67%
Barley	8,325	15	8,340	4,597	3,743	55%
Oat	458	1	459	12	447	3%
Rye	457	1	458	51	407	11%
Sorghum	173	0	173	113	60	65%
Millet	159	0	159	87	72	55%
Rice	60	0	60	1	59	2%
Sunflower	14,232	26	14,258	97	14,161	1%
Soybean	3,670	9	3,679	2,333	1,346	63%
Rapeseed	2,744	23	2,767	2,489	278	90%
Potato	10,718	151	10,869	14	10,855	0%
Total	112,728	209	42,290	4,933	49,117	10%

Source: Prepared by JICA Survey Team referring to FAOSTAT

Imported amounts of the major crops are extremely limited. In contrast, 60 to 90% of domestic production of corn, wheat, soybeans, and rapeseeds are exported. Ukraine has been rapidly growing as major exporter of agricultural products since its independence, The agricultural sector contributed to USD27.8 billion or 41% of USD68 billion of Ukraine's total export value in 2021. It is noted that grains and oilseeds accounted for 75% of agricultural exports. The export value of the major agricultural products in 2021is shown in Table A2.3.9.

Table A2.3.9 Amounts and Values of Major Agricultural Products in 2021

Crop	Domestic Production (1,000ha)	Exported Products (1.000ton)	Proportion of Exported Products (%)	Export Value (USD billion)
Corn	41,900	23,000	56	5.9
Wheat	33,000	19,000	58	5.1
Sunflower oil	5,676	4,950	87	6.9
Sunflower meal	5,452	4,100	75	1.2
Rapeseeds	3,015	2,700	89	0.2

Source: USDA, April 2022

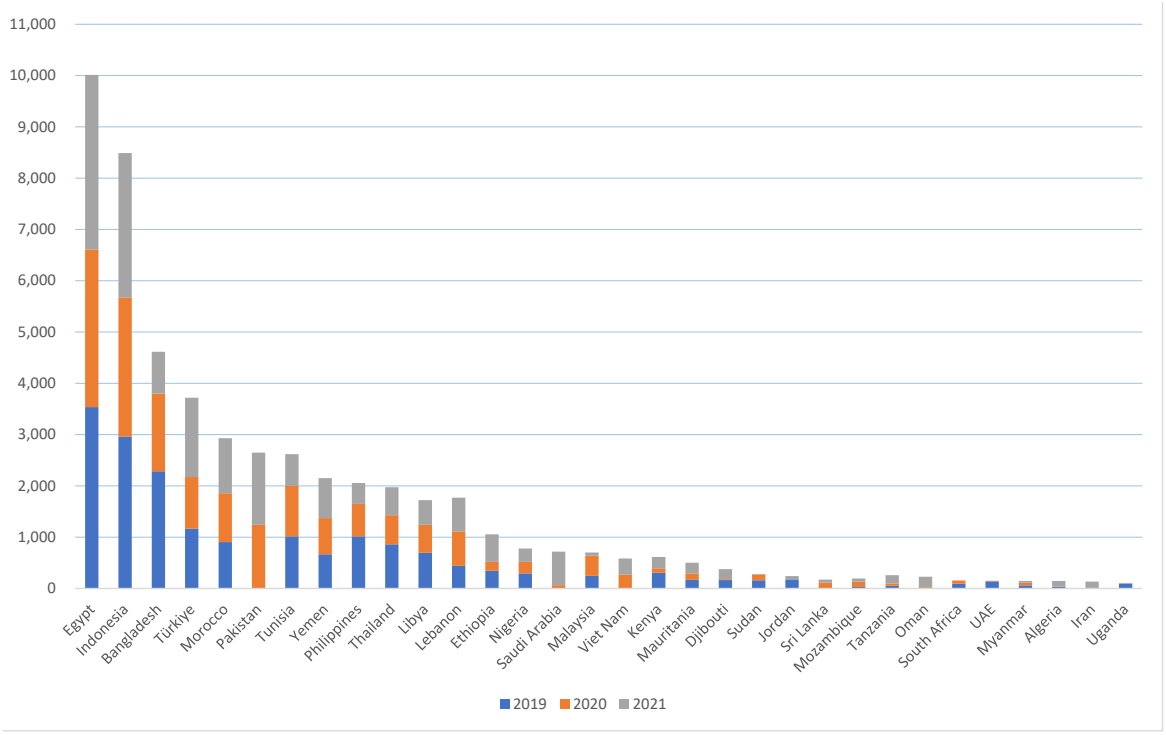
Before the dissolution of the Soviet Union in 1991, sunflower seeds were exported unprocessed, but export duties were introduced to curb exports and promote export as sunflower oil. As a result, the

cultivated area has doubled since 1991. Currently, the export value of sunflower oil and meal (for livestock feed) is USD1.2 billion (2021), and sunflower oil from Ukraine accounted for almost half of the world's distribution and almost two-thirds of the world's sunflower meal. Profitability has been stable in recent years as demand for sunflower oil has increased and international prices have remained at high levels. In addition, Ukraine is one of the world's top 10 exporters of rapeseed oil with an export value of USD1.7 billion in 2021. The export volume of soybean oil is also on the rise with the export value reaching USD600 million.

Stable production increases the grain export. Cost saving is the keys to improve its price competitiveness in the international market. However, after the military invasion in 2022, crop production costs were sharply increased due to soaring prices of fuel and chemical fertilizers. At present, grain producer prices are below international prices, but further cost reduction through improved production systems continues to be a challenge for the agricultural sector of Ukraine.

(2) Destination of export

Ukraine is the world's fifth largest wheat exporter with an export value of USD5.1 billion in 2021/22. The export destinations are represented by Egypt, Indonesia, Turkey, Morocco, Pakistan, Bangladesh, etc., as shown in Figure A2.3.5.

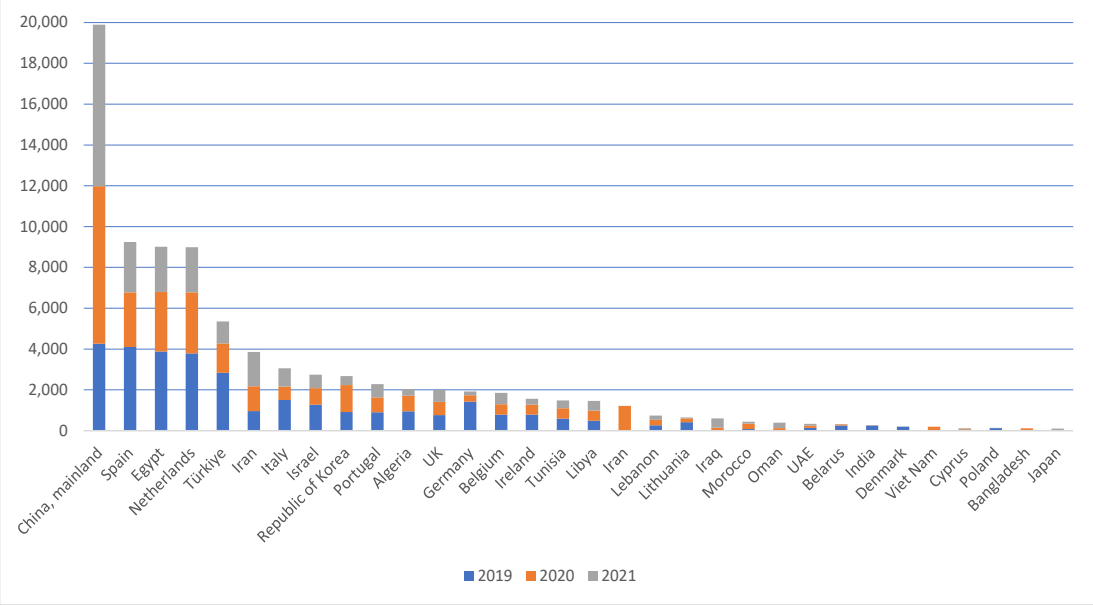


Source: FAOSTAT

Figure A2.3.5 Destination Counties of Ukrainian Wheat

EU countries are the leading exporter of wheat on the international market, followed by Russia, USA, Canada, and Ukraine. Ministry of Agricultural Policy and Food of Ukraine announced in June 2023 that the production of the 2022/23 winter wheat remains at 22 million ton or 19% lower than in 2022.

Most of corn produced in Ukraine is used for animal feed with export value of USD 5.9 billion in 2021. China imported 32% of the total exported amount as seen in Figure A2.3.6. Since China's domestic production reached the highest record in 2022, its imports from the United States and Ukraine declined by 27%.



Source: FAOSTAT

Figure A2.3.6 Destination Counties of Ukrainian Corn

2.3.6 Grain Storage

(1) Storage facilities in producing areas

Grain storages in Ukraine have developed in response to expansion of cereal production. The components of a typical grain storage in Ukraine include storage bins, delivery elevators and drying and preparation facilities. In the early 1990s, there were 545 storage facilities in the country with a total storage capacity of 30 million tons, which was equivalent to approximately 50% of grain production at the time.

With increased grain production, storage facilities have been newly built, expanded and modernized. As described below, the number of facilities has increased to 1,400 even in 16 major cereal producing oblasts alone. As of 2023, storage capacity has expanded to a total of 57.2 million tons, as presented in Table A2.3.10 on the next page.

In order to avoid increasing costs for post-harvest, however, cereal producers and traders often ship their produces to the export terminals of the Black Sea coast immediately after harvesting grains rather than keeping them in the production area. As a result, some storage facilities currently receive grains less than their designed capacity.

The diversification of the supply chain currently affects regional needs of the storage facilities. Some 95% of agricultural products were exported through the seaports of the Black Sea coast, of which 65 to 70% was transported by railway from producing areas to export terminals before the conflict.

However, substantial portions of grains for export are also transported to the western border to Poland by both road and railway. Therefore, country elevators in the western regions of Ukraine become more important although financial burden for logistics tend to increase.

Tabel A2.3.9 Existing Grain Storages by Oblast (Unit:1,000 ton)

Oblast	Average cereal production 2018-2022 (1)	Elevator capacities (2)	Availability of grain elevators (2)/(1)
Vinnytsia	6,544	4,157	0.64
Volyn	1,584	976	0.62
Dnipropetrovsk	5,344	3,211	0.60
Donetsk	2,163	1,091	0.50
Zhytomyr	3,183	1,343	0.42
Zakarpattia	3,87	186	0.48
Zaporizhzhia	3,444	2,221	0.64
Ivano-Frankivsk	1,071	507	0.47
Kyiv	4,536	2,809	0.62
Kirovohrad	5,569	3,653	0.66
Luhansk	1,048	870	0.83
Lviv	2,089	1,026	0.49
Mykolaiv	3,852	4,417	1.17
Odesa	4,550	5,476	1.20
Poltava	7,178	5,208	0.73
Rivne	1,691	1,014	0.60
Sumy	5,260	2,895	0.55
Ternopil	3,550	1,824	0.51
Kharkiv	5,220	2,882	0.57
Kherson	2,582	2,057	0.80
Khmelnytskyi	5,260	3,105	0.59
Cherkasy	5,154	2,861	0.56
Chernivtsi	850	235	0.28
Chernihiv	5,732	3,187	0.56
Ukraine, Total	87,841	57,210	0.65

Source: JICA Survey Team

(2) Storage facility damage investigation

In September 2022, the Humanitarian Research Laboratory (HRL) of Yale School of Public Health (YSPH) and the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL) reported the study results of the impacts to the grain storages by Russia's invasion as of July 2022. YSPH and ORNL conducted the impact assessment of damaged storages by full use of the satellite imageries. It is not a nationwide survey but covers 16 oblasts affected by the Russian invasion. The surveyed 16 oblasts are listed in Table A2.3.11.

Table A2.3.11 Results of the Impact Survey for Grain Storage Facilities

Oblast	No. of Existing Storage Facilities (No.)	No. of Facilities Assessed for Damage using Satellite Imageries (No.)	No. of Facilities Classified as Sustained Conflict Affected Damage (No.)	Damaged Tonnage (1000ton)
Donetsk	35	18	17	439
Mykolaiv	70	42	13	1,046
Zaporizhzhia	55	12	10	444
Kharkiv	87	32	9	300
Kherson	59	6	6	185
Chernihiv	74	41	4	135
Dnipropetrovsk	93	54	4	121
Luhansk	23	4	4	94
Kyiv	70	24	2	22
Poltava	109	27	2	159
Zhytomyr	54	14	2	111
Kirovohrad	98	0	1	30
Sumy	56	16	1	18
Cherkasy	62	8	0	0
Odesa	93	44	0	0
Vinnytsia	9	90	0	0
Rivne	2	81	0	0
Volyn	2	71	0	0
Total	1,399	344	75	3,104

Source: Ukraine's Crop Storage Infrastructure: Post-Invasion Impact Assessment, Yale School of Public Health (YSPH), September 2022

As seen in Table A2.3.12, the study concluded that at least 8.49 million tons (14.57%) of the storage capacities are damaged out of the total capacity of 58 million tons of existing storage facilities, while the remaining storage capacity is 49.8 million tons.

Table A2.3.12 Impacted Storage Capacity in Million Metric Tons (rounded) (Unit:1,000ton)

Location category as of July 2022	Pre-war storage capacity	Impacted storage capacity	Remaining storage capacity	Percent of pre-war storage capacity impacted
Under Russia's control among 16 Oblasts	6,240	6,240	0	100.00
In Area of Interest (AOI) among 16 Oblasts	30,840	2,250	28,590	7.35
Elsewhere in Ukraine *(not assessed for damage)	21,180	0.00	19,300	0.00
Total	58,260	8,490	49,800	14.57

Source: Prepared by JICA Survey Team based on Ukraine's Crop Storage Infrastructure: Post-Invasion Impact Assessment, Yale School of Public Health (YSPH), September 2022

Out of 75 storage facilities damaged, 49 were located adjacent to the railway. Those damaged storages are either connected with the main line by siding line or located within 1 km of the main line. In addition, 60 related facilities including nine major ports with rail access near the cities of Mykolaiv and Mariupol as well as two shipping wharves were damaged.

(3) Storage facilities for export grains in the Black Sea

In June 2022, four months after the Russian invasion of Ukraine, Mykola Gorbachev, the head of the Ukrainian Grains Association, stated at the International Grains Council (IGC) meeting in London that

Ukraine would have about 55 million tons of grain of which about 30 million tons are already harvested and stored. If the Black Sea blockade by Russian continues, grain exports in 2022/23 will be limited to a maximum of 20 million tons. Limited storage facilities would be further restricted once wheat and barley harvests would begin in July and corn in November. It was also mentioned that a half of matured corn would be left unharvested on farmland.

Table A2.3.13 11 Ports of Black Sea Coast and Grain Export

Name of Port	Note	Cargo handling company	Grain handling amount (1,000ton)	
			2020/2021	2021/2022
1. Nikolaev Port (Black Sea, Mykolaiv Oblast)	Managed by the state-run Ukrainian Sea Ports Authority. One of the three major ports in Ukraine	Sate 1. Private 2. Foreign company1. Not determined 1	11,044	13,223
2. Chornomorsk Port (Black Sea, Odessa Oblast)	It is located on the northwestern coast of the Black Sea at the mouth of the Skui River, southwest of Odessa.	Sate 1, Private 2, Foreign company	8,094	12,553
3. Vivdeni Port (Black Sea, Odessa)	Managed by the National Seaport Authority. One of the largest and most profitable ports in the country	Private 1, Foreign company 1	6,066	8,663
4. Berdiansk Port (Azov Sea, Zaporizhzhia Oblast)	Specialized Seaport. Bug estuary port. Managed by the National Port Authority.	Private 1	316	2,609
5. Berdiansk Port (Azov Sea, Zaporizhzhia Oblast)	Managed by National Port Authority	Sate 1	1,173	1,151
6. Lenj Commercial Port (Danube River/Odessa Oblast)	An important transport hub where river, sea, road and rail transport are closely intertwined.	Sate 1	11	833
7. Mariupol Port (Azov Sea, Donetsk Oblast)	As of June 2022, it is occupied by the Russian military. Managed by National Port Authority	Private 1	747	780
8. Kherson Port (Black Sea, Kherson Oblast)	Located in the Dnieper delta. Maximum water depth is 9.6 m. Adjacent to railway and expressway.	Sate 1	133	355
9. Izmail Port (Black Sea/Odessa)	It is located at the mouth of the Kiria River on the Danube. Important transportation hub. Managed by the State Port Authority.	Sate 1	0	26
10. Ust-Danube Commercial Port (Danube River, Odessa Oblast)	It is located at the mouth of the Ocakib estuary in the Danube River delta, in the southern part of the Zebryanska Bay in the Black Sea.	Sate 1	0	2
11 Others			0	12
Total			**31,594**	**44,793**
(1) Wheat			13,789	18,896
(2) Corn			13,925	20,086
(3) Barley			3,880	5,811

Source: Prepared by JICA Survey Team based on wab page of APK Inform

The Black Sea Grain Initiative was concluded on July 22, 2022 through the mediation of Turkey and the United Nations. It was agreed among four parties to resume grain exports and jointly monitor safe shipping routes for a 120-day period and any extension would require a new agreement with Russia. The extension was signed, and the extension expired on March 17, 2023, when Russia unilaterally

shortened the extension period to 60 days. The second and third extensions expired on May 18 and July 18, 2023, respectively. Unfortunately, it was announced that Russia withdrew from the Black Sea Grain Initiative on July 17.

There are 11 ports on the Black Sea coast in Ukraine, and according to the agreement of Black Sea Grain Initiative, grain has been exported from the top three ports in Table 2.3.12. The handling volume in 2020/2021 and 2021/2022 is also shown in Table A2.3.13.

On July 17, Russia decided to withdraw from the Black Sea Grain Initiative. This has severely restricted grain shipments to the Global South, with a major negative impact on global food security. Given the difficulties in transporting grain via the Black Sea, there is an increasing urgency to expand the volume of land transport via Poland and Lithuania, as well as water transport along the Danube River. Due to changes in export routes, it is also necessary to review transportation routes from production areas to border gates and related facilities.

(4) Potential for Future Railway Distribution Network Development

It is expected that Ukraine will continue to decouple from Russia while deepening its economic ties with the EU member states. In this context, strengthening the railway network leading to Europe is of particular interest. In the World Bank report "Ukraine Rapid Damage and Needs Assessment" (July '22), under the "Priorities for Recovery," the second item mentions "2. Strengthening railway links to the EU to promote economic integration with European markets and ensure resilience against possible future disruptions in access to the Black Sea."

Furthermore, at the G7 Transportation Ministers meeting on March 17, 2023, it was indicated that they "support the idea of reconstructing the railway gauge (track width) from the current 1,520 mm Russian type to the 1,435 mm EU standard." This would promote cross-border connectivity and is expected to facilitate railway exports to Europe.

As mentioned above, one of the promising future export corridors is shown in the following diagram leading from western Ukraine to Poland. It is expected that this route will become increasingly active in the distribution of agricultural products.

Source: Prepared by JICA Survey Team based on "Sekai no Tetsudou (SEIZANDO-SHOTEN)"

Figure A2.3.7 Trailway Network toward EU

2.3.7 Livestock Industry

(1) Number of livestock and production

Table A2.3.14 shows the number of animals and the production of livestock products in Ukraine for three years based on FAO statistics.

Table A2.3.14 Animal Population and Livestock Products

Livestock	Unit	2019	2020	2021	Average
Population					
Cow	1000 heads	3,333	3,092	2,874	3,100
Swine	1000 heads	6,025	5,727	5,876	5,876
Poultry	Million heads	192	203	184	193
Goat	1000 heads	570	546	519	545
Sheep	1000 heads	699	659	621	659.
Products					
Cow milk	1000 ton	9,448	9,058	8,517	9.007
Beef	1000 ton	370	345	311	342
Pork	1000 ton	708	697	724	710
Chicken meat	1000 ton	1,322	1,344	1,314	1,326
Chicken eggs	mil. pc	16,511	16,006	13,931	15,482
Chicken egg	1000 ton	954	924	804	894

Source: FAOSTAT

(2) Milk[14]

In Ukraine, the contribution of individual farmers to the livestock sector is significant, with cattle being the most important livestock. Most of cattle in Ukraine are dairy cows. Cool climate of the northwestern and northeastern regions is suitable for dairy industry. The number of raised animals decreased from 6 million in 2007 to 4 million in 2016, and currently stands at 3.1 million, of which 65% are raised by individual farmers. The annual milk production amount to 9 million tons, which are

[14] Ukraine: Livestock and Products Annual, 11 Sept 2023, USDA, same as (3) Beef, (4) Pork, and (5) Chicken and chicken eggs.

important but vulnerable income source for farmers. On the other hand, commercial dairy production by enterprises is highly profitable.

The invasion of Russia has made it difficult to transport dairy products and even milking cows especially in the northeast. As a result, many dairy cows were slaughtered, and the amount of domestic beef distributed temporarily increased. The beef prices fell, and livestock farmers faced large losses. It will take several years to recover the appropriate herd composition (herd structure) to rebuild livestock management due to the overwhelming decrease in the number of livestock.

(3) Beef

The main markets for beef export of Ukraine were Russian followed by Belarus. Since trade restrictions were introduced from 2016 to 2019, Ukraine has shifted its export destination to Central Asian countries. Live cattle were exported to Central Asia and North Africa. China became the largest importer in 2021. On average over the past three years, beef production was 340,000 tons, of which 30,000 tons, or about 10%, was exported to China, Kazakhstan, Uzbekistan, Azerbaijan, Turkey, Moldova, and the Middle East.

Demand for Ukrainian beef cattle remains stable despite the war in Ukraine and the blockade of the Black Sea. Immediately after the start of hostilities, a complete export ban was imposed and transport within the EU was cut off, but exports using the Danube port continued. The transport of live cattle to EU via Romania then resumed in the second half of 2022. Egypt is a major export destination for Ukrainian cattle (live cattle), and exports of live cattle are expected to remain strong due to sluggish domestic demand and prices.

(5) Pork

Individual farmers make a large contribution to the pig industry. About 64% of pigs raised are owned by individual farmers. The pig farming by individual famers is evenly distributed throughout the country, while commercial pig farming is concentrated in the western and central regions of Ukraine. In recent years, the number of pigs has been declined. The pig industry suffers from the loss of the Russian market, a lack of foreign investment and African swine fever (ASF). In 2022, the number of cows and pigs decreased due to the economic downturn caused by the war. Moreover, a significant amount of pork was imported to make up the meat shortage in local market.

(6) Chicken and chicken eggs

The consumption of chicken meat is higher than either beef and pork. In the past three years, the number of chickens was 193 million, and the production was 1.33 million tons as of live weight. Of this amount, 400,000 tons were exported to Saudi Arabia, the Netherlands, Slovakia, UAE, and Azerbaijan. The production of chicken eggs is 9 million tons, making them an important source of animal protein that complements meat.

2.3.8 Agro-Processing Industry

The total production value in 2020 was USD21.2 billion or 23% of GDP as presented in Table A2.3.15.

Table A2.3.15 Total `Production Value in 2020 (Unit 1000 ton)

Agricultural products	2017	2018	2019	2020	2,021	Average
Sunflower oil	5,766	5,585	6,106	6,861	5,161	5,896
Sunflower meal	4,803	4,297	4,767	5,359	4,158	4,677
Soy fat	167	215	375	302	240	260
Soybean meal	309	415	870	584	494	534
Rapeseed oil	64	144	151	137	140	127
Rapeseed meal	74	161	178	148	178	148
Corn milling	24	25	22	29	31	26
Corn oil	9	5	12	10	9	9
Beet pulp	100	109	134	117	119	116
Apple concentrate	60	65	102	51	63	68
Apple juice	2.5	2.0	1.8	1.9	2.1	2.0
Polished rice	0.9	3.4	6.0	4.6	6.0	4.2
Frozen potatoes	0.1	0.3	0.0	0.0	0.1	0.1

Source: FAOSTAT

The industry of agricultural processing of Ukraine covers a wide range of products including vegetable oils, animal fats and oils, confectionery, dairy products, meat and poultry, fruit and vegetable products, etc. Industrial raw materials such as starch and sugar are categorized into industrial products.

The leading export product of Ukraine is edible oil accounting for USD4.4 billion or 70% of the total food exports of USD6.3 billion. Tomato paste and apple concentrate are highly competitive in the EU market. The Ukraine's food industry is advantageous with its abundant raw materials and geographical position allowing it to develop as an export base to Europe.

Currently, there are 2,000 food processing companies in Ukraine, 200 of which are local subsidiaries of international companies such as Mondelez, Nestle, Danone, PepsiCo, Coca Cola and Carlsberg[15]. About 70% of the food processing plants owned by local companies is said to be obsolete. Such countries as Italy, Germany, the Netherlands, Poland, Turkey, etc. are supporting the modernization of processing plants. However, private investment in the food processing industry has decreased significantly since 2020.

A Close and Comprehensive Free Trade Agreement (DCFTA) was signed between Ukraine and EU in January 2016 with the elimination of tariffs and quotas on food processing equipment. In future, demand for high-quality food processing and packaging materials is said to increase due to the enactment of Ukraine's food safety law in accordance with EU standards, HACCP requirements, and expansion of sales channels to overseas markets. However, in order to properly maintain and manage foreign-made food processing equipment, assistance from local distributors or agents with customs clearance, tax payments, certification procedures, and other support functions (spare parts and repair services) is essential.

Ukraine is the world's sixth largest producer of potatoes, producing more than 10 million tons annually. Exports of raw edible potatoes have been limited for many years, and strict control over the

[15] Food Processing Sector Report, 2 Jan 2023, USDA

exclusion of genetically modified potatoes has allowed the country to gain a market within EU. The potato processing industry is dominated by three major companies, PepsiCo, Mondelez, and Club Chips, which manufacture French fries and chips. There are eight companies operating in the starch processing industry with a total processing capacity of 500,000 tons, but due to delays in processing technology, rising production costs, and a lack of engineers. The amount remains at 150,000 tons. On the other hand, dried mashed potatoes are produced, but rather imported from Poland and other European countries. Domestic potato cultivation faces such issues as climate change, rising input prices, i.e. fuel and electricity, fertilizer, pesticides, and factories closed due to the conflict.

2.3.9 Impact of Conflict on Agriculture

(1) Forecast as of June 2022

In June 2022, the Food and Land Use Research Center of the Ministry of Agricultural Policy and Food of Ukraine estimated the damages of agricultural products caused by the war in 2022 excluding damage to infrastructure and machinery using the World Bank/FAO calculation method, namely Rapid Loss Assessment, is projected to USD23.3 billion as shown in Table A2.3.16.

Table A2.3.16 Projected Damages to Agricultural Products by World Bank and FAO

Category	Amount (USD million)	Summary of Damages
Decreased crop production	9,851	The amount of loss by prefecture in 2022, which is calculated by multiplying the production volume in 2021 by the production reduction rate by state, is expected to be 30 to 50% lower than the production value before 2021.
Decreased livestock production	682	He predicted that the loss would be 22% in 2021, based on the number of livestock lost in 2022 and the reduction in production of meat, milk and eggs. He estimated that an additional $3.3 billion would be needed to restore lost numbers.
Lower producer prices	11,935	Producer prices for crops were expected to fall by USD0.07 to $0.26 per kg, resulting in a total decline in sales of USD11.9 billion for producers.
Soaring production costs	859	It predicted that producers would be forced to bear additional costs as retail prices for fuel (1.228 billion liters) and chemical fertilizers (3.22 million tons) soared.
Total	23,327	

Source: Prepared by JICA Survey Team with reference to Rapid Loss Assessment (World Bank and FAO, June 2022)

(2) Decrease in crop production

Due to Russia's invasion of Ukraine in February 2022, the harvesting of winter wheat and barley sown in the fall of 2021, and the sowing and harvesting of the spring crops of 2022 were restricted resulting in a significant decline in agricultural output in 2022. The World Bank and FAO are forecasting losses in June 2022, and the Ministry of Agricultural Policy and Food recently announced the production of grains and oilseeds by state for 2022, as shown in Table A2.3.17.

Table A2.3.17 Impact of Russian Invasion to Crop Production

Crop	2021			2022			Index for 2022 with 2021 as 100		
	Harvested Area (1,000ha)	Production (1,000ton)	Unit Yield (ton/ha)	Harvested Area (1,000ha)	Production (1,000ton)	Unit Yield (ton/ha)	Harvested Area (1,000ha)	Production (1,000ton)	Unit Yield (ton/ha)
Wheat	7,090	32,151	4.53	4,979	20,176	4.05	73	63	89
Barley	2,472	9,437	3.82	1,667	5,778	3.47	67	61	91
Corn	5,482	42,110	7.68	3,963	26,527	6.69	72	63	87
Sunflower	6,665	16,393	2.46	4,826	10,535	2.18	72	64	89
Soybean	1,322	3,492	2.64	1,537	3,741	2.43	116	107	92
Rapeseed	999	2,930	2.93	1,135	3,245.2	2.86	114	111	97
Sugar beet	225	10,778	47.97	181	9,097	50.18	81	84	105
Potato	1,283	10,678	8.32	1,204	10,450	8.68	94	98	104
Apole	94	1,279	13.65	77	565	7.35	82	44	54

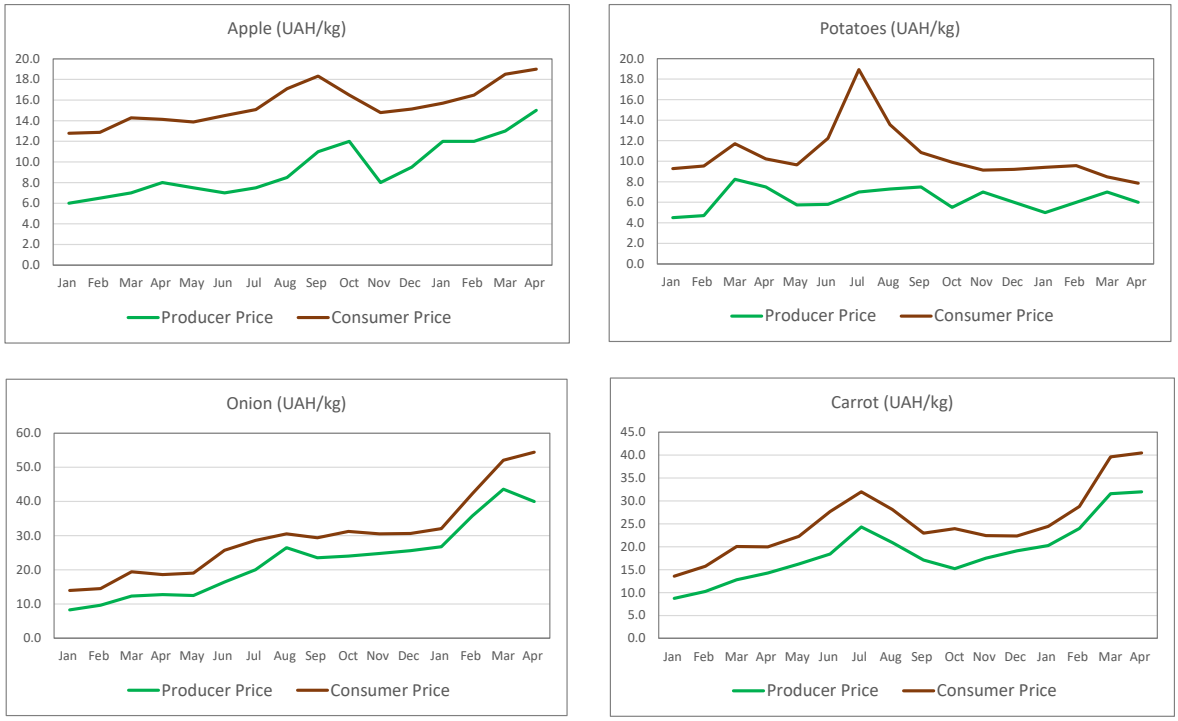
Source: Prepared by JICA Survey Team with reference to the data of State Statistics Service

The impact of Russia's invasion of Ukraine on crop production in 2022 is described below.

1) Production of major grains (wheat, barley, corn) and sunflower seeds remained at the 60% level. The average yield of these crops has maintained around 90% of 2021, but the harvested area has decreased to nearly 40%, so it can be said that the main reason for the decrease in production is the decrease in harvested area.
2) Production of soybeans and rapeseeds increased by about 10% due to a 15% increase in harvested area. In the midst of the war, there are regions where the planted area has been expanded compared to normal years.
3) Although the harvested area for sugar beet shrank by 19%, the average yield increased by 5% compared to before the war.

(3) Soaring crop prices in domestic market

The military invasion caused crop prices to soar in the domestic market. Potatoes are largely self-consumed, so producer prices do not fluctuate significantly. Figure A2.3.8 shows monthly trends in producer prices and consumer prices of major horticultural crops from January 2022 to April 2023, according to the State Statistical Service of Ukraine.

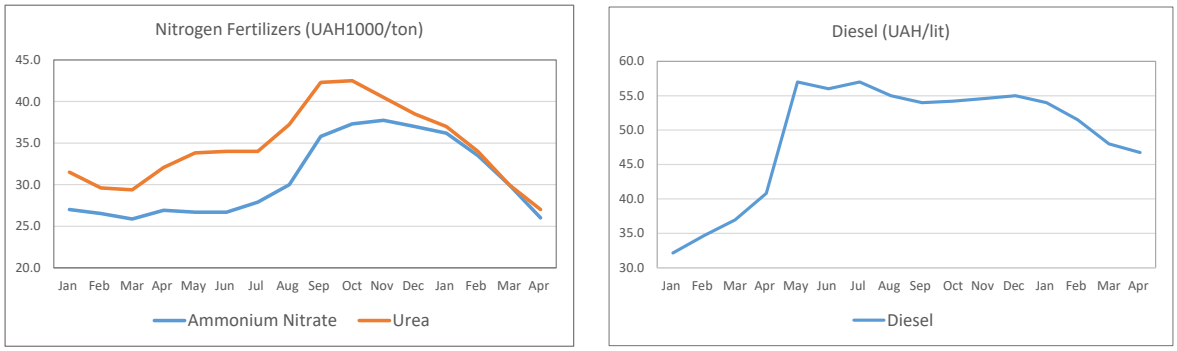


Source: JICA Survey Team

Figure A2.3.8 Monthly Producer and Consumer Prices of Major Crops (Jan. 2022-Apr. 2023)

(4) Increase in crop production costs

The military invasion has increased crop production costs causing significantly reduced profitability for farmers. The detailed information on production costs collected only for major crops in the survey as shown in Table A2.3.7. The changes in the prices of chemical fertilizers and fuel, which account for 60% of direct costs, were investigated as shown in Figure A2.3.9.



Source: JICA Survey Team

Figure A2.3.9 Monthly Prices of Chemical Fertilizers and Fuel (Jan. 2022-Apr. 2023)

The unit prices of chemical fertilizers, i.e. ammonium nitrate and urea, have increased since the military invasion in February 2022, peaking in September-October. They returned to normal price levels. On the other hand, diesel fuel rose in price from February and in May it surged to nearly double its pre-invasion price. Since then, prices have remained stable. As a result, producers' profits are inevitably declining.

(5) Significant decline in grain export volume

In the southern and southeastern parts of the country hit by the Russian invasion, the harvested area for grain sharply fell. In addition, railways, roads, and storage facilities leading to port facilities along the Black Sea coast were destroyed. The function of the supply chain is reduced. Annual grain exports via the Black Sea are roughly 40 million tons, but in 2022 they will remain at 33 million tons[16]. Food shortages and soaring grain prices are becoming more serious in countries in the Global South that depend on grain imports from Ukraine. The Ukrainian Ministry of Agricultural Policy and Food forecasts that if this situation continues, the 2023 cropping season will also be forced to cut production by 30 ~ 50%[17].

The International Food Policy Research Institute (IFPRI) estimates that food exported by both Ukraine and Russia accounts for 12% of the calories consumed globally. Despite being the world's food pantry, Russia's invasion of Ukraine has caused devastating and long-lasting damage to the world's food system. Market turmoil is also expected to lead to starvation. Wheat and corn exports from Russia and Ukraine fell by 7 million tons in 2022.

Russia and Ukraine export grain to many countries, so the longer the conflict, the more strained for both production and exports. Given this situation, the United Nations World Food Program (WFP) worn that all lead to soaring grain prices and undermine food security in many countries and regions. Similarly, FAO estimates that 20 to 30% of winter crops, maize and sunflower seeds will not be planted due to the conflict, resulting in a significant reduction in production.

Japan imports wheat mainly from the United States, Canada, and Australia. The Japan’s government selling price of imported wheat has been raised by an average of 17.3%, and several companies have decided to raise the selling price of commercial flour from the summer of 2022. This is expected to have an impact on the prices of foodstuffs and other items in the future.

2.3.10 Assistance by International Organizations and Donor Countries for Agriculture Sector

(1) Support with silo bags[18]

The grain storages were damaged by Russia's invasion. Besides, grain exports were restricted by the Russia's blockade of the Black Sea, and rural areas of Ukraine were noy enable to release the grain stock to the market. Consequently, the amount of grain stocks was increased in the country. Although the UN-mediated monitoring system was established to ensure the safe transport of grains in the Black Sea, the export number of grains has significantly decreased in comparison with one in previous years. This led to soaring grain prices and increasing global demand. Ministry of Agricultural Policy and Food of Ukraine requested international organizations and donor countries the emergency supports to reserve additional 15 million tons of grains. In response to the request, FAO, Canada, Japan, USAID and

[16] Annual grain exports are taken from FAOSTAT. The data in 2022 provided by the Eastern Europe Assistance Association in Japan.
[17] Published by the Center for Food and Land Use Research as Rapid Loss Assessment values (June 2022).
[18] "International Community Assistance to Ukrainian Farmers to Address Shortage of Grain Storage Facilities" (Press Release), Ministry of Foreign Affairs of Japan, November 28, 2022.

international philanthropic foundations provided silo bags, storage facilities and filling equipment with a storage capacity of 8.6 million ton.

(2) Seed potato distribution by FAO

In June 2022, FAO distributed 862 ton of seed potatoes to 18,000 smallholder farmers. The support continued in 2023 with 3,100 tons of seed potatoes distributed to 62,000 households in nine southeastern states that have been severely affected by the war. FAO estimates that 12 ton of edible potatoes can be harvested from 1 ton of seed potatoes, with a total production of 48,000 metric tons over two years. If the annual per capita consumption of potatoes is 135.1 kg (FAO, 2018), FAO assistance would be enough to secure enough potatoes for 360,000 people. The FAO project was judged to be an immediate and high-impact project in maintaining food security in emergencies.

(3) Support for livestock sector[19]

In cooperation with several international partners, including FAO, USAID, and the Swiss government, it is implementing several projects to support agricultural enterprises affected by the war. A cooperative milk processing factory and a cooperative slaughterhouse will be created and developed, a genetic center, an educational and research facility will be constructed, and new irrigation facilities are being considered.

2.3.11 Major Agricultural Policies

(1) Domestic Producer Protection Policy

Every year, the OECD releases a “Monitoring Report” summarizing trend in agricultural policy reforms of various countries. The report evaluates the agricultural policies of each country primarily based on the Producer Support Estimate (PSE), which measures the extent and nature of subsidies received by agricultural producers. Ukraine's PSE has fluctuated over the past 30 years. This is mainly due to significant variations in Market Price Support (MPS) across different commodities and over time. The prices of domestically produced meat products and sugar exceed international price levels and are protected by import tariffs. On the other hand, cereals, sunflower seeds, and milk generally fall slightly below international prices, resulting in a slightly positive overall MPS for the agricultural sector. Over the past two years, budget measures for tax incentives and input material support have been implemented on a small scale and continuously, contributing to producer support.

General Services Support Estimate (GSSE) is low compared to other countries but has been increasing since 2015. Between 2017 and 2019, GSSE equivalent to an average of 1.7% of the sector's GDP was invested in the agricultural sector, which is significantly lower than the levels in the mid-1990s. Most of these expenditures have been spent on inspection and management services for agricultural products and agricultural schools.

[19] “Ukraine:Livestock Production Annual”,USDA
“Strengthening Ukraine’s Dairy Sector (2017)”, FAO.
“How USAID Partners with Credit Unions to Keep Ukraine’s Dairy Farms Working in Wartime”, 24 Jun 2023, USAID
“Higher Value-Added Trade from the Organic and Dairy Sector in Ukraine” (QFTP), 12 Sep 2023, Swiss-Ukrainian Program

(2) Climate Change Measures

In 2016, Ukraine committed to the Nationally Determined Contributions Registry (NDC) of the Paris Agreement on climate change, promising to limit greenhouse gas (GHG) emissions to no more than 60% of 1990 levels by 2030, including emissions from all agricultural and other land-use sources. Agriculture accounts for over 12% of the country's emissions. In July 2021, Ukraine submitted a revised NDC, raising its emission reduction target to 65% by 2030 compared to 1990 levels.

Laws related to climate change and environmental policy have also been enacted. Specifically, these relate to the monitoring, reporting, and verification of greenhouse gas (GHG) emissions, the use of substances that deplete the ozone layer and fluorinated greenhouse gases, irrigation, and drainage. New laws implemented since early 2020 outline strategies for environmental policies and list indicators for measuring the effectiveness of these policies and compliance with environmental objectives.

In January 2021, two new Free Trade Agreements (FTAs) came into effect. These include the Ukraine-Israel FTA and the Political, Free Trade, and Strategic Partnership Agreement between Ukraine and the United Kingdom. Both agreements aim to promote bilateral trade in agricultural products.

(3) COVID-19 Pandemic Response Measures

The 2020 national economic stimulus program provided several measures targeting the agricultural sector. These measures relate to access to financing, smooth market functioning and enhanced market monitoring, further promotion of organic agriculture, equipment investments, specific subsidies for dairy producers, and social insurance for family-owned farms. In the first half of 2020, Ukraine temporarily banned the export of buckwheat (from April 2 to July 1) and undenatured ethyl alcohol (from March 23 to May 15).

2.3.12 Analysis: Agriculture, Value Chain

i. As shown in Table A2.3.1 in Section 2.3.3, the farming entities in Ukraine are broadly divided into two categories: (i) large-scale agriculture and (ii) small-scale agriculture. (i) Large-scale agriculture refers to registered agricultural corporations (legal entities) as defined in the Agricultural Law of 2003, encompassing large, medium, small, and micro-enterprises. On the other hand, (ii) small-scale farmers refer to registered individual entrepreneurs as well as unregistered peasant households, primarily focused on subsistence farming. The total number of these (ii) small-scale farmers is estimated to be around 4 million, a two-digit difference compared to the 41,070 large-scale enterprises. Despite being often overlooked, these small-scale farmers, as shown in Table A2.3.1, contribute to 41% of the agricultural GDP, focusing mainly on horticulture like vegetable and fruit production. They also occupy 45% of the land, making them one of the key players in Ukrainian agriculture. As for their geographical distribution, they are relatively more concentrated in the western oblasts like Zakarpatty and Chernivtsi, as shown in Figure A2.1.2.
ii. As indicated in Section 2.3.4(3), the total cultivation area for vegetables and fruits in Ukraine in 2021 was 1.7 million ha, with a total harvest of 231.7 million tons, making Ukraine one of

the top three producers in Eastern Europe. The main products are tomatoes and onions, among others, and are exported not only as fresh vegetables but also as frozen, dried, canned, and chilled products. Horticulture is labor-intensive, and given the recent decline in the labor force due to population decrease and Russia's invasion, there is an expectation for women to play a broader role in the agricultural sector.

iii. As shown in Table A2.3.5, small-scale horticulture is relatively more common in the central-western part compared to the southwestern part of Ukraine. Specifically, the western region is a specialty area for almost all kinds of vegetables and fruits except tomatoes and grapes, and the central region also has relatively high production volumes.

iv. Considering the above conditions, there is a high need for capacity-building support mainly related to small-scale horticultural techniques. It is considered effective to start support in the central-western region and gradually expand it nationwide while developing training packages.

v. Regarding the current status of agricultural storage facilities, several surveys have been conducted (refer to Section 2.3.6), but a comprehensive roadmap covering a wide area needs to be developed, taking into account factors such as the regional recovery rate of post-war export agricultural production, the restoration status of maritime transport from the Black Sea, and the expected future development of railway networks leading to Europe. For this, the quick implementation of a nationwide master plan for the restoration of agricultural distribution and storage facilities after the war is required.

2.4 Agricultural Equipment/Inputs (including agricultural equipment/inputs supply chain and market trends, farmers' access to equipment)

2.4.1 Overview of Seed

(1) Seed Production

Western seed companies such as Bayer (Germany), Euralis Semence (France), etc. were carrying out their business in Ukraine. They established seed processing factories, research institute, and they have conducted seed production. However, since the Russian invasion, many companies have scaled back or closed seed production. Their top priority is safety for employees. The Ukrainian government has decided to import or to rely on aid for the shortage supply of seeds. The amount of seeds required for import or aid in 2023 according to the estimation by the Ukrainian government shows on Table A2.4.1.

Table A2.4.1 Needs for Seed in 2023

Crop	Needs for seed (1,000ton)	Area can be sown (1,000ha)
Corn	23.8	1,192
Sunflower	21.1	1,405
Soybeans	37.9	316
Spring barley, Wheat	69.0	353
Spring rapeseed	0.2	51
Oat	11.1	55
Sorghum	0.1	16
Others	31.0	248
Total	194.2	3,636

Source: Ministry of Agrarian Policy and Food of Ukraine

(2) Access to seeds

After invasion of Russia, agricultural input suppliers (seeds, fertilizers, pesticides, agricultural machinery, etc.) stopped their business or could not deliver the required products. So, the farmers were restricted in obtaining these agricultural inputs. According to FAO report, seed suppliers were the most affected by the war among various agricultural input suppliers. It is more than 40% of the farmers said that they have difficulty to access with seed suppliers, especially in the frontline of war provinces. Such shortage of agricultural materials is more popular on the frontlines of war, but the delivery restrictions also occurred difficulties for the farmers even in western and central regions of Ukraine where are far from frontlines.

2.4.2 Overview of Fertilizer

(1) Fertilizer production/consumption, supply chain

It is very popular ammonia production and the nitrogen fertilizer which was one of the major export items in Ukraine before invasion from Russia. Production, import, export, and consumption of nitrogen fertilizers are shown in Table A2.4.2.

Table A2.4.2 Nitrogen Fertilizer Production, Import, Export, and Consumption in Ukraine (tons)

Item		2015	2016	2017	2018	2019
Nitrogen Fertilizer	Production (1)	1,431,218.00	1,510,371.50	1,068,564.00	983,471.50*	983,471.50*
	Import (2)	495,178.84	674,855.40	970,839.80	695,429.80	789,908.50
	Export (3)	875,235.46	748,726.40	268,111.40	128,415.30	395,203.00
	Consumption (4)	984,960.00	1,197380.00	1,365,310.00	1,404,913.00	1,467,547.00
	Balance = (1) +(2)-(3)-(4)	+66,201.38	+239,120.50	+405,982.40	+145,583.00	▲89,370.00

* Estimated Value

Source: FAOSTAT

The amount of applied all fertilizers (nitrogen, phosphoric acid, potash, etc.) per ha is shown in Table A2.4.3

Table A2.4.3 Amount of Applied All Fertilizer (kg/ha)

Item	2016	2017	2018	2019	2020
Applied all fertilizer(kg/ha)	52.7	61.9	65.4	65.1	75.6

Source: FAO

Applied fertilizer per hectare in Ukraine was only 14 kg/ha in 2001, but by 2021 it had increased to 78.5 kg/ha at an average annual rate of 9.65%, a trend that showed an increase in demand for fertilizer and farmers' awareness of fertilizer application[20][21]. However, nitrogen fertilizer was produced by about 10 fertilizer companies in Ukraine before the war, the only two companies, Lobneazot and Cherkassy Azot are continued to produce fertilizer in 2022[22].

(2) Access to Fertilizers and current Situation

As mentioned above, the amount of applied fertilizers has decreased due to the suspension of production and stopped business by fertilizer manufacturers in Ukraine. Fertilizer prices are also rising

[20] "Fertilizer use per hectare of cropland, Ukraine,2001, Our World in Data,https://ourworldindata.org/grapher/fertilizer-per-hectare?time=2001&country=~UKR

[21] https://jp.knoema.com/atlas/%e3%82%a6%e3%82%af%e3%83%a9%e3%82%a4%e3%83%8a/%e8%82%a5%e6%96%99%e6%b6%88%e8%b2%bb

[22] Interfax, https://interfax.com/newsroom/top-stories/87994/

and it is one of the factors that make it difficult for the farmers to get fertilizers. The price of nitrate nitrogen in Ukraine was 12,100 UAH (approximately 48,400 yen)/ton in July 2021, but in October 2022, it increased from UAH27,000(approximately JPY108,000) to UAH37,000(approximately JPY148,000) per ton, which is about two to three times higher than before the war.

According to the FAO report "Impact of the war on agricultural enterprise" (January-February 2023), the main difficulties by the farmers are the high cost of fuel for agricultural machinery, electricity, difficulty of access to seeds and fertilizers. It is also said that it is a problem of access to the agricultural market and buyers. The farmers that experienced difficulties with agricultural inputs were more likely to report revenue decrease, compared with those that did not have problems with inputs. However, the farmers reporting difficulties in production and commercialization. In other words, access to agricultural supply stores was one of the reasons for the decline in income, but not the main reason. Most of the reasons for the difficulty in obtaining agricultural materials are related to price. The farmers say that price hikes are more of a problem than accessibility to agricultural input suppliers. In addition to rising fertilizer prices, it is become too difficult for the farmers to secure markets and buyers, and there are also problems such as low product prices and the inability to find buyers. The major export ports in Ukraine are blocked and they have problems with shipping, the crops for export have changed to supply for domestic, which has led to a decline in domestic sales crop prices and a decrease in farmer income. The most important things for the farmers to continue their farming is to be able to obtain agricultural inputs at a reasonable price for maintaining farming in the future. The farmers are most frequently requested for fertilizers, fuels for agricultural machinery and seeds.

2.4.3 Overview of Agrochemicals

(1) Application of agrochemicals and supply chain

Number of applied agrochemicals before the invasion from Russia are shown in Table A2.4.4

Table A2.4.4 Number of Applied Agrochemicals (ton)

Type	2017	2018	2019	2020	2021
Insecticide	38,557.50	25,343.00	24,325.00	24,622.00	26,974.00
Herbicide	N/A	17,951.00	16,646.00	17,660.00	19,245.00
Fungicide	N/A	4,802.00	4,925.00	4,867.00	5,515.00

Source: FAOSTAT

Insecticides were the most used in agrochemicals. It was used approximately 25,000 tons per annual. In addition, approximately 17,000 tons of herbicides and 5,000 tons of fungicides were applied per annual, and the amount of each agrochemical tended to increase little by little per year.

However, after the Russian invasion, the farmers are having difficulty securing pesticides as well as seeds and fertilizers and it was said that the farmers keep only 9,356 tons of herbicides and insecticides in early 2023. It was only 34.7% of the 26,926 tons which were necessary amount in the half of the year. FAO report said that 55% of farmers have had difficulty accessing agrochemical suppliers, and difficulty of the connection with equipment and material suppliers, in addition to the farmers are experiencing a severe lack of funds due to reduced sales prices and income. As a result, there are growing concerns about the decrease in yields due to the lack of inputs such as not only agrochemicals but also seeds and

fertilizers. The National Academy of Agrarian Sciences of Ukraine said that the crop harvest is only 34 million tons in 2023 may be decreased from 54 million tons in 2022.

2.4.4 Overview of Agricultural Machinery

(1) Overview of Major Agricultural Machinery in Ukraine

1) Tractors

The major tractors in Ukraine are very large from 120 to 400 hp[23][24]. The other hand, the main tractors in Japan are around 30 hp for 20 ha in paddy field. It means that huge size tractors are used in Ukraine.

John Deere (USA) 270 hp

Source: John Deere (USA) Homepage

KUBOTA (Japan) Approx. 30 hp

Source: Kubota (Japan) Homepage

2) Combine harvester

The huge conventional combine harvesters (it cut stem, grain, and all plant, and it is available for many variety crops) from 300 to 400 hp with a cutting width of 4 to 5 m are majority in Ukraine[25]. The main combine harvesters in Japan have been developed for harvesting rice and it is called "head-feeding combine harvester", (it cuts each stem of rice and only takes grains). The head-feeding combine harvesters in Japan generally have 2 to 7 row cutters and in some cases 10 row cutters with a special attachment. For example, 7 row cutters combine harvester has approximately 130 hp and about 2 m cutting width.

The comparison between conventional combine harvesters and head-feeding combine harvesters are shown in Table A2.4.5

Table A2.4.5 Comparison of Combine Harvesters.

Type	Target crops	Sorting function	Structure
Conventional combine harvester	Soybeans, Corn, Wheat	Not good	Simple
Head-feeding combine harvester	Rice,Wheat	Good	Intricate

[23] "Ukraine Agricultural Machinery and Equipment" International Trade Administration, Department of Commerce, USA, https://www.trade.gov/market-intelligence/ukraine-agricultural-machinery-and-equipment

[24] "Ukrainian Market of Tractors with capacity 260-390 hp on results of 2013", APK-Inform, Ukrainian Market of Tractors with capacity 260-390 hp on results of 2013 (apk-inform.com)

[25] Information from interviews with local agricultural equipment and materials distributors

Source: JICA Survey Team

	
CLAAS (Germany) Approx. 400 hp, Cutting width 5.4 m, Conventional combine harvester	KUBOTA (Japan) Approx. 130 hp, Cutting width 2.4 m, Head-feeding combine harvester

Source: CLAAS(Germany) Homepage Source: KUBOTA (Japan) Homepage

3) Seeder

The seeder which is attached with tractor is very utilized in Ukraine. It is necessary to finish sowing seeds within the appropriate sowing time for huge area. The farmers are trying to shorten the sowing time by using huge seeder. Seeding is involvement of multiple processes such as grooving, seeding, soil covering, and compaction. Usage of seeder enables these processes to be carried out efficiently and in a short time. Seeding width of about 10 m seeders are used in Ukraine. Seeders are also used in Japan for wheat, buckwheat, soybeans and so on, however, seeding width of about 2 to 2.5 m seeders are suitable for the size of fields in Japan.

	
Big seeder connected to a tractor, seeding width is about 10 m	4 row seeder in Japan, seeding width is about 2 m

Source: John Deere (USA) Homepage Source: Yanmar (Japan) Homepage

(2) Past Market Situation of Agricultural Machinery

1) Tractor

Before the war, the USA was the largest exporter for tractors to Ukraine. The tractors which were exported from USA to Ukraine accounted 44% in USD of all imported tractors of Ukraine in

2019. Regarding manufacturers, John Deer (USA) was the most common, followed by Case IH (USA) and New Holland (Italy), with European and USA manufacturers were the main companies. The tractors from 260 to 390 hp were imported 1,440 units in 2013 and the imported units by major manufacturers are shown in Table A2.4.6

Table A2.4.6 Imported Quantity by Manufacturer (2013)

No.	Manufacturer	Units
1	John Deere	537
2	Case IH	332
3	New Holland	221
4	Others	350
Total		1,440

Source: APK-Inform (https://www.apk-inform.com/en/exclusive/topic/1028489)

2) Combine harvester

The combine harvesters were imported about 11,960 units to Ukraine during five years from 2015 to 2019. Imported combine harvesters were included not only new but also used ones and the ratio of new ones were 52% and used ones were 48%. Poland, Germany, Belgium, and USA are the major exporting countries to Ukraine. The main exporting countries in 2019 are shown in Table A2.4.7

Table A2.4.7 Main Exporting Countries of Combine Harvesters to Ukraine (2019)

No.	Exporting country	Units
1	Poland	889
2	Germany	603
3	Belgium	248
4	USA	218
5	Others	189
Total		2,147

Source: World Bank (https://wits.worldbank.org/trade/comtrade/en/country/UKR/year/2019/tradeflow/Imports/partner/ALL/product/843351#)

3) Seeder

Seeder is an important equipment that determine the accuracy of seeding, the depth of seeding and the shorten for seeding time. Imported seeders were 2,485 units in 2006 and 3,138 units in 2007, but it increased to 3,380 units in 2018 and 5,166 units in 2019. It is tendency of increasing imported seeders year by year. Ukraine was imported country for many seeders in the world and the total import value of seeders in 2021 were about 161 million USD, which is the second largest in the world following the USA with 186 million USD. The main export country of seeders to Ukraine were Sweden, Germany, and USA in past.

(3) Overview of Agricultural Machinery Leasing in Ukraine

The agricultural machinery leasing market in Ukraine is rapidly growing due to the increasing international demand for agricultural products and the need for modernization in agriculture. State-owned and private companies serve as major players in this market. Through this leasing system,

agricultural enterprises can reduce their initial investment and improve production efficiency and competitiveness by utilizing the latest technology and machinery.

According to the report "National policies to support the modernization of farm machinery in CIS countries" (Prepared under the FAO/World Bank Cooperative Programme, 2010), there are 11 organizations in Ukraine providing agricultural machinery leasing, both state-owned and private. Ukragroleasing, a state-owned enterprise, has been identified as the largest player. According to estimates, since its establishment in 1999, the company has leased 5,822 tractors, 959 combine harvesters, and 9,555 seeders, totaling 18,505 agricultural machinery units. Although the company was initially state-funded and operated under cabinet decisions, its current website lists it as a "National joint-stock company," suggesting the involvement of private capital.

Regarding the activities of leasing companies, the relationship with finance is also strong. Details will be elaborated in "Section 2.5 on Financial Access, Subsection 2.5.3(5)," but an overview is summarized below:

- Agricultural machinery leasing is offered at a level almost equivalent to auto leasing. According to an announcement by the Ukrainian Union of Lessors in January 2022, 5,874 units of agricultural machinery were leased in 2021.
- Among the types of agricultural machinery leased throughout the country, tractors account for 35% of the total, while combine harvesters and seeders are around 10% (see Table A2.5.13).
- Due to restrictions stemming from the property registration system, the equipment that leasing companies can lease is limited. Fixed agricultural machinery, for example, cannot be leased, and purchases by agricultural enterprises are the norm.
- According to a press release from the Central Bank in April 2022, 24 leasing companies were forcibly deregistered by the NBU in March, the month following the start of the Russian invasion, revealing the vulnerability of the leasing companies' operational foundations.

(4) Losses of agricultural machinery

According to the Kyiv School of Economics as of April 2023, the total damage to the agricultural sector has reached approximately 8.7 billion USD, with the largest losses are agricultural machinery. Losses of agricultural machinery are estimated about 4.7 billion USD. It means that losses of agricultural machinery are about half of the damage in the agricultural sector.

The tractors are the most damages approximately 1.6 billion USD and followed by the seeders, which was estimated approximately 640 million USD in the losses of agricultural machinery. The losses of major agricultural machinery are shown in Table A2.4.8

Table A2.4.8 Losses of Major Agricultural Machinery

No.	Agricultural machinery	Amount of loss (million USD)
1	Tractors	1,665
2	Seeders	646
3	Harrows	442
4	Combine harvesters	338
5	Others	1,574
Total		4,665

Source: Agricultural War Damages, Losses, and Needs Review 2023, April 24, Kyiv School of Economics

There was also about 1.4 billion USD in damage to storage warehouses. So, agricultural machinery and storage warehouses are totaled about 6 billion USD. It is 1.2 billion USD more than estimate as of November 2022. It is said that more than 17% of agricultural machinery and storage facilities have been damaged, destroyed or stolen in the whole country compared with 2019.

(5) Current sales status of agricultural machinery

Although agricultural machineries are still sold and distributed in present, foreign manufacturers and distributors demand full payment in advance in order to avoid risks during war. As a result, dealers in Ukraine are having trouble raising funds. In addition, nobody knows when the Russian will attack the warehouses and agricultural machinery themselves will be directly damaged and domestic dealers are trying to do not keep the inventory as much as possible. That's why it is said that the supply and distribution of agricultural machineries have decreased. In the same situation as of agricultural materials such as seeds, fertilizers and agrochemicals, the farmers are difficult to procure the agricultural machineries.

2.4.5 Analysis: Agricultural Equipment/Inputs

i. As indicated in Section 2.4.4, the mainstream agricultural machinery in Ukraine consists of large machines like tractors and combines in the 300-400 horsepower range, primarily from Western manufacturers. Due to this, Japanese-made agricultural machinery, which is typically around 100 horsepower and designed for smaller fields, is expected to face challenges in terms of specifications. However, given that the Ukrainian government is considering a shift from large-scale land-based agriculture to labor-intensive, high-value-added agriculture through facility cultivation, it is speculated that there may be room for differentiation between Western large-scale machinery and Japanese machinery in the future.

ii. As shown from Section 2.4.1 to 2.4.3, the availability of agricultural inputs like seeds, fertilizers, and pesticides has become difficult due to reduced or halted production within Ukraine, leading to a decline in usage among farmers. This reduction in the use of agricultural inputs is pointed out to be causing a decline in crop yields. Even farms that had no issues in accessing these inputs experienced a decline in income. This is speculated to be due to a combination of declining crop prices and rising input costs, putting pressure on farm management. Therefore, for farmers to continue farming, it is essential to secure the necessary agricultural inputs at a price that is sustainable for farm management.

iii. As for the leasing of agricultural machinery, it is offered at a level almost equivalent to automobile leasing. Tractors make up about 35% of all leased agricultural machinery in Ukraine, while combine harvesters and seeders account for around 10% (see Table A2.5.13). Due to registration issues, there are restrictions on what equipment leasing companies can offer. Moreover, the vulnerability of leasing companies is evident, as 24 of them were forcibly deregistered by the NBU the month after Russia's invasion began.

iv. While there are many private agricultural machineries leasing companies, providing direct support for agricultural machinery within the constraints and framework of JICA support could lead to crowding out private businesses and requires careful consideration. On the other hand, from the perspective of financial access, it is possible to indirectly support the promotion of machinery leasing by improving capital access for leasing companies.

2.5 Access to Finance

Issues related to farmers' access to finance should be clarified based on interviews with farmers, who are the beneficiaries. However, due to the limitation on the methodology of the survey, this report focuses on the perspective of financial institutions.

2.5.1 Overview of the Financial Sector

(1) Composition of assets of financial Sector

For an overview of the financial sector centered on banks and of the banking sector, please refer to JICA's "Information Collection and Confirmation Survey on Financing for Small and Medium Enterprises (SMEs) in Ukraine Final Report" (hereinafter referred to as "the preceding survey") prepared in March 2021, Chapter 2, "Current Situation and Issues of the Ukrainian Financial Sector". This report provides an overview of non-bank financial companies, credit unions, and insurance companies. It then discusses existing tools for access to finance in the agricultural sector, including bank loans.

The Ukrainian financial sector consists of banks as deposit-taking corporations and finance companies, credit unions, leasing companies, insurance companies and pawn shops as non-banks. According to the latest National Bank of Ukraine (hereinafter NBU) statistics[26] released at the time of writing this report (February 2023), the number of banks operating in Ukraine as of October 1, 2022 was 67. It consists of 4 state-run commercial banks, 47 local private banks, and 16 foreign private banks. Four banks bankrupted by the third quarter of 2022. Due to the implementation of martial law, the NBU has given non-bank financial institutions a grace period to submit their regular activity reports, so the latest published statistics at the time of writing this report are as of September 2022.

[26] NBU, Banking Sector Review, November 2022

Table A2.5.1 Assets Owned by Ukrainian Financial Institutions (UAH billion)

	2018/12/31	2019/12/31	2020/12/31	2021/12/31	2022/03/31	2022/06/30
Banks	1,360	1,493	1,823	2,054	1,970	2,043
Insurers	63	64	65	65	65	66
Credit Union	2	3	2	2	2	2
Finance Companies	125	162	188	214	205	204
Pawnshops	4	4	4	4	4	3
Total	1,554	1,726	2,081	2,339	2,245	2,317

Source: Prepared by JICA Survey Team based on Non-Bank Financial Sector Review, September 2022

Table A2.5.2 Percentage of Ukrainian Financial Institutions Assets to Total Financial Assets (%)

	2018/12/31	2019/12/31	2020/12/31	2021/12/31	2022/03/31	2022/06/30
Banks	87%	87%	88%	88%	88%	88%
Insurers	4%	4%	3%	3%	3%	3%
Credit Union	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
Finance Companies	8%	9%	9%	9%	9%	9%
Pawnshops	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Total	100%	100%	100%	100%	100%	100%

Source: Prepared by JICA Survey Team based on Non-Bank Financial Sector Review, September 2022

Table A2.5.1 shows the assets owned by Ukrainian financial institutions. Table A2.5.2 also shows the data in Table A2.5.1 as a percentage of total financial assets. These tables show that banks hold an overwhelming portion of financial assets. Finance companies are second only to banks in terms of financial assets, but their scale is about 10% of that of banks. Therefore, it is not exaggerating to say that financial sector in Ukraine is represented by banks.

Table A2.5.3 presents the number of financial institutions. As of the end of June 2022, finance companies are the most numerous, followed by pawnshops, credit unions, and insurance companies. While the number of banks with the largest amount of assets is the smallest, the number of finance companies with one-tenth the size of bank assets is 12 times as large. It indicates that the amount of individual financial services handled by non-bank financial institutions is extremely small compared to the banks[27].

Table A2.5.3 Number of Ukrainian Financial Institutions

	2018/12/31	2019/12/31	2020/12/31	2021/12/31	2022/03/31	2022/06/30
Banks	77	75	73	71	69	69
Insurers	281	233	210	155	145	142
Finance Companies	940	986	960	922	894	892
Legal Entity Lessors	167	157	146	137	110	108
Credit Union	358	337	322	278	205	187
Pawnshops	359	324	302	261	197	195

Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Due to the extremely low proportion of non-bank financial institutions in the Ukrainian financial sector, the supervision by the NBU has not been sufficient in the past. In response, since 2016, the NBU

[27] Since leasing companies (Legal Entity Lessors (LE Lessors)) are not financial institutions, they are not included in the assets of financial institution. However, since it can provide financial leasing, its overview is described in Non-Bank Financial Review.

has started lobbying for regulation of non-bank financial institutions, and from July 2020, the NBU has been regulating non-bank financial institutions. The NBU imposes regular business reports on non-bank financial institutions and regularly publishes the results as the Non-Bank Financial Sector Review.

2.5.2 Financing for the Agricultural Sector

As described in section 2.1.6 Definition and Classification of Farmers, there are no statistics on financing of farmers by using the cultivated area and the number of livestock. Therefore, this report analyses the data by using the business classification under Economic Code on which the statistics of the State Statistical Services (hereafter referred to as the Statistics Bureau) and NBU are based. In other words, registered agricultural corporations and individual farmers are regarded as medium, small and micro enterprises under Economic Code[28].

(1) Bank loans for the agricultural sector

Table B2.5.1 lists loan schemes explicitly designated for the agricultural sector in the web pages of major banks[29].

Looking at this, it can be seen that each bank mainly provides loans for the purchase of agricultural machinery and equipment and provision of working capital, while the loans for capital investment are limited. In addition, there are banks which requires explicit conditions on the borrowers: for First Ukrainian International Bank, a cultivated area of 500 ha or more and a track record of 3 years of operation and for Credit Agricole, limits the type of agricultural products in addition to the operation track record.

In the following section, the actual situation of bank loans to the agricultural sector is analogized by using NBU statistics.

The NBU publishes the data on loans to non-financial enterprises separately for companies and individual entrepreneur but does not disclose the amount of loans by industrial sector or company size. For agricultural sector loan statistics, only total loan amount by loan period listed in Table A2.5.7 is released. Therefore, the amount of loans by company size in the agricultural sector is analogized by the following manner: first, from both the amount of loans of depository financial institutions to non-financial enterprises by company size shown in Table B2.5.2 and the amount of loans to agriculture, forestry and fisheries companies shown in Table A2.5.7, calculate the ratio of corporate loans of agriculture, forestry, and fisheries companies to all non-financial enterprises. Then, assuming that the same ratio of loans to agriculture, forestry and fisheries companies is provided equally for each size of company, the ratio of loans by company size and the average amount of loans per company are calculated.

[28] According to staff at the World Bank Kyiv office, small-scale farmers have arable land of 0.5 to 5 ha, micro enterprises 5 to 20 ha, small enterprises 20 to 150 ha , and medium-sized farmers 40 to 2,000 ha . However, it has not been officially confirmed. (Interview with Ms. Oksana Reshenkova on March 6, 2023) Also, the difference between smallholder farmers and small enterprises is whether they are registered or not.

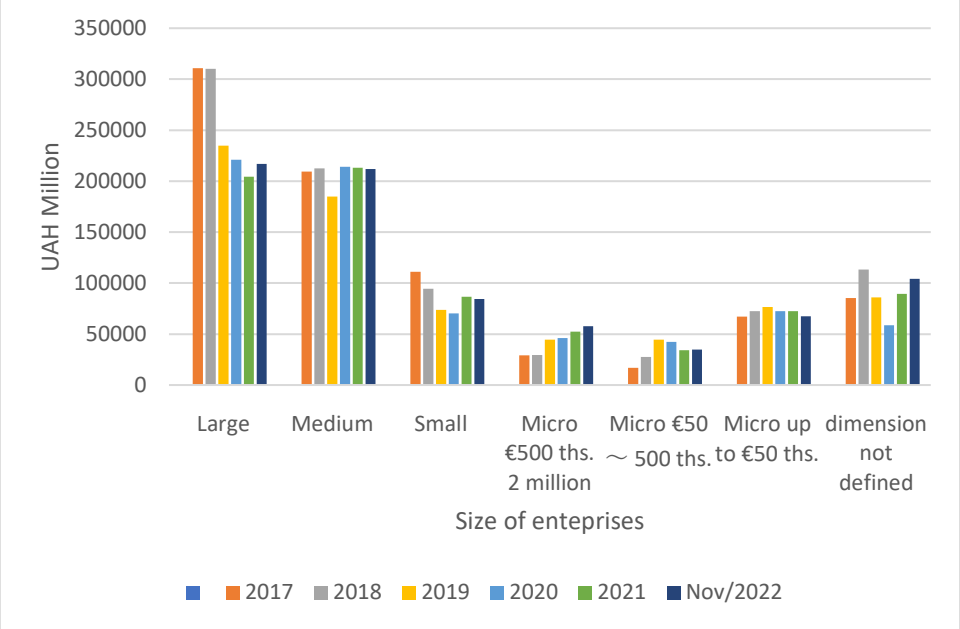
[29] Banks were selected based on Table 2-1 of the previous survey. ALFA-Bank renamed Sense Bank and extends no loans for agricultural sector. Web access was not possible for Sberbank. Added Credit Agricole, which is listed as a foreign bank with know-how in lending to the agricultural sector in its own country in the survey Potential for Agricultural Finance in Ukraine of the Development Facility of the European Fund for Southeast Europe. The ProCredit does not mention loans to the agricultural sector, and the Bank Forum had bankrupted.

a) Loan amount by company size

Table B2.5.2 shows loans to non-financial enterprises by deposit taking financial institutions by company size and lending currency. Both figures show year-end loan amounts, both in UAH and in foreign currency. The previous survey showed trends up to the end of June 2020, but here reflects the latest data.

It should be noted that Table A2.5.7 is the total amount of loans to agriculture, forestry and fisheries sector, not the total amount of loans to the agricultural sector only.

Figure A2.5.1 is based on Table B2.5.2 and compares year-end total loans by company size. As of the end of November 2022, the ratio of loans to small and micro enterprises to the total amount of loans to non-financial enterprises is 10.8% and 20.6%, respectively. Comparing the figures for large and medium enterprises, which are 27.9% and 27.2% respectively, it can be seen that the absolute amount of loans to companies of these sizes is small. From this, it can be seen that there is a large difference in the loan balance between small and micro enterprises and large and medium enterprises, and that it is more difficult for small and medium enterprises to access finance than for large and medium enterprises. The total amount of loans to micro enterprises is higher than that of small enterprises, but if looked the amount of loans by income scale, loan amount of each threshold is smaller than that of small enterprises. On the other hand, among micro-enterprises, companies with an annual income of up to 50,000 Euro have the highest outstanding loans, and those with an annual income of 50,000 to 500,000 Euro have the lowest loan amounts. Many micro enterprises with an annual income of less than 50,000 Euros are said to be subsidiaries established by conglomerates in order to avoid Ukrainian tax laws[30]. In addition, statistically speaking, this category includes consumer loans to individuals. As a result, the loan amount appears to be large.



Source: Prepared by JICA Survey Team based on NBU statistics

Figure A2.5.1 Loan by deposit taking institutions to non-financial enterprises by size (UAH Million)

[30]March 1, 2023, Based on a hearing from Deloitte Ukraine.

Table A2.5.4 shows the loan balance by loan term as of the end of November 2022. Compared to the trend pointed out in the previous survey, there is a change in the trend based on the changes in economic conditions.

- According to the result of the previous survey, the proportion of short-term funds with a term of one year or less and of medium- to long-term funds with a term of more than one year was half and half, but the proportion of short-term funds is increasing.
- As in the previous survey result, small enterprises have the highest ratio of medium- to long-term loans of more than one year, but the ratio of the same terms of loan is also increasing among micro enterprises with an annual income of 50,000 Euro or more.

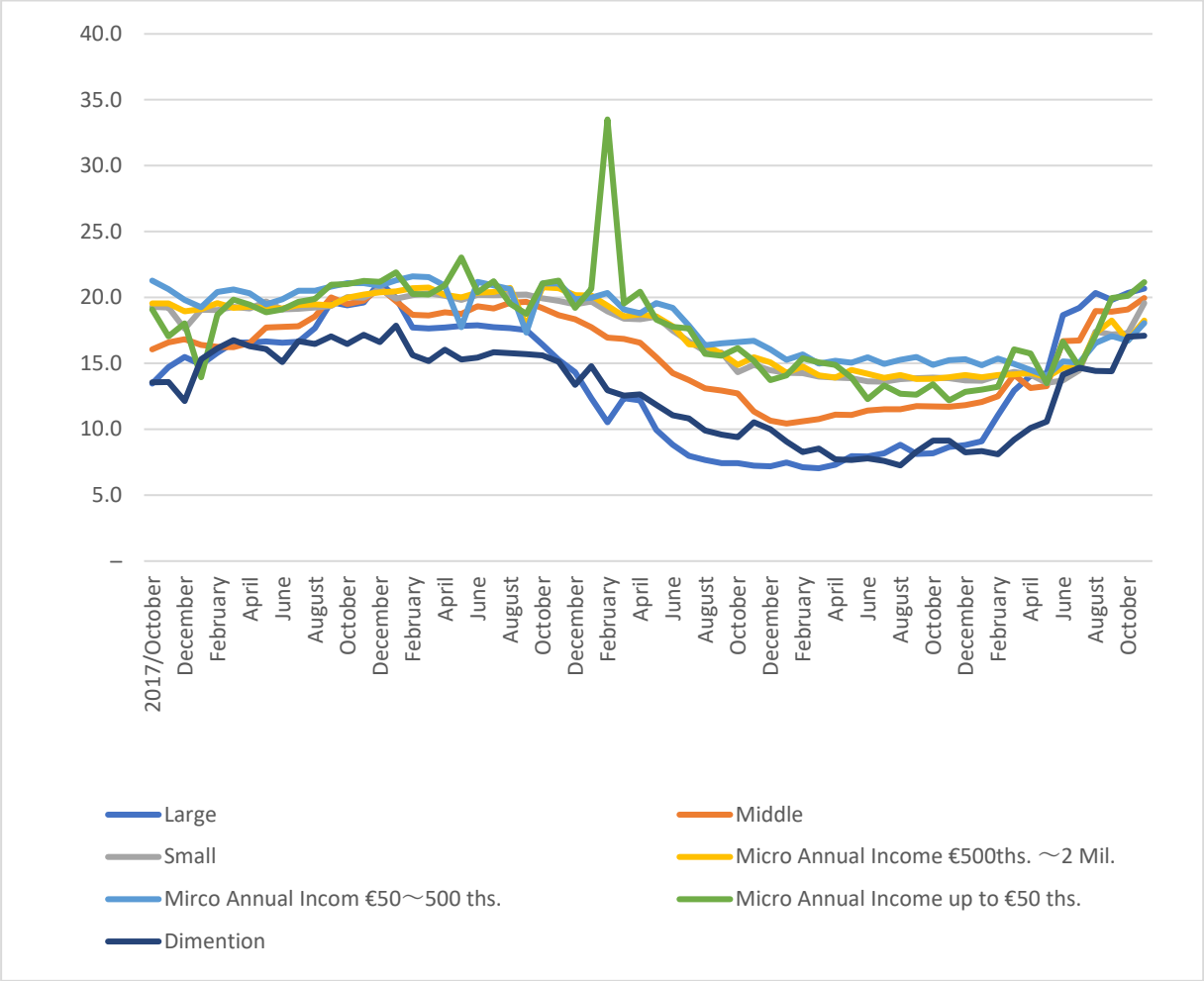
Table A2.5.4 Loan Balance by Loan Term (End of November 2022) (UAH billion)

Size of Enterprises		Total	Less than 1 year		1～5 years		More than 5 years	
Large		216,797	116,985	54%	79,111	36%	20,701	10%
Medium		211,959	121,477	57%	57,184	27%	33,298	16%
Small		84,295	35,119	42%	33,642	40%	15,533	18%
Micro	Annual Income €500ths. - 2 mil	57,722	30,741	53%	18,971	33%	8,010	14%
	Annual Income €50 - 500 ths.	34,841	16,842	48%	10,506	30%	7,493	22%
	Annual Income up to €50 ths.	67,506	62,001	92%	4,703	7%	802	1%

Source: Prepared by JICA Survey Team based on NBU statistics

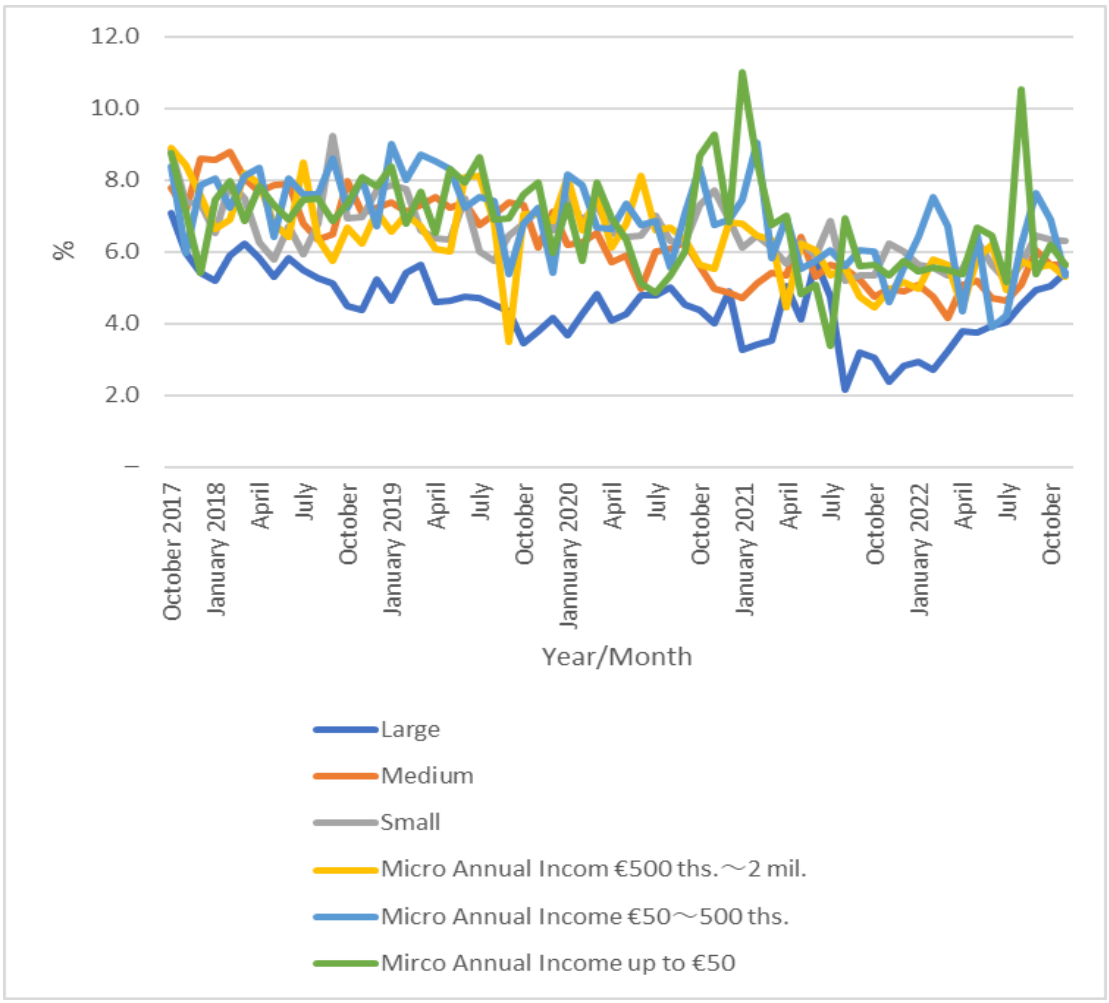
b) Interest rate for corporate loans

FiguresA2.5.2 and A2.5.3 show changes in interest rates for corporate loans, divided by denomination, UAH, and foreign currency. Although the interest rate of UAH-denominated loans declined in 2021, only interest rate to large companies fell below 10%. The interest rate is at least around 15% for company sizes smaller than medium- company. A comparison of corporate size reveals that the interest rate structure is advantageous to large companies.



Source: Prepared by JICA Survey Team based on NBU statistics

Figure A2.5.2 Trend of interest rate of loans in UAH



Source: Prepared by JICA Survey Team based on NBU statistics

Figure A2.5.3 Trend of interest rate of loans in foreign currency

On the other hand, the interest rate of foreign currency-denominated loans is around 6-8%, which is lower than that of UAH-denominated loans. Again, there is a big difference between the interest rates for micro enterprises and those for large enterprises.

Due to spread of COVID-19, interest rates are in an increasing trend, but following two trends have not changed much since the result of the previous survey was published: the interest rate structure which is lower for large companies than the other sizes of companies, and the least interest rate around 10%.

c) Loans for Individual Entrepreneur

Based on the definition of the Agricultural Law, non-corporate farmers are individual agricultural entrepreneurs, so the following analyses trends in loans to individual entrepreneurs.

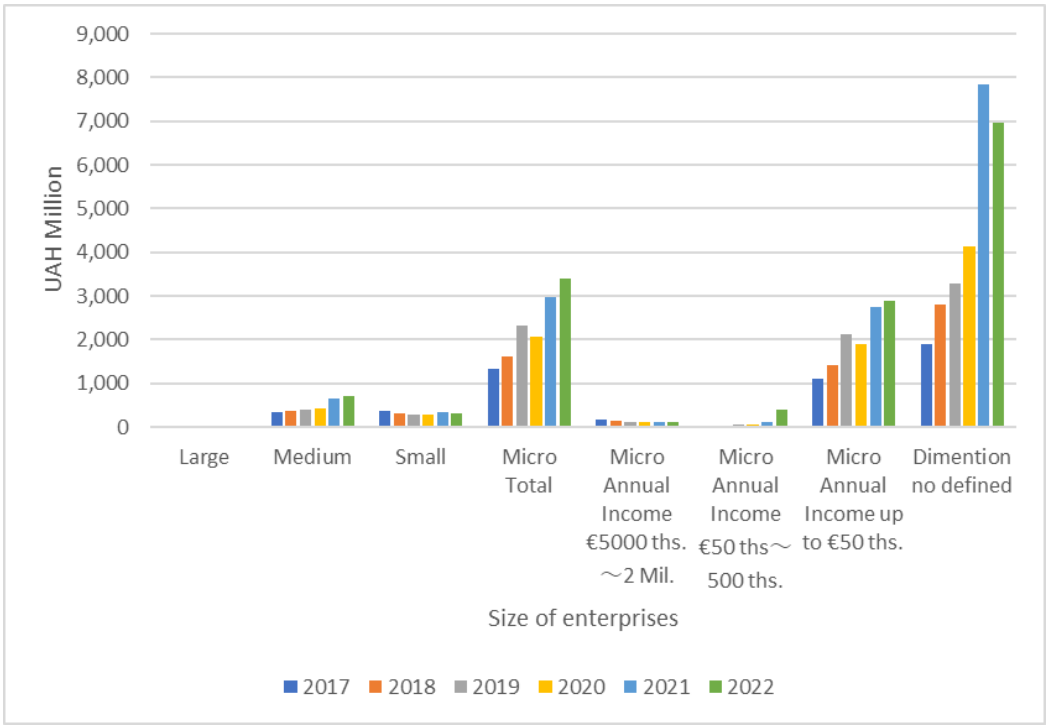
Table A2.5.5 shows loans to all individual entrepreneurs, including those in the agricultural sector, by enterprise size. The total amount of loans 11,364 million UAH to private companies accounted only for 14.6% of the 777,369 million UAH, which is the loans outstanding of depository financial institutions to non-financial enterprises at the end of November 2022.

Table A2.5.5 Loans for Individual Companies by Size

	Total	Large Com.	Medium sized Com.		Small Com. (except for micro-Com.)		Micro Com.						Not defined
							Annual income from €500 thousand to €2 millions		Annual income from €50 thousand to €500 thousand		Annual income up to €50 thousand		
			UAH	Foreign currency	UAH	Foreign currency	UAH	Foreign Currency	UAH	Foreign currency	UAH	Foreign currency	
2017	3,942	–	245	92	165	199	118	66	15	17	902	214	1,909
2018	5,105	–	302	73	186	130	100	54	32	8	1,302	139	2,798
2019	6,294	–	364	33	208	82	123	7	54	2	2,078	54	3,290
2020	6,900	–	394	22	214	72	108	5	53	4	1,863	34	4,130
2021	11,808	–	563	104	321	19	116	1	103	4	2,732	18	7,828
2022	11,364	–	588	109	296	26	108	–	394	–	2,886	5	6,953

Source: Prepared by JICA Survey Team based on NBU statistics

Figure A2.5.4 compares personal business lending by company size. Looking at this, it can be said that borrowing amounts are extremely small, with the exception of UAH borrowings by individual micro-enterprises with an annual income of 50,000 Euro or less. The smallest are micro-enterprises with annual revenues of between 50,000 and 2 million Euro, which are with little or no debt. On the other hand, UAH borrowings by micro-individuals with an annual income of less than 50,000 Euros appear to be higher because they include consumer loans for individuals, as mentioned above. However, when comparing the amount of loans to companies and individuals in the category of micro-enterprises with an annual income of 50,000 Euro or less, the amount of loans to individuals is extremely small at 1-4% of the total amount of loans to non-financial enterprises.



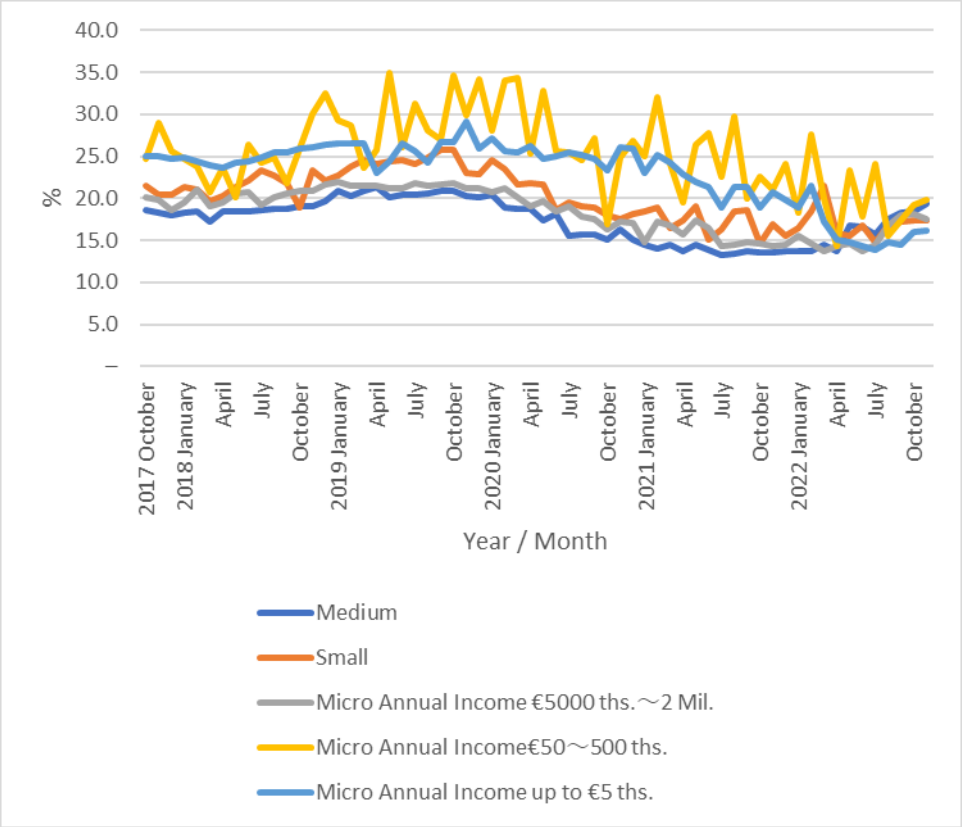
Source: Prepared by JICA Survey Team based on NBU statistics

Figure A2.5.4 Loans to individuals by size of enterprise

Based on the above, in the agricultural sector, personal loans to small and micro enterprises are estimated to be around 0.3% of all bank loans.

d) Interest rates for individual entrepreneurs

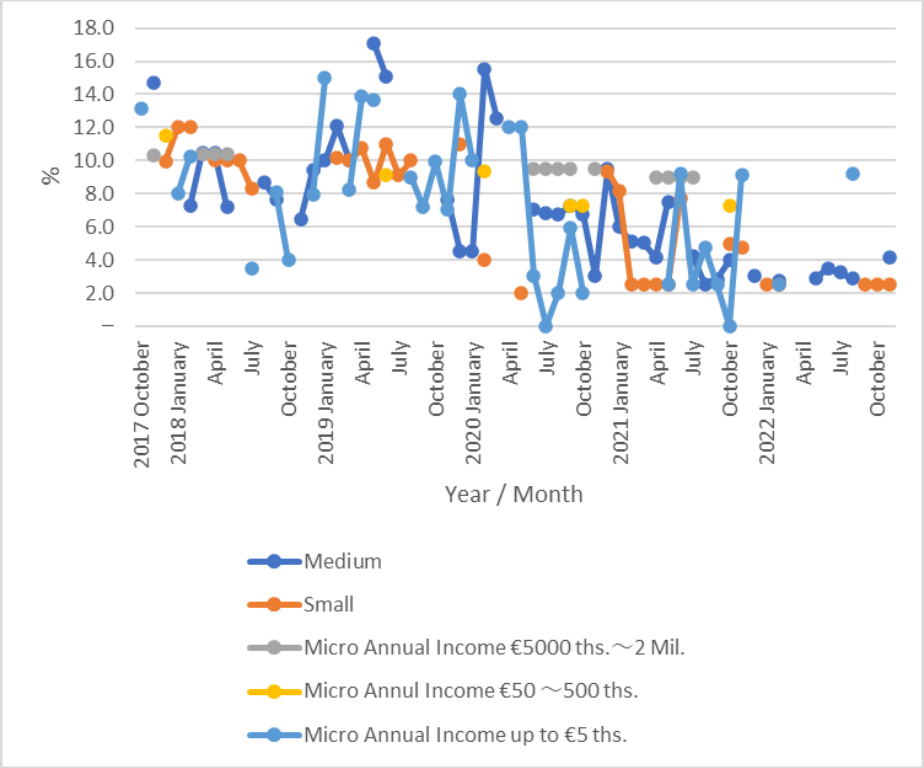
Figures A2.5.5 and A2.5.6 show changes in interest rates for loans to individual entrepreneurs. Looking at UAH-denominated loans, interest rates for medium-sized enterprises was less than 15% in 2021, while there were periods when those for small and micro enterprises have risen to 35%. In general trend, it exceeds 20%.



Source: Prepared by JICA Survey Team based on NBU statistics

Figure A2.5.5 Trend of interest rate of loans in UAH to the individuals by enterprise size

On the other hand, the shape of the graph for foreign currency-denominated interest rates is intermittent because there are months in which there were no loans. While interest rates for corporations are concentrated around 6% to 8%, interest rates for individual entrepreneurs fluctuate widely. From the end of 2021, it will be at an extremely low level of 2-3% for small and medium enterprises. On the other hand, even during the same period, the interest rate for individuals with an annual income of less than 50,000 Euro was high at 9.2%.



Source: Prepared by JICA Survey Team based on NBU statistics

Figure A2.5.6 Trend of Interest Rate for Foreign Currency Loans to Individuals

e) Estimation of Amount of Loans by Banks for the Agriculture Sector

Table A2.5.6 shows the number of agricultural enterprises by size. The company size is defined based on the provisions of Economic Code shown in Table A2.5.4. According to this, most enterprises in grain production, animal husbandry, hunting and related services are small and micro enterprises. In addition, individual farmers account for 1.5% of each of small and micro enterprises.

Table A2.5.6 Number of Registered Grain and Livestock Farms by Type of Business and Scale

Industry type	Total	Large companies	Medium company		Small business		Micro enterprise	
				of which private companies		of which private companies		of which private companies
Total number of companies	3,837,106	610	17,811	309	1,937,827	1,585,105	1,880,858	1,576,209
Crop and animal production, hunting and related services	122,823	49	1,793	3	63,118	18,887	57,863	18,819
Of which growing of non-perennial crops		41	1,389	2	50,253	11,672	45,746	11,636
Cereals, Legumes, Oilseeds		41	1,335	2	48,027	10,451	43,647	10,417
Vegetables, melons, roots and tubers		-	44	-	1,646	870	1,541	868
Of which perennial crops		-	47	-	2,178	797	2,048	793
Grape		-	11	-	176	-	145	46
Pome fruits, stone fruits		-	27	-	827	227	770	225
Other tree and bush fruits, nuts		-	9	-	912	378	879	377
Of which animal production		7	289	-	3,726	1,855	3,386	1,851
dairy cattle		-	182	-	729	209	626	209
sheep and goats		-		-	193	75	186	75
swine and pig		3	50	-	1,006	582	909	579
poultry		4	40	-	870	443	784	442
Of which mixed farming			12	-	1,381	431	1,304	439
Percentage of the total number of companies of that size		8%	10%	1%	3%	1%	3%	1%
Percentage of total grain production, livestock, hunting and related service enterprises		0%	1%	0%	51%	15%	47%	15%

Source: Prepared by JICA Survey Team based on State Statistics Service of Ukraine

Table A2.5.7 shows the amount of bank loans to non-financial enterprises and loans to agriculture, forestry, and fisheries companies at the end of November 2022, both in domestic and foreign currencies and by term. In Table B2.5.2, the total amount of loans to non-financial enterprises as of the end of November 2022 was 777,369 million UAH, while in Table A2.5.7 the total amount of loans to agricultural, forestry and fishery companies was 121,742 million UAH. The ratio of loans to agriculture, forestry and fisheries companies to non-financial enterprises is 15.7%. Looking at loan terms, more than half of loans to non-financial enterprises and agriculture, forestry and fisheries companies are for less than one year, while the proportion of loans for more than five years is low at 13% and 8%, respectively.

By currency, three-fourths of loans to agriculture, forestry and fisheries companies are denominated in UAH. 42% of loans to agriculture, forestry and fisheries companies are UAH- denominated with a term of less than one year and 4% with a term of more than five years. The same tendency is observed in foreign- denominated loans. In Affordable Loans 5-7-9% program, which was launched in March 2020, loans with a lending period of 1 to 3 years accounted for 64%[31]. The increase in loans with the period of 1 to 3 years can be attributed to the program of Affordable Loan.

Table A2.5.7 Bank Loans to Non-Financial and Agriculture, Forestry and Fisheries Companies by Term (million UAH)

Item			All non-financial companies		Agriculture, forestry and fisheries companies	
			Loan Amount	Ratio	Loan Amount	Ratio
Total			777,369	100%	121,742	16%
By loan term		less than 1 year	429,782	55%	67,652	56%
		1-5 years	246,021	32%	48,820	40%
		over 5 years	101,566	13%	5,271	4%
By lending currency	UAH	less than 1 year	334,136	78%	51,176	42%
		1-5 years	141,822	58%	37,849	31%
		over 5 years	38,186	38%	2,575	5%
		subtotal	263,225	34%	91,600	75%
	Foreign currency	less than 1 year	95,646	22%	16,475	14%
		1-5 years	104,199	24%	10,970	9%
		over 5 years	63,380	15%	2,696	2%
		subtotal	263,225	34%	30,141	25%

* As of end of November 2022

Source: Prepared by JICA Survey Team based on NBU statistics

Since the ratio of loans to agriculture, forestry, and fisheries companies to loans to non-financial enterprises is 15.7%, simply assuming that 15.7% of loans are financed to small and micro enterprises in agriculture, forestry and fisheries companies, the amount of total loan amount to small companies account 1.70% of loans to non-financial enterprises and that ratio is 3.23% for micro enterprises. These percentages show that the absolute amount of loans to small and micro enterprises, which account for most of the agricultural sector, is extremely small compared to the total amount of loans.

[31] Business Development Fund Annual Report 2021 Page 41

Table A2.5.8 Average Loan Amount Per Company by Size

Item	Total amount	Large company	Percentage in all loan amount	Medium company	Percentage in all loan amount	Small business	Percentage in all loan amount	Micro enterprise	Percentage in all loan amount
Loan balance at the end of November 2022 (million UAH)	777,369	216,797	27.89%	211,959	27.27%	84,295	10.84%	160,069	20.59%
Of which, loans for the agriculture, forestry and fisheries industries (million UAH)	121,742	33,952	-	33,194	-	1,122,705	-	25,068	-
Number of agricultures, forestry and fisheries companies	-	49	-	1389	-	63118	-	57863	-
Estimated Average Loan Amount (million UAH)	-	692.90	-	23.90	-	17.79	-	0.43	-
Yen equivalent (million yen)*	-	2,543	-	87.71	-	65.28	-	1.59	-

* MSN Money rate as of May 14, 2023: 1 UAH=3.67 JPY

Source: Prepared by JICA Survey Team based of Central Bank statistics and Statistics Bureau statistics

Table A2.5.9 Average Loan Amount for an Individual Entrepreneur by Company Size

Item	Total amount	Large company	Percentage in all loan amount	Medium company	Percentage in all loan amount	Individual small business	Percentage in all loan amount	Individual micro enterprise	Percentage in all loan amount
Balance at the end of November 2022 (million UAH)	11364	0.00	0.00%	697	6.13%	322	28.34%	3392	29.85%
Of which, loans for the agriculture, forestry and fisheries industries (million UAH)	1779.60	0.00	-	109.15	-	50.43	-	531.19	-
Of which, loans for private companies (million UAH)	-	0.00	-	6.695	-	1.43	-	158.55	-
Number of private enterprises in agriculture, forestry and fisheries	-	-	-	3	-	18887	-	18819	-
Estimated Average Loan Amount (million UAH)	-	-	-	2.23	-	0.000076	-	0.0084	-
Yen equivalent (million yen) *	-	-	-	8.19	-	0.00028	-	0.030	-

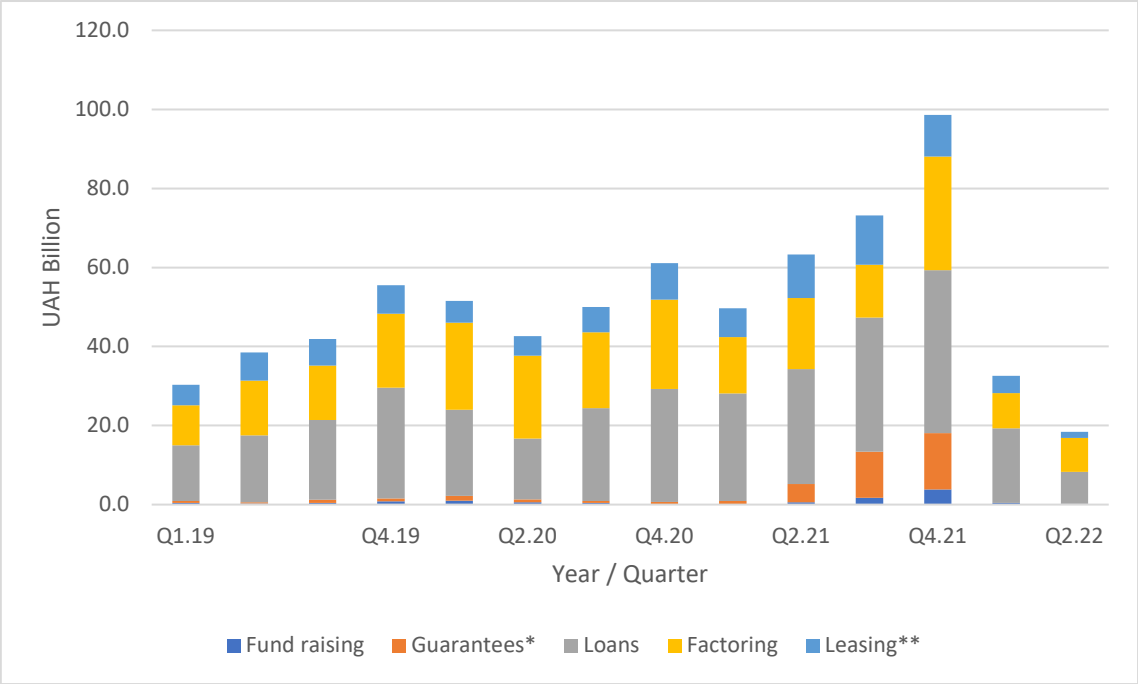
* MSN Money rate as of May 14, 2023: 1 UAH=3.67 JPY

Source: Prepared by JICA Survey Team based of Central Bank statistics and Statistics Bureau statistics

Tables A2.5.8 and A2.5.9 are the results of attempts to calculate the average loan amount per company and by size. After calculating the amount of loans to agriculture, forestry and fisheries companies by using the ratio of loans to agriculture, forestry and fisheries companies to all non-financial enterprises, the average amount of loan per company is calculated by dividing that amount of loan by the number of companies in the grain production, livestock farming, hunting and related service industries shown in Table A2.5.6. Looking at the results, we can see that while large companies received

a loan averaging 2,543 million Yen per company, medium-sized companies received the average amount of 87million Yen, small companies 65 million Yen, and micro companies received loans of 1.5 million Yen. It can be seen that the borrowing amount varies greatly depending on the size of the company. Among individual entrepreneurs, medium-sized companies receive 8 million Yen, while individual micro entrepreneur receive 278 Yen, which is unrealistic amount. Such result may have given due to the large number of individual small businesses which do not borrow from the banks. From this, it can be concluded that many agricultural enterprises do not receive bank loans when considered in terms of enterprise size, and that even among enterprises do that, the amount of loans received by individual enterprises is extremely small.

(3) Financing by Finance Company

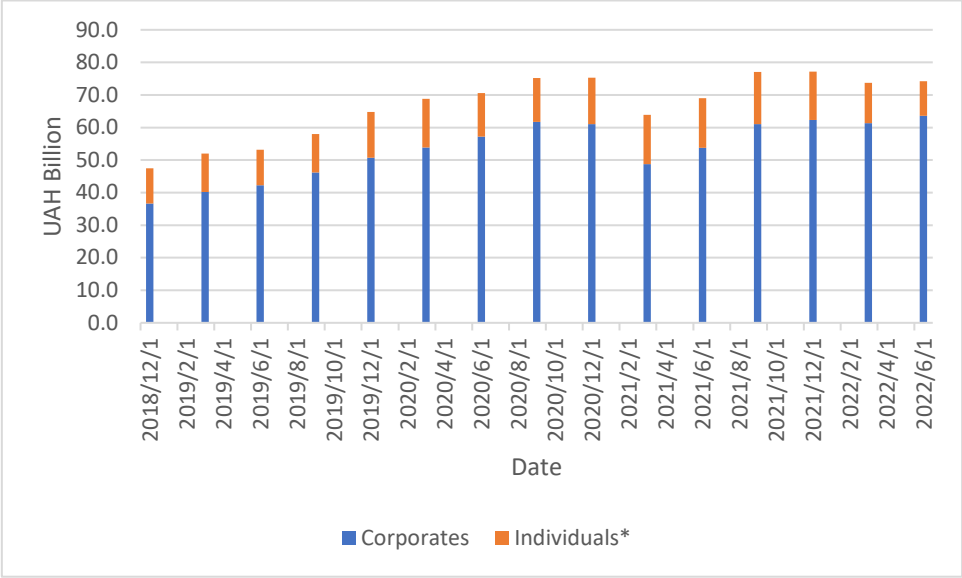


* Up to July 1st, 2020, data includes both guarantee and sureties, afterwards it is only guarantee.
** Includes both Finance Company and legal entities-lessors
Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Figure A2.5.7 Services provided by Finance Companies

Figure A2.5.7 shows the financial services provided by finance companies. Loans are important among the services and those to companies account for the majority. The NBU statistics do not disclose the breakdown by industry, to which companies belong, receiving financial services from finance companies, so the proportion of loans to agricultural companies is unknown. According to the NBU 's white paper on the finance company market[32], loans of finance companies are increasing to companies and individuals that cannot borrow from banks thanks to the ease and rapidity of borrowing.

[32]" White Book Regulation Market Lending by Finance Companies" National Bank of Ukraine, April 2020

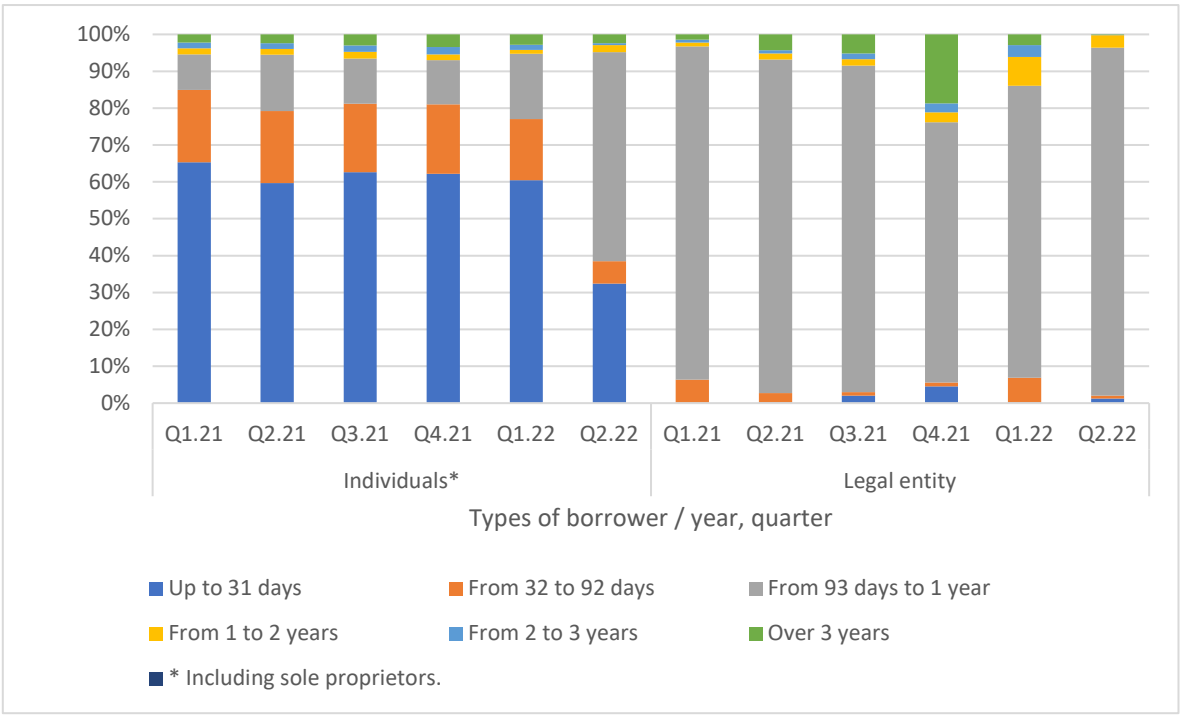


* Includes sole proprietors

Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Figure A2.5.8 Beneficiaries of services by Finance Companies

Figure A2.5.9 shows the financing period of finance companies. 70% to 90% of corporate loans have a loan period of 93 days to 1 year, accounting for an overwhelming proportion. From this, it can be considered that financing companies' corporate loans are mainly working capital loans. On the other hand, for individuals, consumer loans with a loan term of 30 days or less account for a large percentage, and it is thought that finance companies are suppliers of short-term loans with small amount.

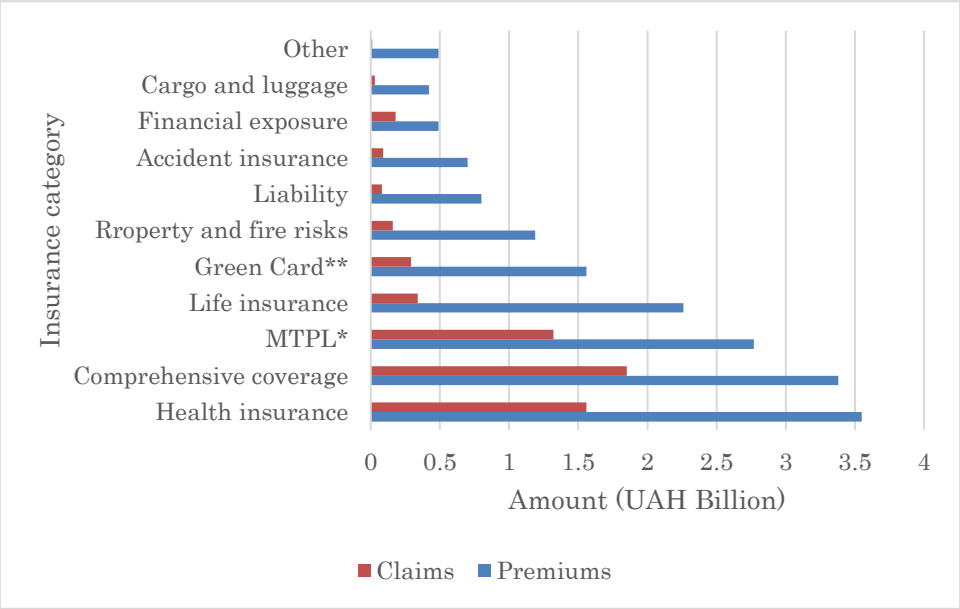


Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Figure A2.5.9 Lending terms of Finance Companies

(4) Insurance company

Figure A2.5.10 shows premiums and claims by type of insurance. Automobile insurance, comprehensive insurance, compulsory automobile insurance, and international automobile insurance account for more than half of non-life insurance. As will be discussed later, agricultural insurance exists as a system, but it is statistically included in "others" and does not play a major role yet.



Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Figure A2.5.10 Types of Insurance

"Future of Insurance Market Regulation in Ukraine"[33] published by the NBU in April 2020, pointed out that the Ukrainian insurance market is not sufficiently developed. According to the same report, Ukraine has a low insurance penetration rate of 1.4%[34], compared to the world average of 6.1%. NBU cited insufficient legal regulatory frameworks, insufficient regulatory policies, and insufficient supervision of the insurance market as reasons for underdevelopment. It also pointed out the following reasons: the low penetration rate of life insurance resulting into a lack of assets by insurers to invest in the domestic capital market, the current regulatory framework that limits the liquidity of insurers' cash reserves, the company inability to build an appropriate business model, and the insufficient backing on calculation of insurance premium resulting into low payment against insurance claims.

(5) Loans by Credit Union

A credit union is a non-profit organization that lends money to its members based on funds invested by its members.

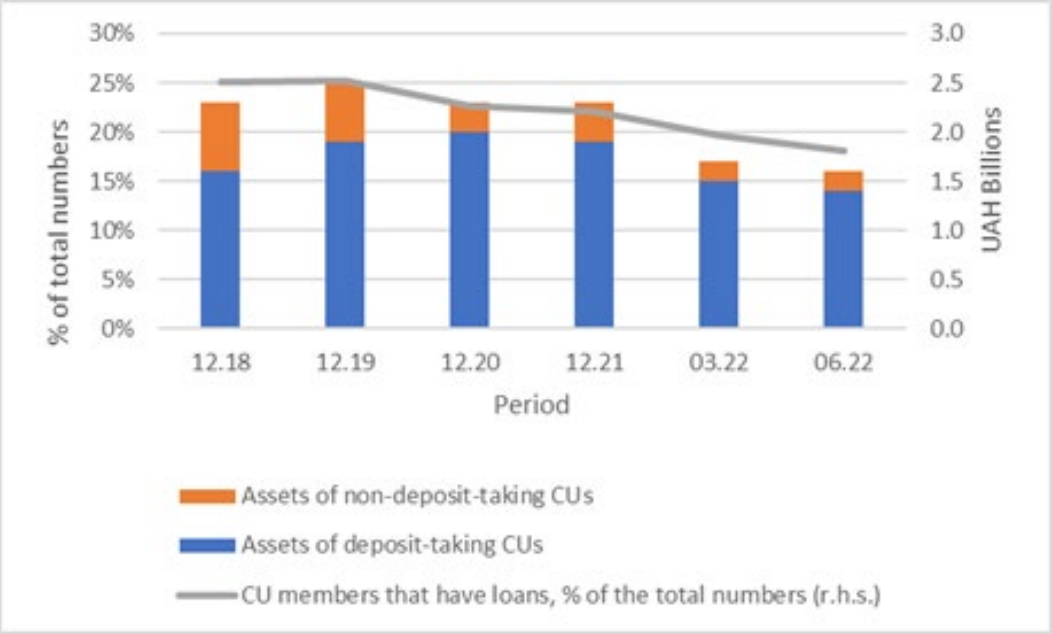
Figure A2.5.11 shows the total assets of domestic credit unions and the proportion of members receiving loans. Table A2.5.3 shows that the number of credit unions has continued to decline since the

[33] "Future Regulation of Insurance Market in Ukraine "April 2020, National Bank of Ukraine

[34] According to the survey on insurance density index among 88 countries by Swiss Re, Ukraine ranks 73rd in the use of non-life insurance and 82nd in the use of life insurance. (White Book, "Regulation of the Insurance Market in Ukraine" National Bank of Ukraine, April 2020, Google translation)

end of 2018. Since the end of 2019, total assets have decreased and the proportion of members receiving loans has also decreased. Figure A2.5.12 shows credit union loans by type. According to this, consumer finance accounts for about half. Business loans, by contrast, will account for just over 26% of all loans on average between 2018 and 2022[35]. Since the breakdown of business loans in Figure A2.5.12 is not published, the proportion of loans to farmers cannot be read from the NBU statistics. Even if we assume that most business loans are for agriculture, the amount of such loans is extremely limited, as can be inferred from the percentage of total financial assets in Tables A2.5.1 and A2.5.2. Looking at the ratio of overdue debts of three months or more in credit union loans, the highest was 22% in December 2020, and 13% in March 2022, showing a high overall level.

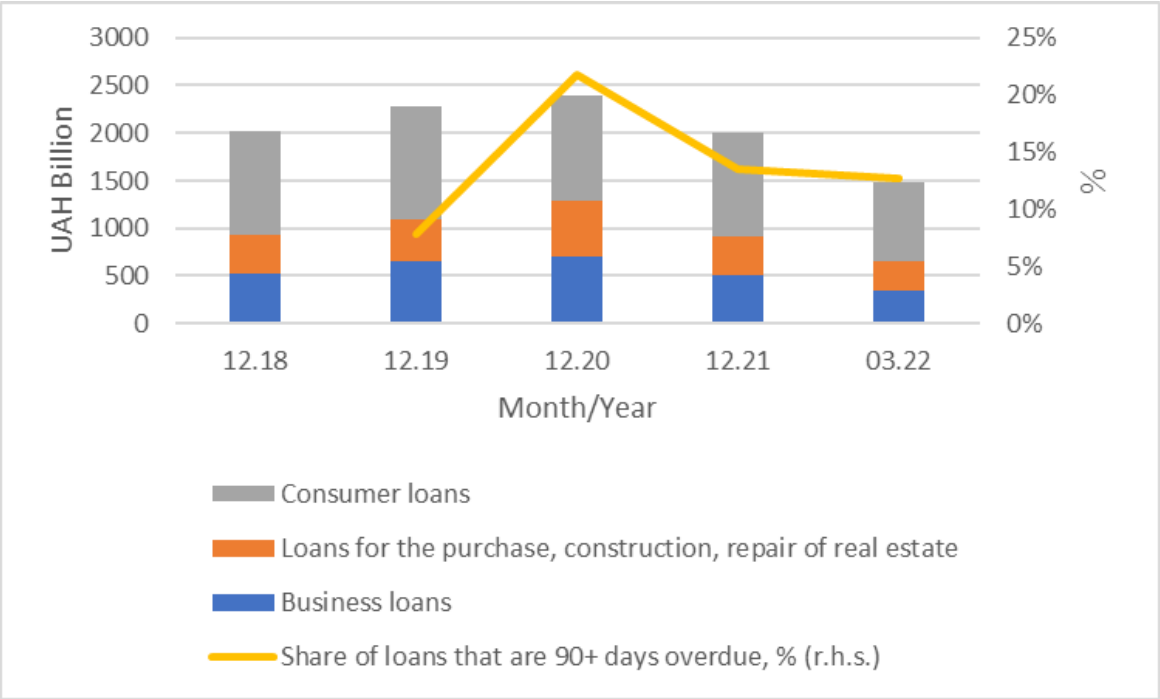
Figure A2.5.13 shows the spread between lending and deposit rates by loan type. Although lending interest rates for business loans fell from 42.1% in December 2018 to 35.9% in June 2022, it is still considered to be high, making the hurdle for borrowing high.



Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

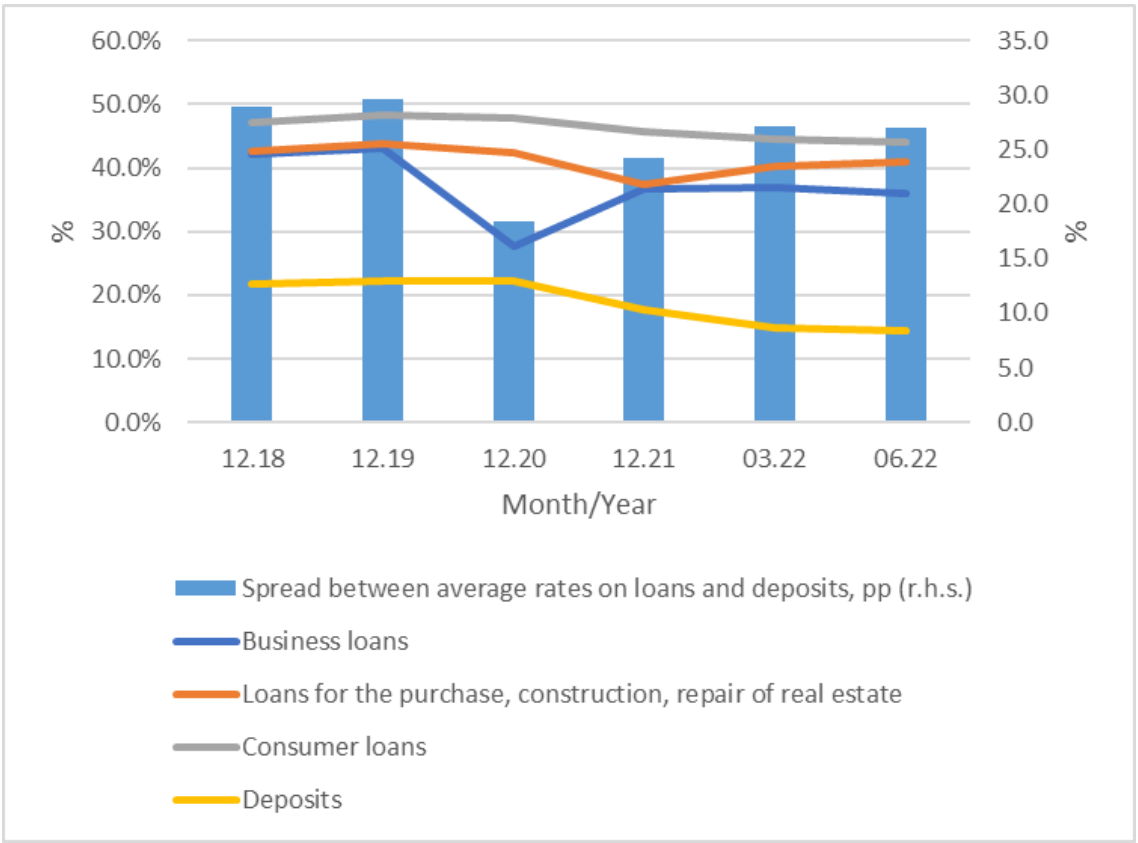
Figure A2.5.11 Assets of Credit Unions and Proportion of Members Benefiting Their Loans

[35]"Non-Bank Financial Sector Review September 2022", National Bank of Ukraine, Table 22



Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Figure A2.5.12 Types of Loans of Credit Unions and the Proportion of Share of Overdue Loans More than 3 Months



Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Figure A2.5.13 Interest Rates of Credit Union by Types of Loan, Deposit Interest Rate and the Gap Between Them

Based on literature research, it was inferred that loans to smallholder farmers were provided by credit unions. So, in this research, online interviews with credit unions to learn more. Table A2.5.10 provides an overview of the three credit unions interviewed, and Table A2.5.11 shows the loan menu of each credit union. Table A2.5.12 summarizes the interview results.

Table A2.5.10 Overview of Credit Unions

Name	Credit Union (CU) A	Credit Union (CU) B	Credit Union (CU) C
Location	Rivne Province	Lviv Province	Cherkasy Region
Capital (including registered capital, reserved capital, and retained earnings)	563,000 UAH (2,035,414 yen) (1 UAH = 3.62 yen)	12,353,000 UAH (44,659,801 yen) (1 UAH = 3.62 yen)	66,621,000 UAH (240,854,901 yen) (1 UAH = 3.62 yen)
Number of employees, number of branches	10 staff, no branches	33 staff, 10 branches	50 staff, 13 branches
Interviewee	Chairman of the Board, Chief Accountant	Head of the Board Deputy Head of the Board, Head of the Credit Committee Secretary of the Board, Chief Accountant Member of the Board, Executive Director	CEO Head of the credit committee Development Director
Remarks	Credit union for dairy farmers established in 2021	A credit union established mainly by members of the Ukrainian Orthodox Church in 1995	A major credit union celebrating its 25th anniversary. Received long-term support from the USAID CAP project

Source: Prepared by JICA Survey Team

Table A2.5.11 Loan menu of credit unions

Credit Union A				
Use of loan	For home ranchers	Appropriation for working capital	Purchase of automobiles, agricultural machinery and equipment	Economic need
Interest rate	17%	25%	18% to 26% (varies depending on the borrower's self-pay amount)	25-35%
Loan Amount	Over 10,000 UAH	Over 50,000 UAH	Over 50,000 UAH	5,000 UAH or more
Loan period	12-60 months	3-24 months	12-60 months	12-60 months
Collateral	Movable property, real estate, money guarantee	Movable property, real estate, money guarantee	Movable property, real estate, products handled, money guarantee	Money guarantee
Notices	Eligible borrowers: 5-20% of co-payments, individuals, 21-65 years old (age at the time of completion of repayment) Fees: 17%, excluding insurance and notary fees	Loan Eligibility: Individuals, ages 21-65 (age at time of completion of repayment) Insured property Fee: 25%, excluding insurance and notary fees Fee: 17%, excluding insurance and notary fees	Eligible borrowers: Individuals aged 21 to 65 (age at the time of completion of repayment) Asset insurance, borrower disability insurance coverage required	Eligible borrowers: Individuals aged 21 to 65 (age at the time of completion of repayment) Insurance with disability insurance for borrowers Commission: 25% to 35%

Credit Union B					
Use of loan	Purchasing seeds, fuels, fertilizers and crop protection products for: cattle, pigs, sheep, poultry, beekeeping, cereals, fodder, vegetables, melons, potatoes, horticultural crops, grapes, floriculture	For farmers who comply with environmental regulations	Operating funds for private family farms, consumer finance	For sole proprietors (working capital, purchase of fixed assets, expansion of production)	Buying, building, repairing or rebuilding real estate Buying a car
interest rate	27-30%	21%	36-39% Real interest rate 47.37-49.82%	34-37%	24% real interest rate: 28.01-110.37%
Loan Amount	20,000 to 1,000,000 UAH	20,000 to 1,000,000 UAH	7,000-300,000 UAH	20,000 to 1,000,000 UAH	20,000 to 1,000,000 UAH
Loan period	3-36 months	3-20 months	3-36 months	3-36 months	3-60 months
Collateral	Not listed	Not listed	Not listed	Not listed	Not listed
Loan eligibility requirements	Registered in Lviv, Lviv Oblast, fixed income (income proof for the last 6 months required), age 21-70				
Notices	Individual farmer, president of an agricultural company, landowner of 1ha or more, operation record of 6 months or more	An individual farmer, president of an agricultural company, owner of land of 1ha or more, operating record of 6 months or more, and compliance with environmental regulations.	Not listed	More than 6 months of operation results	Not listed

Credit Union C		
Loan type	For individual farmers	Special program
Interest rate	30-42%	15%
Loan Amount	300-10,000,000 UAH (but less than 20% of credit union capital)	300-500,000 UAH
Loan period	1 to 120 months	Up to 36 months
Collateral	Guarantor, movable property, real estate, agricultural machinery and equipment	Guarantor, movable and real estate, agricultural machinery and equipment
Notices	Proof of income or proof of credit of the individual, presentation of proof of income or proof of family's credit	Subject to a written commitment to donate a portion of the produce to charitable organizations that assist the Ukrainian military, internally displaced persons or other war-affected populations.

Source: Prepared by JICA Survey Team based on the websites of each credit union

Table A2.5.12 Credit Union Interview Results (summary)

<table>
<tr><th>Hearing item</th><th>Hearing result</th></tr>
<tr><td>Membership of credit unions</td><td>Members are individuals only. (Common to all CUs) Current laws and regulations do not allow companies to join credit unions. A law allowing companies to join credit unions is currently being debated in the Diet (CU B) .</td></tr>
<tr><td>Beneficiaries of loan</td><td>Although they are individuals, each individual is a representative of a farmer or agricultural enterprise who uses personal loans to fund their own business (common to all CUs). Farmers have 6 to 600 ha (CU C), 2 to 4 ha (CU B), and dairy farmers with 2 to 3 cows (CU A & C) to 300 (CU C). Sizes of borrowers vary by credit union. Borrowers include unregistered farmers (CU B, CU C).</td></tr>
<tr><td>Loan size, period, money</td><td>
<table>
<tr><th></th><th>Credit Union A</th><th>Credit Union B</th><th>Credit Union C</th></tr>
<tr><td>Average loan amount</td><td>100,000 UAH</td><td>Individual: 1,500USD
Agricultural Entrepreneur: 15,000USD</td><td>7,048 US $</td></tr>
<tr><td>Average loan term</td><td>3 to 5 years</td><td>12-18 months</td><td>12-36 months</td></tr>
<tr><td>average interest rate</td><td>9%</td><td>Individuals: 37%
Agricultural entrepreneurs: 24%</td><td>32.37%</td></tr>
</table>
</td></tr>
<tr><td>Use of funds</td><td>90% investment capital, 10% working capital (CU A), 10% investment capital, 90% working capital (CU B), 30% investment capital, 70% working capital (CU C)</td></tr>
<tr><td>Collateral</td><td>Liquid assets, Personal Guarantee (CU A), Guarantee by family, Member of agricultural enterprise (CU B), Liquid assets (CU C)</td></tr>
<tr><td>Loan source</td><td>In addition to deposits by members, free loans from the United Credit Union (CU B) and borrowings from other financial institutions (20% of loan capital) (CU C)</td></tr>
<tr><td>Percentage of agricultural loans</td><td>100% (CU A), 31% (CU B), 30% (CU C)</td></tr>
<tr><td>Factors impeding expansion of lending</td><td>Non-application of deposit guarantee system, lack of loan resources (CU A), constraints to loan only to individuals, high interest rate, impossibility of treating interest payment as cost, non-applicability of compensation program, non-applicability of deposit guarantee fund (CU B), high interest rates, lack of liquidity collateral, anxiety about the future due to war (CU C)</td></tr>
</table>

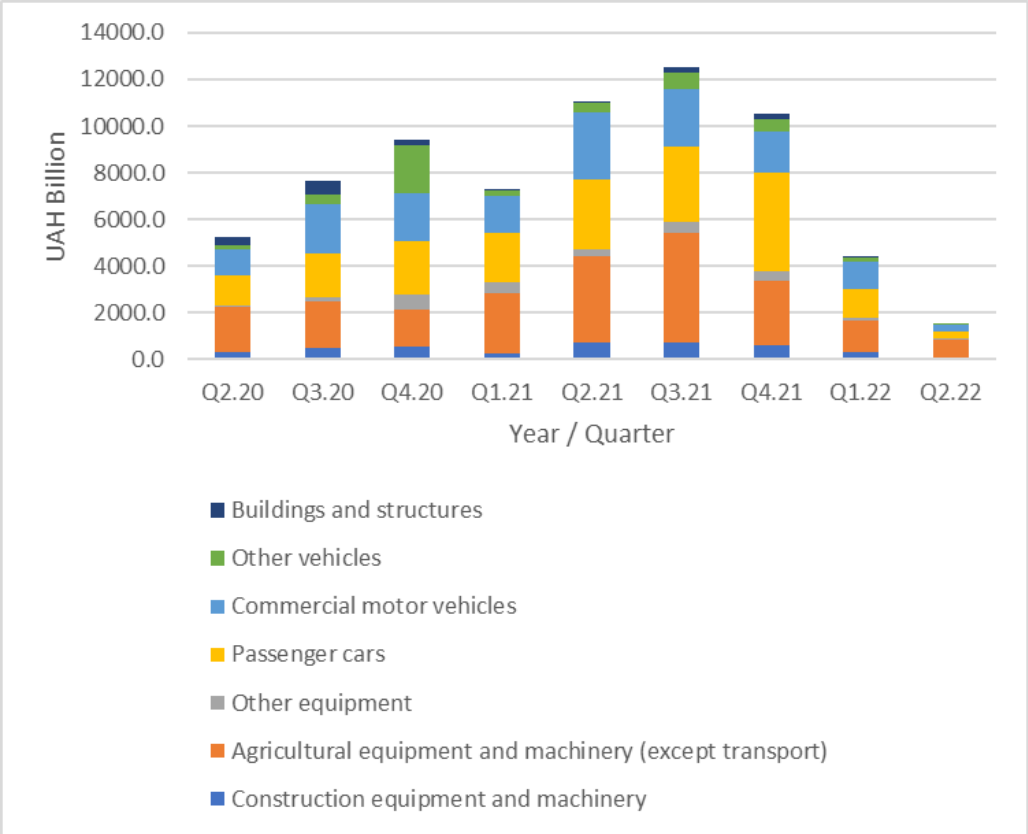
Source: Prepared by JICA Survey Team based on interviews with credit unions

In addition to what is noted in Table A2.5.12, Credit Union C, which has long been supported by the US Agency for International Development's (USAID) Credit for Agriculture Producers (CAP) project, was the first credit union to handle crops receipt. In addition, although credit unions cannot lend to corporations, it provides loans for the purchase of machines that add value to products, such as grain dryers, machines for drying apples, and oil extractors. Such examples are considered as value chain financing. This is presumed to be the result of the support provided by CAP project, which has enhanced its capabilities as a financial institution. CU C also pointed out that banks can procure loans at low prices from multilateral financial institutions, and as a result they are able to provide loans at low interest rates, making the conditions of competition tougher for the credit union. CU A said it needed grants from aid agencies to survive. In addition, CU B explained that extending credit is judged based on personality of borrower, in addition to on-site inspection of the borrower's activities and assets, and examination of accounting-related documents. It was also explained that CU A frequently provides management guidance to borrowers. Through the interviews, it became clear that credit unions do not provide loans based on physical collateral, and that they provide loans purely based on the creditworthiness of the

borrower, but the loan amount is small. Therefore, it is understood that because of the small amount unsecured loans are made possible, and the credit union's screening ability and management guidance for borrowers are considered to have great influence on the business performance of the credit union[36].

(6) Business of the leasing company

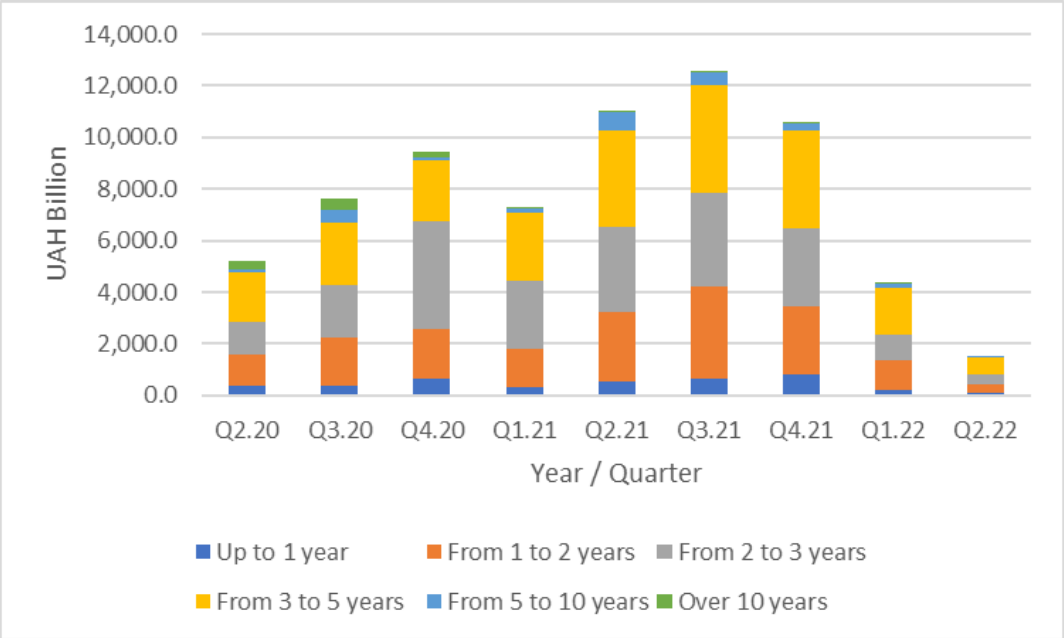
Figure A2.5.14 shows contract amounts by categories of leasing contract by leasing companies from the second quarter of 2020 to that of 2022, and Figure A2.5.15 shows contract amounts by lease term.



Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Figure A2.5.14 Contract Amount of Leasing Companies by Lease Material.

[36]According to USAID 's Quarterly Update Oct-Dec 2022 Issue No.9 of the Credit for Agriculture Producers (CAP) Project, since the beginning of Russian invasion, loans and deposits in general financial markets have declined by 50%, while it stopped at 5% for both among CAP supported credit unions.



Source: Prepared by JICA Survey Team based on NBU Non-Bank Financial Sector Review, September 2022

Figure A2.5.15 Leasing Companies' Contract Amounts by Terms of Leasing

Looking at the breakdown by type of leasing contract, the volume of leasing of agricultural machinery is about the same as that of automobiles. According to the announcement made by the Ukrainian Union of Lessors in January 2022, 5,874 units of agricultural equipment was leased in 2021.

That announcement also shows the major leasing companies and their market shares which are as follows.

Table A2.5.13 Major Leasing Companies and Leasing of Agricultural Machineries

Company name	Market share (%)	Lease model	Ratio (%)
OTP Leasing	52	Tractor	35
Kredobank	15	Combine	11
Alfa-Leasing	11	Tiller	10
ULF Finance	7	Seeder / Reaper	9

Source: Prepared by JICA Survey Team from the website of the Ukrainian Leasing

Table A2.5.14 shows the rental terms of the major leasing companies listed in Table A2.5.13. There is a wide range of interest rates depending on the amount of the advance payment and the term of the lease. In addition, the interest rate conditions differ greatly depending on the individual company, and some leasing companies offer favorable conditions compared to the bank interest rates shown in Figures A2.5.2 and A2.5.3. In addition, from October 2021 onwards, leasing of agricultural machinery is eligible for Affordable Loan 5-7-9%, which are policy-based financing explained later.

Table A2.5.14 Leasing Terms of Major Leasing Companies

Company name	Payment currency	Advance payment	Interest rate	Period	Repayment method
OTP Leasing	USD・EUR・UAH	Advance payment	Interest rate	Period	Repayment method
Kredo Bank*	UAH	20%	UAH 23%~, USD7,5%~, EUR 6,5%~	up to 5 years	Seasonal payment possible
Alfa-Leasing*	USD・EUR・UAH	20%~	Self-propelled vehicle: UAH denominated: Advance payment 30% 2.6% (1 year) - 11% (5 years) 40% 0.8% (1 year) - 10.5% (5 years) 50% 0.01 (1 year) - 9.9% (5 years)	up to 6 years	Four ways: Annuity, Classic, Seasonal, Individual
ULF Finance*	USD・EUR・UAH	20% minimum	UAH advance payment 20% 4.6% (1 year) - 11.6% (2 years) 40% 0.01% (1 year) - 9.6% (5 years) 50% 0.01% (1 year) - 6.7% (5 years) EUR Deposit: Advance payment 20% 0.01% (1 year) - 2.6% (2 year) 40% 0.01% (1 year) - 1.8% (3 years) 50% 0.01% (1 year) - 0.01% (3 years)	1-5 years	Three ways: Classic, Annuity, Seasonal

* Since interest rates are not disclosed on each company's website, the interest rates of each company are quoted from Landtech's website

Source: Prepared by JICA Survey Team from the company website

Currently in Ukraine, there is a registry for movable properties such as cars, trucks and tractors, as well as immobile properties such as land, buildings and apartments. However, immobile registry does not register stationary machineries, such as factory equipment and grain dryer. In addition, the central bank's lending regulations require that loans and leases be granted against registered assets. Therefore, there is a constraint that the types of movable properties that can be leased by the leasing company are limited. For this reason, a system has been developed in which a lease contract is concluded by collateralizing the tractor to be leased[37] and such leasing is offered by a specific manufacturer.

There are two types of leasing companies: bank subsidiaries and non-bank leasing companies. Like the insurance industry, Ukrainian leasing companies were under the supervision of the National Securities and Stock Market Surveillance Commission until 2019. However, its supervision was not sufficient, so that non-bank leasing companies had the issues such as undercapitalization, poor corporate governance, poor risk management, and poor company management. According to the press release of the NBU in April 2022, 24 leasing companies were forcibly removed from the NBU registration in March, a month after the Russian invasion began. Such event suggests vulnerability in leasing company's poor business base. On the other hand, as a result of the strengthening of the NBU's supervisory functions over banks from 2014 to 2015, bank subsidiary leasing companies were able to secure a sound financial position thus outperformed non-bank subsidiary leasing companies. However, due to restrictions imposed by the movable and immobile registry, the equipment that can be leased is limited, and stationary agricultural machinery is mainly purchased[38]. This restriction hinders the expansion of the leasing market in Ukraine.

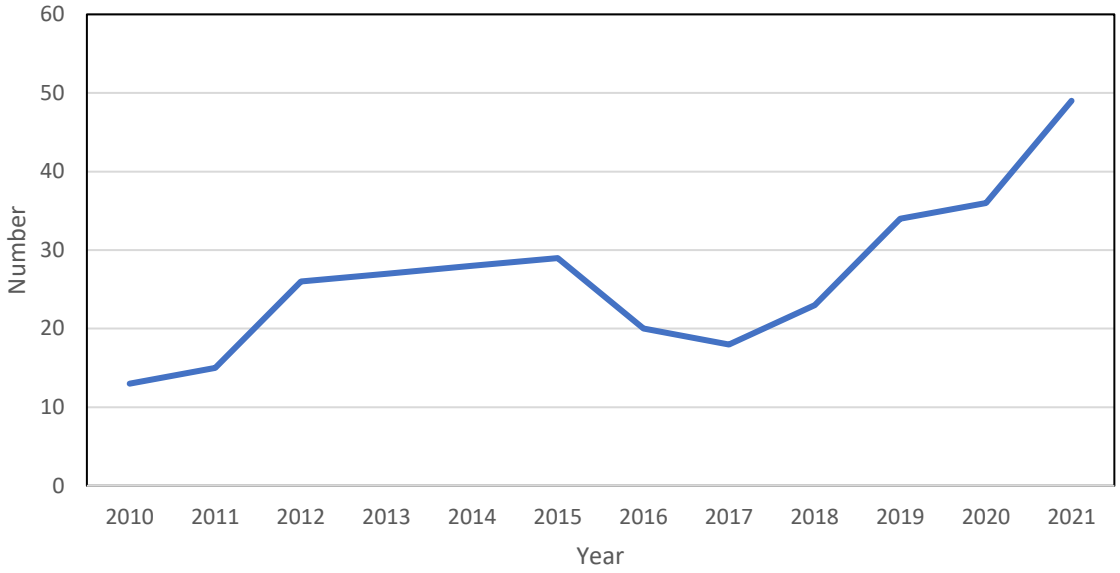
[37] The first leasing of the products of a specific agricultural machinery manufacturer was started in 2012 by Credit Agricole, a French bank, together with AGCO. After that, other banks introduced the same business model of Credit Agricole, and the agricultural machinery leasing market developed.

[38] According to the manufacturing machinery statistics of the Statistics Bureau, the replacement rate for stationary machines in Ukraine is 1-4%, depending on the type of machine, which is almost the same as that in the United States and Japan.

(7) Financing of international financial institutions for large enterprises in the agricultural sector

Table B2.5.3 shows a list of Ukrainian companies receiving loans from three international financial institutions [39], namely the International Finance Corporation (IFC), the European Bank for Reconstruction and Development (EBRD), and the European Investment Bank: EIB) since 2004. It is understood that agro holdings grew after 2004.

Looking at the economic activities of each company described in this table, there are grain companies that vertically integrate everything from grain cultivation to storage and export, and livestock companies which produce processed meat from breeding of pig and poultry. These companies are known as agro holdings. Agro-holdings have emerged as a progressive consolidation of land in informal ways amid the ban on land sales since[40] 2004. Some of the companies on the list have received multiple loans from multiple international financial institutions or from specific international financial institutions to expand their arable land and production facilities. The loans also include working capital loans.



Source: Prepared by JICA Survey Team based on NBU statistics

Figure A2.5.16 Number of Large Enterprises in Agriculture Sector

Figure A2.5.16 is a graphic representation of changes in the number of large enterprises in the agricultural sector based on statistics from the State Statistical Services. Looking at this change in the number of companies, the number of companies in 2021 is almost the same as the 50 companies in Table A2.5.15. Since the specific names of the companies in Figure A2.5.16 are not clear, the comparison between the two numbers is not precise, but it can be seen from here that large companies in the agricultural sector, including agro-holdings, have received loans from international financial institutions. Bank loans to non-financial large companies also accounted for the highest ratio of 27.9%, suggesting that large-scale agricultural companies do not have any difficulties in access to finance.

[39] Reflects acceptances since 2004 .
[40] Joint Research Center: Farming and rural development in Ukraine: making dualization work, December 2012, pp.22

(8) Business Development Fund (BDF)

Since small and medium-sized enterprises account for a high proportion of all industries in Ukraine, support for small and medium-sized enterprises has been provided for some time. It is BDF which provides loans to SMEs. The BDF was initially established as a German-Ukrainian fund with 6.1 million Euros contributed by the German government in 1996 but changed its name to BDF when it became a state institution of Ukraine in 2020.

Regarding BDF, please refer to Chapter 7 of the preceding survey for details. In the preceding survey, there was no detailed explanation of the Affordable Loans 5-7-9% program for which BDF is the executing agency, so the following supplementary information is given by focusing on the agricultural sector.

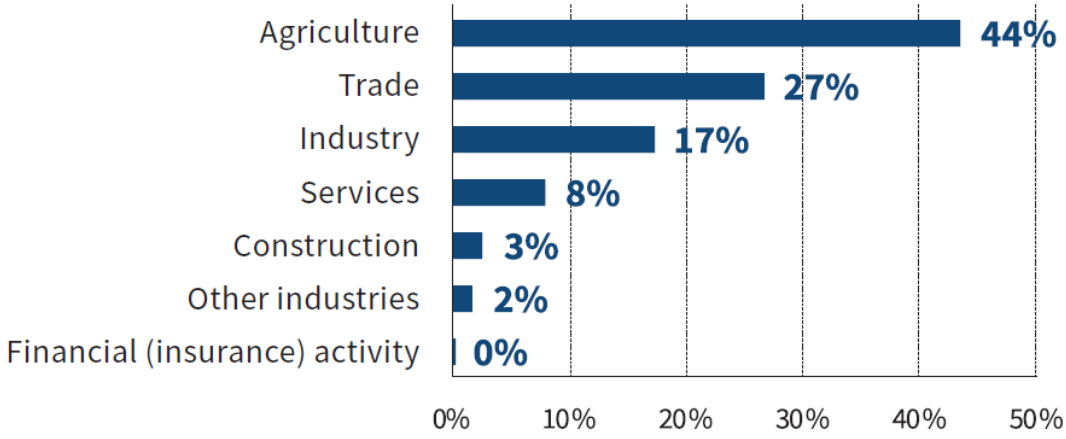
2.5.3 Policy-based Financing and Other Financial Instruments

From the perspective of access to finance to the agricultural sector, in addition to bank and non-bank loans, Affordable Loan 5-7-9%, Partial Risk Guarantee, Warehouse Receipt, Crop Receipt, and agricultural insurance have already been introduced. These are described below.

(1) Affordable Loans 5 -7-9%

This program (hereafter referred to as the Program) is a policy-based financing for SMEs launched by the President in March 2020. The details are stipulated in Cabinet Order No. 28 (dated January 24, 2020) and Cabinet Order No. 29 (dated the same date). In a nutshell, the contents of the Program are interest compensation and debt guarantee for loans to small and medium-sized enterprises from the national budget.

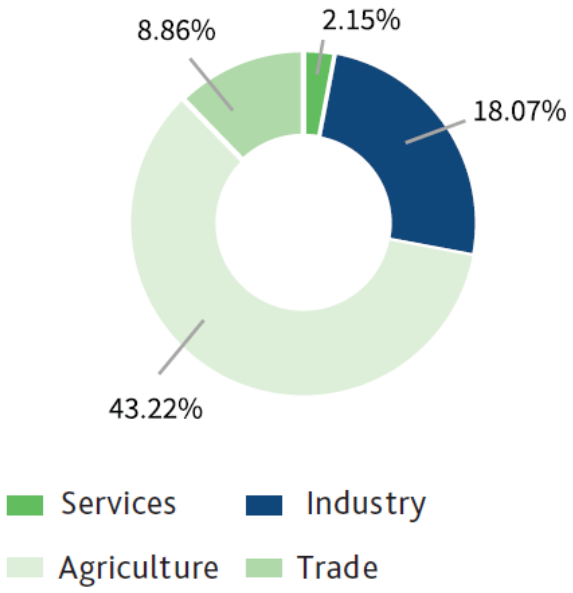
The initial objective of the Program was to improve access to capital investment funds for SMEs, and the maximum loan amount was set at 1.5 million UAH. After that, due to the spread of COVID-19, it was also used as a measure to mitigate the impact of COVID-19, and in April 2020, anti-crisis component and a refinancing component were added. Furthermore, in 2021, support for individual entrepreneurs with an annual income of up to 50 million UAH, which were initially excluded from the Program, had been added. Further in March 2022, a component aimed at providing short-term liquidity to farmers was added, along with an anti-war component aimed at mitigating the impact of Russia's military aggression on SMEs. The former provides subsidy so that the interest rate on working capital loans for micro, small and medium enterprises is 0%.



Source: BDF Annual Report 2021

Figure A2.5.17 Proportion by Sector for Loans for Interest Subvention (as of January 1st, 2022,%)

Figure A2.5.17 shows loan balances for all components of subsidized loans as of 1 January 2022, by sector. As is clear from the graph, the beneficiaries of Affordable Loans 5-7-9% are overwhelmingly in the agricultural sector. This trend is the same for debt guarantees. (Fig. A2.5.18)

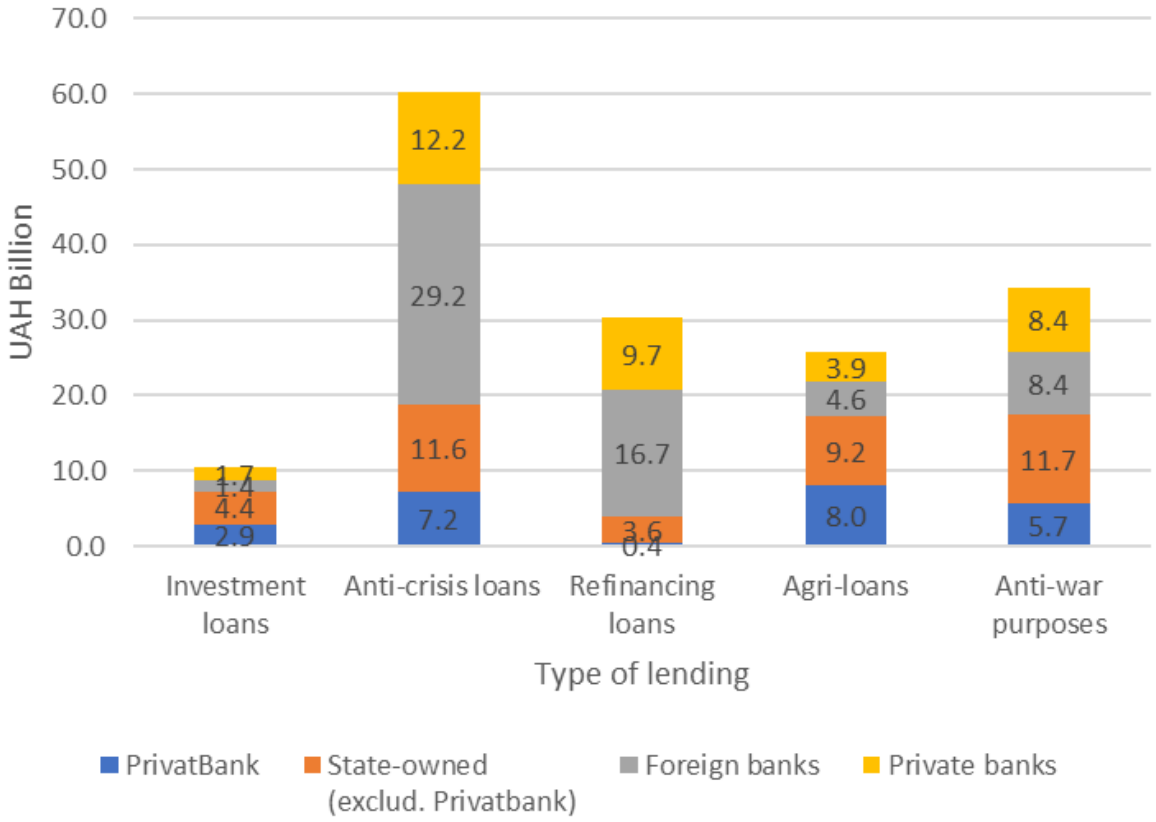


Source: BDF Annul Report 2021

Figure A2.5.18 Proportion by Sector of Guarantee (As of January 1st, 2022,%)

On the other hand, looking at the breakdown by components as of December 19, 2022 (Figure A2.5.19), anti-crisis loans have the largest amount[41], while 0% interest loans for farmers (5% interest after 6 months of borrowing) and anti-war component loans from national banks are increasing.

[41] The following description is based on N BU Financial Stability Report December 2022 Box 1 .

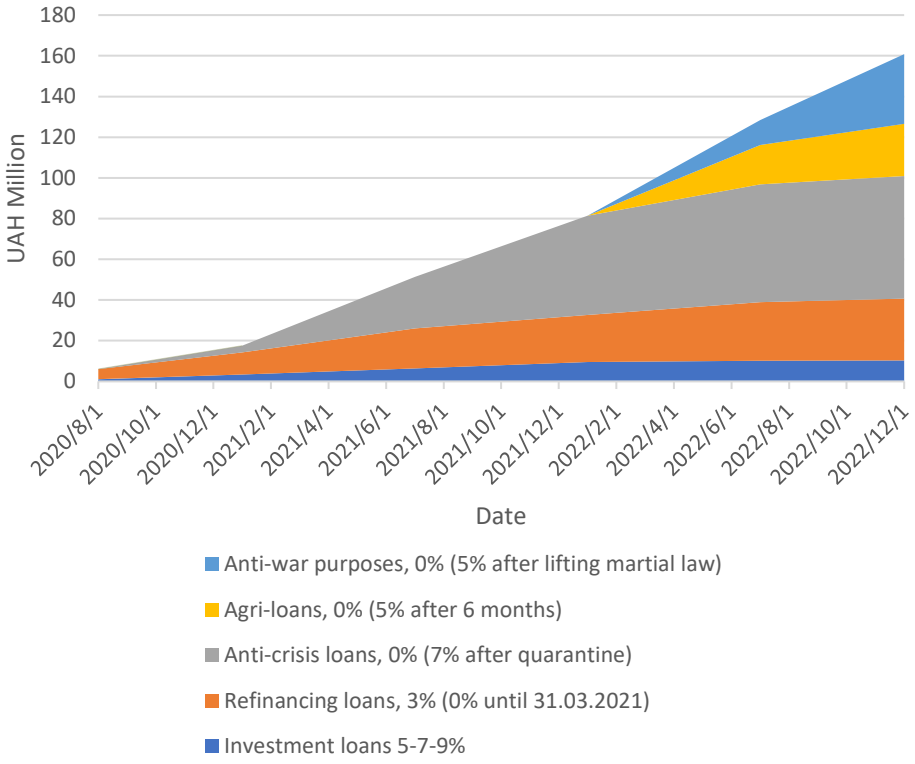


Source: Prepared by JICA Survey Team based on NBU report

Figure A2.5.19 Proportion of Affordable Loans 5-7-9% by Objective and by Bank

Figure A2.5.20 shows the annual balance of loans for each purpose since the start of Affordable Loans 5-7-9%. From here, the proportion of anti-crisis loans introduced in response to COVID-19 is the highest, followed by the anti-war component, refinancing, and loans to farmers. Investment loans, which were the original purpose of Affordable Loans, have remained at the same level with the lowest ratio[42].

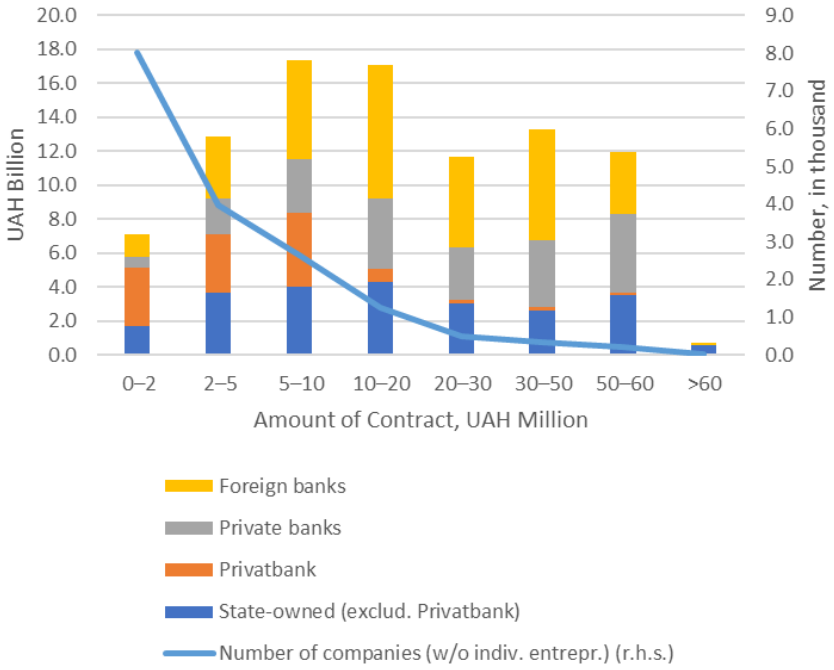
[42]November 7 , 2021 , Kyiv Post reported that Raiffeisen Bank President Pisaruk, representing 12 banks, stated that he send a letter which criticized the government based on observation of Raiffeisen Bank's lending statistics, as Affordable Loans of 5-7-9% is used for those agriculture enterprises which do not need to benefit from that program. Mr. Pisaruk argues that while refinancing was a necessary financial tool during the expansion of COVID-19 pandemic, it should be scaled back after Economy returns to normal.



Source: Prepared by JICA Survey Team based on NBU report

Figure A2.5.20 Trend of Total Amount of Affordable Loans 5-7-9% by Types of Lending

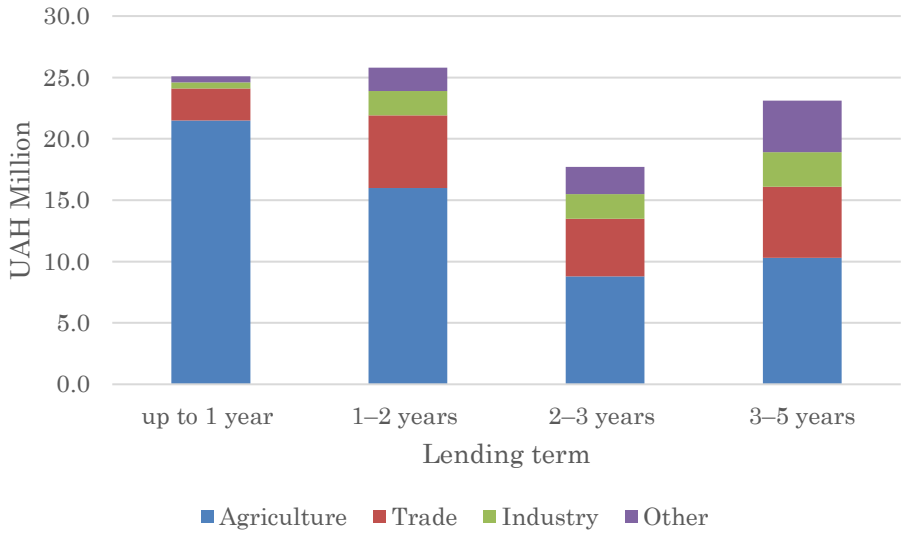
Figure 2.5.21 shows the relationship between the number of companies receiving loans and the amount of loans by bank. NBU points out that the average loan amount through the Program's implementing period is approximately 3 million UAH (approximately 11 million Yen), with the majority being small loans to individual businesses and micro enterprises. This trend endorses the conclusions drawn in section (1) Bank loans for the agricultural sector, e) Estimation of bank lending to the agricultural sector by size.



Source: Prepared by JICA Survey Team based on NBU report

Figure A2.5.21 Loan amount by Bank and Number of Beneficiaries of Affordable Loans 5-7-9%

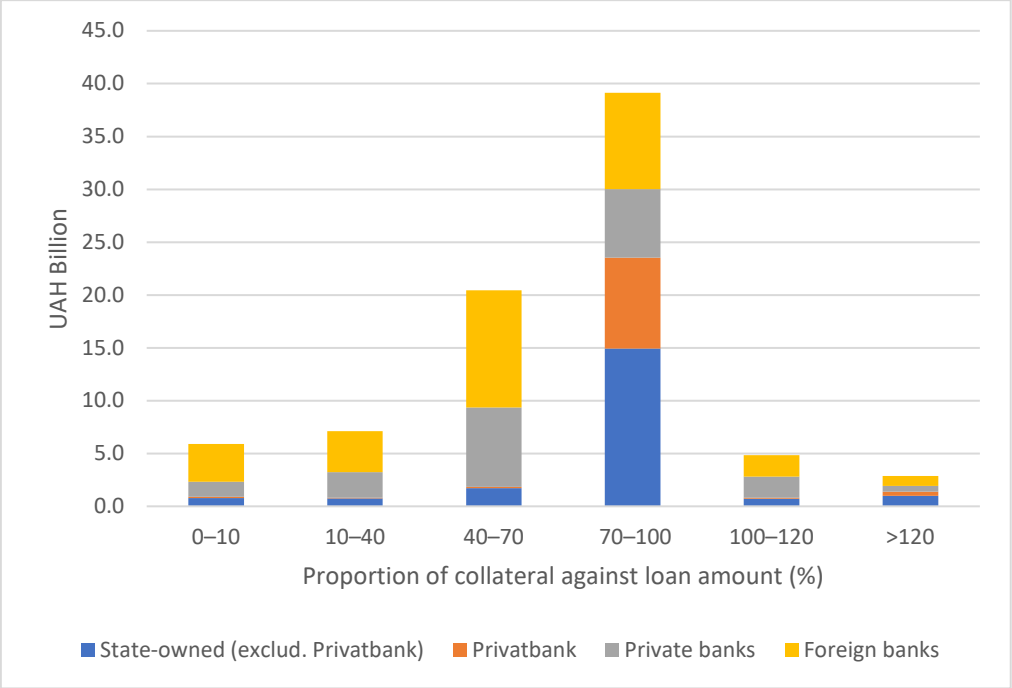
Figure A2.5.22 shows the sector classification of the beneficiaries of Affordable Loans 5-7-9% and the loan period. It is characteristic that the agriculture sector accounts for an overwhelming share of short-term loans of less than one year, but even among loans of more than one year, the agricultural sector accounts for 60% in a loan period of 1-2 years, 50% in 2-3 years and 45% of the loan of 3-5 years.



Source: Prepared by JICA Survey Team based on NBU report

Figure A2.5.22 Loan amount of Affordable loans 5-7-9% by Sector and by Lending Term

Figure A2.5.23 shows the distribution of collateral amounts for Affordable Loans 5-7-9%. 70% to 100% followed by 40% to 70% accounted for the majority, indicating that the amount of collateral is a condition for lending.



Source: Prepared by JICA Survey Team based on N BU report

Figure A2.5.23 Amount of collateral of Affordable Loans 5-7-9% by Bank

Whether or not to extend Affordable Loans of 5-7-9% is up to the discretion of each bank. According to the annual report of NBU, about 60% of the applications were successful in obtaining a loan. Poor business plans, inadequate debt service capacity, poor business reputation and lack of proper financial reporting are cited as reasons for loan applications not being accepted. In addition, about half of the companies that use Affordable Loans 5-7-9% from NBU have never received a bank loan in the past. It also points out that 40% of the total are part of the group companies[43]. The NBU also reported that the non - performing loan rate, which was below 1% in 2020-2021, rose to 8% in early November 2022 after the war began.

Affordable Loans 5-7-9% have rapidly expanded during wartime. The fiscal burden is increasing, due to increase of zero-interest loan of the market interest rate and of the total amount of lending. The original capital of 3 million UAH in 2021 turned out to be more than 9 million UAH in 2022. NBU points out that delays in budget execution, resulting into delays in supply of resource for interest compensation to banks may hinder loan expansion.

(2) Partial risk guarantee[44]

Partial risk guarantees for agricultural loans were introduced in 1999. The mechanism was to subsidize interest on bank loans. For this reason, farmers who could receive partial risk guarantees were limited to those who could borrow money from banks. In addition, the national budget which was the source of subsidy had been always insufficient, thereby created in a situation where a strong backroom influence was necessary to benefit.

[43]National Bank of Ukraine, Financial Stability Report, December 2022, Box 1
[44] This part is mainly based on "Strengthening the Partial Credit Guarantee (PCG) Fund for smallholder farmers in Ukraine (P180242) November 23, 2022" .

The Law on Partial Risk Guarantees was passed in December 2021 at the same time as the budget allocation by the State Budget for 2022, having allocated 200 million UAH. Of this, however, 1.90 million UAH was diverted for other purposes due to the Russian military aggression. On the other hand, preparations for its introduction were progressing, and the Cabinet issued a decree to establish a partial risk guarantee fund in February 2022, and the NBU established a monitoring system in August 2022. The Ministry of Agricultural Policy and Food and NBU were working together on the details of the requirements for issuing an operating license in 2022. As of December 2021, 12 financial institutions have been approved to handle partial risk guarantees by the Cabinet[45] with Ukreximbank as the implementing agency. EC starts to support partial risk guarantees from 2023, as explained in the section on other donor support.

(3) Warehouse Receipt

Warehouse receipts had already been introduced in Ukraine in the Grain and Grain Market Law of 2002 but were not utilized due to the obstacles such as forged documents, high handling costs, and the difference between what securities describes and actual commodities. In 2011, EBRD together with USAID and the Dutch government[46] started policy dialogue with the aim of activating the use of warehouse receipts described in the 2002 law as part of support to agricultural sector.

Before 2014, only certified warehouses were allowed to issue warehouse receipts, but the law was amended in 2014to allow any warehouse to issue warehouse receipts.

In 2018, the Massachusetts Institute of Technology Sloan School of Management conducted a survey on the usage of warehouse receipts in Ukraine[47]. In this survey, based on field observations of grain silos and interviews with related organizations, problems with warehouse receipts in Ukraine are pointed out in terms of both physical management and administrative aspects. Vulnerabilities pointed out in terms of physical management include theft of stored crops, falsification of delivery books, and the presence of emergency outlets in silos. In addition, from the perspective of document integrity, concerns have been raised about the weakness of security checks, the ease of counterfeiting, and the doubt on reliability of the state registry of warehouse receipts. In addition to these, under the current system, the purchaser must be present at the warehouse for transactions based on warehouse receipts, so the purchaser must visit several warehouses. Because of poor state of roads to warehouses, it has also been pointed out that the opportunity cost is extremely high and dangerous for both parties. In addition to the ease of forging warehouse receipts, it has also been pointed out that there is a high risk that warehouse owners will disobey the contract and sell the stored grain to others. The domestic litigation process is extremely slow, and even if a judgment is delivered, there is a risk that it will not be enforced. For this reason, the grain traders surveyed said they only do business with carefully selected warehouse operators. These facts highlight the current situation where the use of warehouse receipts is not an effective business tool.

[45] World Bank Project Appraisal Document on Supplemental Financing for "Financing of Recovery from Economic Emergency (Supplemental Loan for Second Economic Recovery Development Policy Loan)" March 4, 2022 paragraph 3 2

[46] https://www.ebrd.com/news/2011/advancing-ukraines-grain-sector-through-policy-dialogue.html

[47] "Stakeholder Analysis of Agricultural Finance in Ukraine: Prospect for blockchain -based warehouse receipts" by Mark Weber, Mykola Yerin, May 24, 2018

In 2021, the State Securities and Stocks Commission, which had actively supervised warehouse receipts, submitted a new bill to Parliament which enables registering agricultural securities as electronic securities in the registry as a way to meet the funding needs of the agricultural sector[48]. The bill, which covers both warehouse receipts and crop receipts, will replace the current notarization of documents by notaries and encourage the use of digital technology in data processing. The purpose was to integrate the registry of agriculture related securities with the other registry of the country, thereby ensuring the uniformity of the national registry and enabling automatically to confirm user information from the registry, and to confirm the user by electronic signature. However, in February 2022, the anti-corruption committee of the Ukrainian parliament judged that the bill did not meet the requirements under an anti-corruption bill, and it is unlikely that it will be introduced again in the future.

(4) Crop Receipt

The law on crop receipts was enacted in 2012. From 2013 to 2020, IFC was implementing a technical assistance project with the Swiss government to disseminate crop receipts, with the aim of expanding the scope from grain to horticultural crops, barley, buckwheat, raspberries, blueberries, etc. In 2015, the first crop receipts were issued in the Poltava region. In 2018, the Crop Receipt Register was put into operation[49]. In Ukraine, two types of receipts are stipulated by law: Commodity Crop Receipt and Financial Crop Receipt. The former, as the name suggests, is a credit provision secured by the amount of future harvests, while the latter is secured by the amount of money converted from the harvested amount according to a pre-agreed formula. The number of receipts issued as of December 2019 is shown in Table A2.5.15[50].

Table A2.5.15 Current status of Crop Receipt in Ukraine (as of September 12, 2019)

Item	Status
Number of crop receipts issued	2,081
Value of Crop receipt	USD 574 million
Number of creditor companies	126
Crop type	35
Number of participating notaries	262
Number of enforcement cases	16

Source: Prepared by JICA Survey Team based on IFC/SECO materials

Table A2.5.16 lists business models using crop receipts. The majority of use is by agricultural input traders.

[48] https://www.nssmc.gov.ua/en/komisiia-pidtrymuie-zakonoproekt-2805-d-shchodo-funktsionuvannia-ta-obihu-ahrarnykh-rozpysok/
[49] IFC /State Secretariat for Economic Affairs, Swiss Confederation" What is Crop Receipt?"
[50] IFC/SECO "Crop Receipt: Fast and Cost-effective financing instrument ", PowerPoint presentation

Table A2.5.16 Ukrainian Crop Receipt Business Model

Credit institution	Crop receipt type	Ratio
Agricultural Input Company (Addition to Input Contract)	Product/Finance	58%
Bank (with loan agreement)	Finance	28%
Grain trading company (Addition to forward contract)	Product	12%
Cooperatives/credit unions	Product/Finance	1%
Non-resident	Product/Finance	1%

Source: Prepared by JICA Survey Team based on IFC/SECO materials

According to interviews with local accounting firms, the use of crop receipts has expanded since 2017 and is being handled by at least four banks, including Raiffeisen Bank [51]. On the other hand, when the question was asked to Japanese companies that deal with agricultural inputs about their use, they said that out of the 5,000 farms they do business with, only a portion of them use crop receipts[52]. The reason for this is that the procedure is complicated and takes too much time and effort, such as the need for notarization and the need to monitor the growth process of the agricultural products cultivated as collateral. The businessperson interviewed also pointed out that despite his limited experience in doing business in Ukraine, he felt that, as a general trend, the level of non-compliance in payments in accordance with contracts was higher than in Western European countries.

A Ukrainian law firm points out the following risks related to crop receipts[53]:

- The borrower has a high incentive to get more money from their product promised in the crop receipt and does not comply with the contract.
- The Ukrainian law enforcement process does not clearly define procedures for enforcing collateral, making it difficult to monetize collateral.
- It is not possible to segregate the grain specified in the crop receipt from the grain stored in the grain storage.
- The grain silo operator will only deliver the stored grain to those who present the original storage document. The storage document of the grain is owned only by the borrower, and the borrower does not hand over the storage document to the lender of the funds. Also, the law stipulates that only the borrower can secure collateral.
- The quality of the grain on the crop receipt is dictated by consensus, but it is easy for a single borrower to interfere with the consensus at the time of release from storage, delaying the process.
- Inadequate legal provisions allow the borrower to prevent enforcement by the lender and during that period, the borrower sells the collateral at a more favourable price.
- Farmland that is finely divided like a chessboard is exchanged for cultivation and precise record of such exchange is not recorded. If a crop receipt is issued based on the register without a location map, this enables the borrower to delay delivery of the harvest.
- Lenders issue crop receipts without due scrutiny of legal requirements.

[51]March 1, 2023 Deloitte Ukraine Messrs. Hearing from Serputko Iaroslav and Grygorenko Yegor
[52]February 24 , 2023 Meeting with Mr. Hiroki Miyazaki of Sumitomo Corporation Europe (Spectr-Agro) and Mr. Toru Ota, General Manager of Kyiv Branch of Sumitomo Corporation
[53] DLF Attorneys-at-Law "Usage, benefits and risks of agricultural receipt in Ukraine", May 3, 2022

In the IFC/Swiss government project, the compulsory execution process by the lender is guaranteed by a notary to avoid lawsuits, but the law firm explains that the lack of legislation can delay execution.

(5) Agricultural Insurance

The law on agricultural insurance was enacted in 1996[54] and revised in 2012[55] and 2021[56]. In 2001, compulsory agricultural insurance coverage was introduced for grain and sugar beet production. The Law "About the Main Principles of State Agrarian Policy for the period up to 2015"[57], enacted in 2005, provide for the provision of state subsidies for agricultural insurance. Based on this, from 2005 to 2008, government subsidies were paid for insurance claims, but the procedures for obtaining such subsidies were opaque and complicated. This was exacerbated by economic crisis in 2009, which saw a significant reduction in insurance coverage in the same year, partly due to the termination of state subsidies for agricultural insurance [58]. In 2012, the government enacted a law titled "About the peculiarities of insurance of agricultural products with state support", in which insurance premiums were covered by state expenses[59]. In 2012, 70 million UAH was budgeted, but no budget measures were taken from 2013 to 2015. As a result, confidence in agricultural insurance has been lost.

The types of agricultural insurance offered are as follows[60]:

Table A2.5.17 Types of Agricultural Insurance in Ukraine

Type of insurance	Content
Multi-year insurance	Insurance against fruits of perennial plantation
Crop insurance for the overwintering period	Compensation for crop failure due to bad winter weather during winter
Future harvest insurance for Spring-Summer period	Compensation for crop failures in spring and summer
Future harvest insurance for the entire growing period	Compensation for crop failures throughout the year
Livestock and poultry insurance	Compensation for livestock and poultry deaths and forced slaughter due to infectious diseases
Agricultural machinery insurance	Compensation for damage, loss, traffic accident, theft, fire, natural disaster damage to agricultural machinery and cargo
Yield index insurance	Compensation for future harvest based on past harvest
Weather index insurance	Compensation for certain weather conditions from 10 to 20 days

Source: Prepared by JICA Survey Team based on the article "Current Trends in the Agriculture Insurance Market Operation in Ukraine" and information from local consultant

According to "Current Trends in the Agricultural Insurance Market Operation in Ukraine"[61], 12 insurance companies undertook agricultural insurance in 2019, and a total of 973,803 ha of arable land were insured across Ukraine. The total number of contracts was 1,207 and the total insurance premium

[54] "Law on Specifics of Agricultural Products Insurance with Support from the State"
[55] "Law on the Peculiarities of Agricultural Crop Insurance"
[56] "Law of Ukraine on the Features of Insurance of Agricultural Products with state support" February 9, 2012, No. 4391-VI
[57] Law on "About the main principles of state agrarian policy for the period up to 2015", Article 4, subparagraph 2
[58] "Institutionalization Agriculture Insurance in Ukraine: Impact Factors and Vectors of Development" by Natalia Shibaeva, Tatyana Baban, Agricultural and Resource Economics, Vol.6, No.2, 2020
[59] The reimbursement ratio of subsidy vis-à-vis insurance premium was raised to 60% by Law on "the Introduction of changes to some laws of Ukraine regarding the improvement of the legal regulation of insurance of agricultural products with state support, No.1601-IX, 01 July 2021.
[60] "Insurance Protection of Agricultural Producers of Ukraine: Overview of Insurance Companies and Products" by Robtsova N.M., Radchenko NG, Trusova NV, Business Information, No. 4, 2021
[61] "Current Trends in Agricultural Insurance Market Operation in Ukraine" by Olena Prokopchuk, Yulia Nesterchuk, Yuriy Tsymbalyuk, Oleksandr Rolinskyi, Problems and perspectives in Management, Volume 17, Issue 3, 2019

amounted to 208.8 million UAH. In addition, the ratio of insurance premium to insured value was 3.1% on average, and 17 types of crops[62] were covered by the insurance. The total insured area of 970,000 ha represents 2.3% of Ukraine's total agricultural land area of 41 million ha, the total premiums of 8.5 billion UAH is 0.08% of total non-life insurance premium of 8.5 billion UAH at the end of the fourth quarter 2019.

The above-mentioned paper and "Institutionalization Agricultural Insurance in Ukraine: Factors of influence and vector of development" pointed out the following challenges for the Ukrainian agricultural insurance market[63]:

- Agricultural producers have little awareness of mitigating agricultural production risks with insurance. It is not recognized as risk management in agricultural production activities and is only recognized as a non-productive cost that increases production costs.
- Agro-holdings, which produces grains, owns farmland in various parts of the country with different climate conditions, and such diversification of farmland functions as a risk avoidance measure.
- Agricultural production that specializes in specific crops is not carried out, which itself is a risk avoidance measure.
- The insured cultivated area has not exceeded 3% since 2009 (2.6% on average) and has been declining in recent years.
- Between 2005 and 2017, the insurance payment rate for general insurance ranged from 16.2% (2013) to 32.9% (2009), while the payment rate for agricultural insurance was 7.6% (2014) ~ 50.9%, with an average of 23%, and the payment rate fluctuates year by year. As such, the general insurance market and agricultural insurance market are still developing.
- The Agrarian Fund of Ukraine and the State Food and Grain Corporation of Ukraine have a high share of insurance associated with planned state purchases (61.7% of all agricultural insurance premiums in 2017, while in terms of cultivated land, it covers 25.35% and the number of contracts covered by this insurance is 23.3%).
- Coverage is limited to grain produced by large farms.
- Current insurance coverage generally includes individual risks and multi-risks, and most of them cover the winter season.
- The index insurance covers only the limited regions, and its coverage is limited to wheat and corn. It is operated only on a pilot basis, so it has not been sufficiently penetrated.
- In addition to the limited number of insurance brokers (1 broker for 20 insurers), there are only 13 insurers (in 2017) that offer agricultural insurance, 8 of which are affiliated with the Agricultural Fund.
- Despite the fact that insurance needs differ among agricultural producers, insurance companies are not able to meet those needs.

[62]Winter wheat, winter rapeseed, corn, sunflowers, winter barley, winter rye, ravine wheat, winter garlic, gardens, pea, sugar beet, spring barley, vegetables, winter pea, vineyards, oats, roses

[63]"Institutionalization Agriculture Insurance in Ukraine: Factors of Influence and Vectors of Development" by Natalia Shibaeva, Tatyana Baban, Agricultural and Resource Economics, Vol.6, No.2, 2020

In 2005, IFC provided technical assistance to an agricultural insurance development project. The achievement of this project was the establishment of an insurance pool for systemic risks. However, the operation required the pool to pay for all risks, even though the premium income that had to be credited to the pool was not paid. In addition, the government did not provide sufficient compensation for losses and responded by changing the scope of insurance coverage for assumed losses, so the usefulness of agricultural insurance was not recognized. Insurance pools were abolished in July 2021 by "Law on introduction of changes to some laws of Ukraine regarding the improvement of the legal regulation of insurance of agricultural products with state support" [64]. This failure was one of the reasons why the government transferred the regulatory and oversight powers of the insurance industry from the National Financial Regulatory Commission to the NBU in order to address the problems of the insurance market in general. However, the NBU 's immediate task is to improve the services and operations of the insurance companies, and improvement measures regarding agricultural insurance are expected to come after the former is achieved.

2.5.4 Other Donors' Support for Access to Finance

Please refer to "2.8.2 Trends of other donors/institutions" for an overview of the trends of other donors' support in the agricultural sector in general. The other donors supporting the access to finance include the European Union, the USAID, the World Bank, IFC, EBRD and the German government. The details are described in detail in Appendix B2.5.1, so please refer to it.

2.5.5 Challenges and Direction of Support for Farmers' Access to Finance

Table B2.5.4 summarizes the issues related to access to finance highlighted by the Survey results above, including assistances from other donors that has already been implemented, as well as remaining issues, and targets for future assistance.

As stated in section 2.5.2 Financing for the Agricultural Sector (1) Classification of Farmers Based on Economic Code, farmers other than holding companies are either individuals or SMEs. This suggests the support for access to finance in agricultural sector is categorized under the support for SMEs, which was the subject of the previous survey. However, assistance for access to finance in the agricultural sector is intricately intertwined with the issues faced by both financial institutions and the agricultural sector, which cannot be solved only by providing two-step loans for SMEs through banks and BDF. Therefore, Table B2.5.4 summarizes the issues from these three perspectives that were clarified in the survey.

It can be concluded from Table B2.5.4 first that other donors have already provided support for most of the issues identified through the Survey. For example, in the case of support for SMEs, as the previous survey has clarified, two-step loans are provided through BDF by multilateral financial institutions and Germany, and EU4Business, a technical cooperation by EC, supports corporate management. In addition, international financial institutions and EC have been supporting the development of systems in the areas such as warehouse receipts, crop receipts, agricultural insurance, and partial risk guarantee.

[64]Law on "the Introduction of changes to some laws of Ukraine regarding the improvement of the legal regulation of insurance of agricultural products with state support, No.1601-IX, 01 July 2021

In terms of support for smallholder farmers' access to finance, USAID CAP provides not only loans to smallholder farmers but also comprehensive support to strengthen the position of credit unions in the financial sector. Furthermore, as the foundation of these, in terms of support for institutional building, the Association Agreement with the EU and Deep and Comprehensive Free Trade Area provide the basis for the institutional framework of Ukraine. Therefore, when considering support measures for Ukraine, it is necessary to take these existing frameworks into account, and depending on the situation, it may be useful to utilize them.

Next, in the current Ukrainian financial sector, which is dominated by banks, the biggest challenge is to expand lending to SMEs in the agricultural sector which have a big potential. However, when considering support in the financial sector, it is necessary to take into account the need to improve the financial sector itself, such as developing financial institutions in the non-bank sector and tightening regulations. Supports are going on for such issues like reducing high non-performing loan ratio of state-owned commercial banks, ensuring the independence of its management, and expanding overwhelmingly small weight in the financial sector of non-bank which have weak management bodies and have not yet developed a competitive environment on an equal footing with banks. Those are being worked on by the NBU with the support of the IMF. At the same time, it is necessary to take measures in parallel with the reduction in interest rate levels caused by the macroeconomic situation.

From the perspective of SME assistance, the biggest beneficiary of BDF assistance is the agricultural sector. Considering that the support for the SME loan business proposed in the previous survey was via commercial banks, including state-owned banks, the support measures proposed in the previous survey will also implicitly target the agricultural sector. However, assistance through BDF does not include credit unions that extend credit to smallholder farmers and individual farmers. In addition, among the loans provided by BDF, 20% of loans requiring collateral of 40% to 70% of loan amount and 40% of loans requiring collateral of 70% to 100%, thus collateral is a prerequisite for borrowing. According to the annual report of the BDF, the bank has acquired know-how in SME financing through the BDF's loans to SMEs, and has begun providing its own loans to SMEs, separately from the BDF's support. As such, it is expected that loans will expand on a commercial basis in the future. On the other hand, the NBU reported that 40% of loan applications to BDF did not result in loans due to the lack of ability of borrowers to receive loans, such as inadequate business plans and lack of appropriate financial reporting. Therefore, there seems to be a large gap in the financial and other capabilities of companies between those can be targeted for BDF and those that credit unions provide loans. Agricultural enterprises that do not normally borrow from financial institutions, individual farmers, and small enterprises targeted by credit unions that provide unsecured or family-guaranteed loans need to overcome the challenges pointed out by the NBU. Without it, it would be impossible to receive loans through BDF. When considering assistance to compensate for the lack of capacity on the borrower side, it is necessary to examine in more detail the extent to which EU4Business, which is provided by EC, is working to improve access to finance for small-scale farmers.

Loans through credit unions are an option that small and micro enterprises can benefit from, but since savings from union members alone are insufficient for source of lending, lending afforded by credit unions has limitation. While some credit unions rely on borrowing, others seek financial support from

aid agencies. Therefore, in order to further expand the amount of loans to small-scale farmers, extending loans through credit unions that specialize in lending to small-scale farmers can be an option. As mentioned above, USAID's CAP is providing support for loans through credit unions until 2024. The project does not cover all Ukrainian credit unions as beneficiaries. Its newsletter explains a big difference in performance between those credit unions with CAP support and those unions without CAP support under war situation[65]. It is unclear whether USAID will continue to implement this project after 2025, but if access to finance to support for smallholder farmers is to be examined, it is beneficial to utilize the framework that has been developed by CAP. Since this project is being implemented by the World Credit Union Council utilizing its network, it is considered beneficial to consult with the Council when formulating a project. In addition to credit unions, CAP also provides management guidance to credit union members who are borrowers. Support for management and financial capabilities and for loan application procedures for small and medium-sized agricultural enterprises and individual farmers, which are borrowers, can be provided independently or in conjunction with a two-step loan, with a possibility of cooperation with EU4Bsuiness.

When considering support for access to finance for smallholder farmers, the fact that smallholder farmers do not have the ability to provide collateral is a bottleneck in benefiting credit. Therefore, it is conceivable to provide support to solve this problem. In this regard, the partial lifting of the ban on individual land transactions of up to 100 ha in July 2021under the revised Land Law creates an environment in which collateral for small-scale farmers can be secured. WB is currently working to improve the functions of the land market to ensure its transparency. Although the content of the program has been changed to emergency assistance due to the war of aggression, it is expected that assistance will continue even after the end of the current project. Instruments that complement land collateral include warehouse receipts, crop receipts, value chain financing, and leasing. However, as mentioned in the section “2.6.3 Policy-based financing and other financial instruments," all of these instruments have their own problems in terms of their systems and actual implementation, and it cannot be said that they are being fully utilized, therefore there is room for support.

Leveraging warehouse receipts and crops receipts is in line with the enhancement of promissory notes and factoring, which have been launched as measures to expand access to finance under the policy for SMEs development. Although the use of warehouse receipts is currently limited to a small number of large-scale agro-holdings, they are also considered to be a useful means of access to finance for small and medium-sized agricultural enterprises that produce most of the grain for export. Together with the reconstruction of grain warehouses damaged by the war, it is possible to consider a method of utilizing them while improving their operational aspects on a pilot basis. On the other hand, since the IFC project is currently underway, it is possible to incorporate the use of crop receipts within a scope provided by the proposed project in collaboration with the IFC when considering two-step loans to smallholder farmers through credit unions.

As for value chain financing, some credit unions have already provided financing for processing equipment to produce agricultural product. However, a value chain financing which credit union links

[65]The October - December 2022 Quarterly Update of CAP February 2022, explained that deposits in financial markets and loan portfolios in general had fallen by 50% , while deposits in CAP- backed credit unions have fallen only by 5%.

the producers and food processors has not yet been materialized in its lending to smallholder farmers. In one hand coordinating with EC's support for EU4Business, which supports SMEs, on other hand, watching at the same time the movement of the Ukrainian parliament to revise the law on credit union to enable corporate lending, it would be appropriate to consider including the building of such capacity in the scope of technical assistance when providing two steps loan for credit unions.

Since the movable and immovable registry register only part of movable and immovable assets, leasing is limited only in tractor in agricultural sector. In order to expand the scope of loanable properties, technical assistance in developing movable and immovable registry is considered beneficial for expanding leasing to the agricultural sector.

SME support strategies for 2017-2020, which have been evaluated by the OECD as not having sufficient results, includes the policy items related to improving access to finance such as strengthening export loans, export insurance and export guarantees[66]. Regarding export promotion, Export Credit Agency was established in 2018 as a stock company funded by the Ukrainian government to promote exports and Entrepreneurship and Export Promotion Office has been created in the Ministry of Economy. Although the survey did not conduct a survey of the works and performance of these organizations, it is also conceivable to provide support such as building a mechanism to promote exports of local agricultural SMEs by collaborating with local governments which also provide support measures to agricultural small and medium-sized enterprises development in its jurisdiction.

2.5.6 Analysis: Financial Access

i. As detailed in Section 2.5.6, the current situation is that most financial access issues identified through this survey are already being addressed by other donors. This coincides with the circumstances described in Section 2.8.2 regarding the support trends of other donors/institutions. However, as will be discussed next, this does not imply that the support provided is sufficient or that no further assistance is necessary.

ii. First, let's address the capability challenges faced by the recipients of loans. As detailed in Section 2.5.2 (7) for financial services aimed at the agricultural sector, the Business Development Fund (BDF) primarily benefits the agricultural sector, playing a significant role in supporting small to medium agricultural enterprises. However, according to the NBU report, 40% of loan applications to the BDF do not result in funding due to the borrowers' lack of capability (such as insufficient business plans or inadequate financial reporting). Agricultural enterprises and individual farmers who usually manage without borrowing from financial institutions, and small businesses targeted by credit unions that provide loans without collateral or family guarantees, are unlikely to obtain loans through the BDF unless the challenges identified by the NBU are overcome. Therefore, it is essential to enhance the capabilities of the borrowers. When considering support to address these capability deficiencies, a detailed assessment and planning by the European Commission's

[66]"Monitoring the Implementation of Ukraine's SME Development Strategy 2017-2020", OECD Global Relations Euroasia Competitive Program, 2020

EU4Business, which has been addressing financial access improvements for small farm businesses, is recommended.

iii. As detailed in Section 2.5.2 (4), credit unions play a crucial role in lending to small and micro agricultural enterprises, which lack collateral. However, credit unions face a significant discrepancy between the amount of loan capital they can generate from member savings alone and the amount they can lend. Thus, to further expand lending to small-scale farmers, increasing loans through credit unions that specialize in lending to small-scale farmers could be considered. As previously mentioned, USAID's CAP has been supporting this type of lending through 2024, but it is unclear whether the project will continue beyond 2025. If CAP is to consider continuing financial access support for small-scale farmers, it would be beneficial to follow and utilize the framework established by the support provided so far. The project, implemented by the World Council of Credit Unions, should consult with the council when structuring cases, as leveraging its network has been beneficial. Furthermore, CAP not only supports credit unions but also provides business and financial guidance to the borrowers, which are small agricultural enterprises and individual farmers. Coordination with EU4Business, along with standalone or two-step loans, could be considered for these interventions.

iv. In considering support for financial access for small-scale farmers, the lack of collateral capacity remains a bottleneck in credit provision. However, with the partial trial implementation of the Land Law Reform in July 2021, which allows for land transactions up to 100 hectares per individual, the environment for securing collateral for small-scale farmers has improved. Additionally, warehouse receipts, crop receipts, value chain financing, and leasing can serve as complementary means to land collateral.

v. The use of warehouse receipts/crop receipts aligns with the expansion of financial access measures within small enterprise support strategies, such as the enhancement of promissory notes and bill discounting. While currently limited to some large agro-holdings, warehouse receipts could be a beneficial financial access tool for agricultural small and medium enterprises that produce the majority of export grains. It could be feasible to explore ways to utilize and improve operational aspects on a pilot basis, alongside the reconstruction of grain warehouses affected by war. Meanwhile, considering crop receipts as part of the scope offered by the ongoing IFC project could be assessed when considering two-step loans to small farmers through credit unions.

vi. Value chain financing has been implemented by some credit unions for agricultural production-related equipment. However, credit unions have not yet achieved a value chain setup that connects producers and food processors in their lending to small-scale farmers. While coordinating with the support from the European Commission’s EU4Business, it is also prudent to observe the movements in the Ukrainian parliament towards amending the Credit Union Law to enable corporate lending. Including technical support provided by projects in the scope of two-step loans to credit unions could be considered appropriate.

vii. Between 2017 and 2020, the OECD assessed that not enough results had been achieved in the small enterprise support strategy, including policies aimed at improving financial access such as export loans, export insurance, and export guarantees[67]. An Export Credit Agency was established by the Ukrainian cabinet in 2018 to promote exports. Furthermore, the Entrepreneurship and Export Promotion Office has been set up by the Ministry of Economy. While this survey has not conducted a detailed investigation of the operations and performance of these institutions, considering their activities and challenges in light of agricultural products being a primary export of Ukraine, it would be beneficial to coordinate with local governments on agricultural small and medium enterprise development strategies to construct mechanisms that enhance the export capabilities of regional agricultural small and medium enterprises.

2.6 Overview of Damages Caused by the Invasion

2.6.1 Basic Infrastructure Damage Situation

World Bank in March 2023 provides a comprehensive evaluation of the impact caused by the Russian invasion on basic infrastructure, with estimates presented as follows: total damage is quantified at USD 62.2 billion, losses at USD 151.8 billion, and reconstruction costs are projected at USD 169.6 billion. The accompanying tables highlight the most affected Oblasts, marking the top 5/10 in terms of financial impact in red, showcasing significant damages and losses particularly in the eastern and southern regions.

It's essential to clarify the terminologies used in this assessment:

- **"Damage"** is defined as the cost incurred from the direct physical destruction or impairment of assets and infrastructure, quantified based on the pre-war replacement value.
- **"Loss"** refers to the disruptions in economic flows as a result of the conflict, encompassing increased operational expenses and the forfeiture of revenues for both governmental and private entities.
- **"Needs"** for reconstruction are the estimated expenditures necessary to restore pre-war conditions. However, in line with the "Build Back Better" principle, this figure is not merely the aggregate of damages and losses but rather an investment towards a more resilient rebuild.

[67] "Monitoring the Implementation of Ukraine's SME Development Strategy 2017-2020", OECD Global Relations Euroasia Competitive Program, 2020

Table A2.6.1 Damages by Sector in Oblasts

Oblast	Agriculture	Irrigation	Commerce & Industry	Finance & Bank	Energy & Extractives	Transport	Tele-communication	Water & Sanitary	Municipal Services	Total
Cherkaska	0.8	-	-	0.0	0.0	28.1	-	0.0	7.6	36.5
Chernihivska	230.8	90.2	650.3	0.4	86.8	1,661.2	102.3	310.1	116.3	3,248.4
Chernivetska	0.0	-	-	0.0	0.0	2.0	0.9	0.0	4.2	7.1
Dnipropetrovska	1.0	0.2	0.0	0.0	72.8	151.7	6.4	0.0	37.8	269.9
Donetska	959.5	0.7	4,907.7	2.8	751.8	9,254.5	309.2	161.7	477.5	16,825.4
Ivano-Frankivska	-	-	-	0.0	0.0	5.0	1.0	0.0	0.6	6.6
Kharkivska	1,206.9	0.0	2,428.5	6.0	303.3	3,679.9	323.4	811.9	178.9	8,938.8
Khersonska	1,410.7	0.0	18.7	1.4	82.0	5,363.0	215.8	0.0	239.3	7,330.9
Khmelnytska	-	0.0	-	0.0	0.0	9.8	0.2	0.0	1.7	11.7
Kirovohradska	1.1	0.0	-	0.0	0.0	48.9	0.2	0.0	12.0	62.2
Kyiv (City)	0.0	0.0	35.0	0.0	24.4	0.0	0.0	0.0	18.1	77.5
Kyivska	457.0	57.3	579.1	0.6	131.9	0.0	155.9	192.4	147.1	1,721.3
Luhanska	2,499.8	0.0	884.2	2.5	170.0	5,358.7	138.6	505.7	628.5	10,188.0
Lvivska	-	0.0	9.5	0.0	12.0	19.2	0.5	0.0	7.8	49.0
Mykolaivska	385.9	4.9	542.1	1.1	112.9	1,277.6	69.1	46.9	156.3	2,596.8
Odeska	1.0	0.0	58.5	0.0	13.8	130.3	14.5	63.0	14.2	295.3
Poltavska	0.4	-	-	0.0	34.2	7.9	0.2	0.0	7.0	49.7
Rivnenska	-	0.0	-	0.0	0.0	2.4	0.5	0.0	1.3	4.2
Sumska	115.5	32.0	245.6	0.3	251.8	1,315.7	44.9	40.2	95.7	2,141.7
Ternopilska	-	0.0	-	0.0	0.0	-	0.2	0.0	-	0.2
Vinnytska	-	-	-	0.0	12.0	48.1	1.4	0.0	11.2	72.7
Volynska	-	0.0	-	0.0	0.0	1.9	0.2	0.0	1.0	3.1
Zakarpatska	-	-	-	0.0	16.4	2.7	0.7	0.0	0.8	20.6
Zaporizka	1,447.2	0.0	526.0	3.6	423.4	5,076.9	241.4	51.4	171.3	7,941.2
Zhytomyrska	0.0	0.0	58.0	0.0	5.9	249.6	0.6	0.0	42.2	356.3
Nationwide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	8,717.6	185.3	10,943.2	18.7	2,505.4	33,695.1	1,628.1	2,183.3	2,378.4	62,255.1

Source: JICA Survey Team based on Rapid Damage and Needs Assessment Feb 2022 – Feb 2023

Table A2.6.2 Losses by Sector in Oblasts

Oblast	Agriculture	Irrigation	Commerce & Industry	Finance & Bank	Energy & Extractives	Transport	Tele-communication	Water & Sanitary	Municipal Services	Total
Cherkaska	1,580.8	-	42.6	53.9	0.0	771.3	1.2	0.0	69.6	2,519.4
Chernihivska	1,889.3	36.0	7,738.2	29.5	1.6	897.8	71.6	47.8	47.7	10,759.5
Chernivetska	180.8	-	9.1	18.0	0.0	293.4	1.0	0.0	16.3	518.6
Dnipropetrovska	1,827.1	-	255.0	271.3	1.1	2,886.6	6.0	0.0	245.2	5,492.3
Donetska	1,446.6	-	29,972.0	229.3	13.1	1,819.4	263.8	8.0	584.8	34,337.0
Ivano-Frankivska	72.3	-	17.5	60.2	0.0	645.5	2.2	0.0	16.2	813.9
Kharkivska	2,984.8	0.0	21,243.5	1,120.9	5.1	2,101.5	297.8	124.4	448.7	28,326.7
Khersonska	2,136.7	0.0	213.2	241.3	1.4	703.9	50.2	0.0	234.1	3,580.8
Khmelnytska	1,044.4	0.0	24.0	56.9	0.0	616.2	0.8	0.0	18.5	1,760.8
Kirovohradska	1,552.6	-	10.2	36.8	0.0	528.2	0.9	0.0	17.0	2,145.7
Kyiv (City)	0.0	0.0	2,377.7	3,056.7	0.4	0.0	0.0	0.0	235.5	5,670.3
Kyivska	1,777.7	19.4	5,762.4	48.0	1.9	0.0	572.2	28.6	140.3	8,350.5
Luhanska	1,167.3	0.0	6,101.0	40.5	3.1	464.8	65.4	80.7	236.5	8,159.3
Lvivska	384.5	-	218.2	219.9	0.2	1,584.7	2.5	0.0	50.8	2,460.8
Mykolaivska	1,686.4	22.2	3,865.8	122.0	1.6	829.5	86.4	3.0	54.2	6,671.1
Odeska	1,334.8	-	370.8	272.2	0.2	1,488.7	2.8	10.1	89.0	3,568.6
Poltavska	1,985.1	-	76.3	70.3	0.6	1,379.1	1.8	0.0	32.5	3,545.7
Rivnenska	483.6	0.0	10.8	33.3	0.0	498.8	1.1	0.0	14.9	1,042.5
Sumska	1,509.1	12.8	3,470.1	50.1	3.4	728.5	30.7	4.3	43.0	5,852.0
Ternopilska	771.4	0.0	11.8	36.2	0.0	410.8	1.0	0.0	12.3	1,243.5
Vinnytska	2,034.2	-	33.6	58.7	0.2	968.3	1.9	0.0	24.7	3,121.6
Volynska	353.3	0.0	2.0	24.2	0.0	560.2	1.4	0.0	13.3	954.4
Zakarpatska	44.8	-	9.0	26.4	0.3	440.1	1.8	0.0	16.6	539.0
Zaporizka	2,445.2	0.0	3,721.1	549.1	5.3	1,468.4	85.5	7.9	284.8	8,567.3
Zhytomyrska	795.1	0.0	285.1	34.4	0.1	687.5	1.3	0.0	40.5	1,844.0
Nationwide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	31,487.9	90.4	85,841.0	6,760.1	39.6	22,773.2	1,551.3	314.8	2,987.0	151,845.3

Source: JICA Survey Team based on Rapid Damage and Needs Assessment Feb 2022 – Feb 2023

Table A2.6.3 Needs by Sector in Oblasts

Oblast	Agriculture	Irrigation	Commerce & Industry	Finance & Bank	Energy & Extractives	Transport	Tele-communication	Water & Sanitary	Municipal Services	Total
Cherkaska	802.7	82.8	-	53.9	0.0	81.8	21.6	0.0	19.7	1,062.5
Chernihivska	1,321.1	415.1	1,333.8	30.1	173.5	6,022.1	219.3	582.6	277.6	10,375.2
Chernivetska	91.7	92.0	-	18.0	0.0	30.8	5.5	0.0	10.4	248.4
Dnipropetrovska	929.4	476.5	0.0	271.3	137.5	725.7	70.8	0.0	93.3	2,704.5
Donetska	2,290.0	154.4	10,544.6	233.2	1,486.1	20,250.5	757.7	287.0	1,146.9	37,150.4
Ivano-Frankivska	36.6	92.0	-	60.2	0.0	22.6	81.3	0.0	3.5	296.2
Kharkivska	3,449.0	0.0	5,020.2	1,129.4	592.3	9,387.9	824.7	1,525.0	428.4	22,356.9
Khersonska	3,296.9	0.0	40.9	243.4	160.4	14,044.5	311.5	0.0	571.0	18,668.6
Khmelnytska	529.4	0.0	-	56.9	0.0	36.8	1.6	0.0	5.3	630.0
Kirovohradska	788.9	62.8	-	36.8	0.0	115.1	18.3	0.0	30.2	1,052.1
Kyiv (City)	0.0	0.0	71.7	3,056.7	48.6	0.0	0.0	0.0	45.6	3,222.6
Kyivska	1,616.3	787.6	1,228.3	48.9	246.0	0.0	1,214.5	360.5	348.6	5,850.7
Luhanska	4,448.4	0.0	1,835.2	44.0	342.5	13,073.0	253.5	953.1	1,504.3	22,454.0
Lvivska	194.9	182.9	20.7	219.9	25.0	68.9	25.9	0.0	21.4	759.6
Mykolaivska	1,477.1	638.0	1,171.0	123.6	208.0	4,407.7	188.8	84.0	370.6	8,668.8
Odeska	678.3	336.6	127.9	272.2	25.0	402.3	25.2	118.8	35.2	2,021.5
Poltavska	1,006.9	152.8	-	70.3	69.6	52.7	3.3	0.0	19.0	1,374.6
Rivnenska	245.1	0.0	-	33.3	0.0	19.8	22.6	0.0	3.8	324.6
Sumska	951.0	289.1	512.5	50.5	456.7	4,231.1	58.2	73.7	224.4	6,847.2
Ternopilska	391.0	0.0	-	36.2	0.0	15.1	2.1	0.1	1.2	445.7
Vinnytska	1,031.1	230.0	-	58.7	24.4	313.4	5.2	0.0	28.5	1,691.3
Volynska	179.1	0.0	-	24.2	0.0	27.3	2.7	0.0	3.2	236.5
Zakarpatska	22.7	150.0	-	26.4	33.4	22.6	50.6	0.0	4.1	309.8
Zaporizka	3,520.0	0.0	1,150.7	554.2	751.9	12,331.4	348.2	96.5	411.4	19,164.3
Zhytomyrska	403.0	0.0	125.5	34.4	12.0	1,050.3	2.7	0.0	99.6	1,727.5
Nationwide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	29,700.6	4,142.6	23,183.0	6,786.7	4,792.9	86,733.4	4,515.8	4,081.3	5,707.2	169,643.5

Source: JICA Survey Team based on Rapid Damage and Needs Assessment Feb 2022 – Feb 2023

For a more in-depth analysis of the damages sustained by each infrastructure sector, please consult the "Preparatory Study for Infrastructure Reconstruction and Recovery for Ukraine: Final Report." This comprehensive document was meticulously prepared by JICA in April 2023.

2.6.2 Landmine Damages and Soil Contamination

(1) Mine Contamination

As reported by the Ukraine National Mine Action Authority in November 2022, an estimated one-fourth of Ukraine's territory, roughly 160,000 km² out of the total national land area of 603,700 km², is potentially contaminated with mines and other explosive devices. The following figure illustrates the areas covered by the non-technical survey conducted by the authority, primarily spanning the southern, northern, and eastern regions of Ukraine. While the survey does not definitively confirm the presence of mines in these areas, it does identify regions of high suspicion, warranting further, more detailed investigations.

In the context of mine action, a "non-technical survey" refers to the preliminary assessment aimed at detecting the possible existence of mines or explosive remnants. This step precedes a comprehensive survey in areas presumed to be mine-affected. The main objectives of a non-technical survey include:

- **Information Collection:** Gather information from local residents, local authorities, the military, and other stakeholders to identify potential locations of mines or explosive materials.
- **Risk Assessment:** Evaluate the risk of specific areas based on the collected information. This aids in determining which areas are the most hazardous and which should be prioritized for clearance.
- **Area Identification:** Through the non-technical survey, areas suspected of having mines or explosive materials are identified. This narrows down the scope for the next phase, which is the technical survey (a detailed examination using mine detection equipment).
- **Collaboration with the Community:** Engaging with local residents is also a crucial aspect. Understanding their needs and concerns can facilitate more efficient mine-clearing operations when residents cooperate.

Source: The Ukraine National Mine Action Authority's HP (https://www.ua-nmac.org/en)

Figure A2.6.1 Non-Technical Survey Area for Mines after Feb.24, 2022

According to the "Landmine Monitor," aimed at the global eradication of landmines, areas cleared worldwide in 2019 and 2020 totaled 156 km² and 146 km², respectively[68]. Furthermore, the Cambodia Mine Action Centre (CMAC), with notable support from JICA, has maintained an average annual clearance of 94 km².

Therefore, assuming the actual mined area in Ukraine is about one-quarter of 160,000 km² (i.e., 40,000 km²) and that with rapid technological advancements and capacity building, a clearance efficiency double the current rate (312 km²/year = 156 km²/year x 2) could be achieved, it would still take over 120 years (i.e., 40,000 ÷ 312) to clear this 40,000 km² area, even with global demining efforts. This calculation underscores the profound impact landmines will have on Ukraine's reconstruction efforts in the years ahead.

(2) Soil Contamination by Explosives

A March 2023 Reuters article highlighted the Ukraine Institute for Soil Science and Agro-chemistry Research's findings, based on satellite imagery and sample surveys, that soil contamination from harmful substances like mercury and arsenic, present in bullets and fuel from the conflict zones, has become

[68] http://www.the-monitor.org/en-gb/reports/2021/landmine-monitor-2021.aspx

critically severe[69]. The report estimates that about one-fourth of Ukraine's total arable land, or 10.5 million hectares, is affected, emphasizing the need for national-level intervention.

Furthermore, in October 2022, the Taras Shevchenko Scientific Educational Centre at Kyiv National University identified areas of farmland potentially contaminated by soil pollutants in 12 regions heavily affected by combat, detailed in Table A2.6.4.

Table A2.6.4 Estimated Area of Farmland Contaminated by Heavy Metals due to Conflict

Oblasts	Possible Areas under Conflict Influence (1000ha)						High level of heavy metals	Average level of heavy metals
	Wheat	Corn	Barley	Rapeseed	Sunflower	Total		
Donetsk	381.1	55.8	117	5.3	360.3	919.5	Pb, Ni, Cr	-
Zaporizhia	709.3	36.2	195.0	73.1	532.5	1,546.1	Cr	Pb, Ni
Kyiv	207.5	345.9	70.6	33.3	200.9	858.2	Pb, Ni, Cu	-
Lugansk	279.5	55.8	41.1	-	400.2	776.6	Ni	Pb
Sumy	195.5	461.4	33.9	22.2	265.6	978.6	Pb	Ni
Kharkiv	587.5	286.5	136.3	3.7	573.3	1,587.3	Cr, Ni	Pb
Kherson	502.6	58.8	209.7	95.3	345.0	1,211.4	-	Pb
Chernihiv	187.7	568.9	21.3	3.5	240.4	1.052.8	Cu, Pb	Ni
Mykolaiv	479.0	121.9	308.6	62.2	495.1	1,366.8	-	Pb
Zhytomyr	169.5	279.4	31.8	41.0	147.1	668.8	Ni, Pb, Cu	-
Dnipropetrovsk	559.0	303.5	250.0	84.0	598.1	1,795.4	-	Cd. Ni. Pb. Cu
Odessa	675.4	137.6	371.9	118.7	404.8	1,708.4	-	-
Total	4.934.4	2711.7	1,787.2	573.3	4,563.3	14,569.9		

Source: Effect of heavy metals on soil and crop pollution in Ukraine – a review, Oksana Sytar et al. Department of Plant Biology, Institute of Biology and medicine, Taras Shevchenko National University of Kyiv, 2022

In its review, Kyiv National University highlighted the pressing issue of heavy metal contamination across various Ukrainian regions and its potential impact on key crops. Following Russia's 2022 invasion, analyses of heavy metal contamination in Donetsk, Zaporizhzhia, Kyiv, Luhansk, Sumy, Kharkiv, Kherson, Chernihiv, Mykolaiv, Zhytomyr, Dnipro, and Odesa—areas currently experiencing active military conflict—have been linked to potential reduced yields in major crops due to soil contamination by lead (Pb), nickel (Ni), chromium (Cr), and copper (Cu).

Moreover, the United Nations Food and Agriculture Organization (FAO) conducted a study titled "Impact of the war on agricultural enterprises" from January to February 2023, focusing on agricultural companies managing 250 ha or less. The study reports the following about the contamination status of small and medium-sized agricultural enterprises:

- A total of 12% of agricultural companies reported that at least a portion of their land was contaminated by unexploded ordnance, landmines, shells, and debris, accounting for about 9% of the total cultivated area, averaging 48 ha per farm.
- About 5.1% of farmers reported that they could not harvest a portion of the contaminated areas, equivalent to 2.4% of the total cultivated land (an average of 29 ha per affected company).

[69] https://www.nasdaq.com/articles/insight-soils-of-war%3A-the-toxic-legacy-for-ukraines-breadbasket

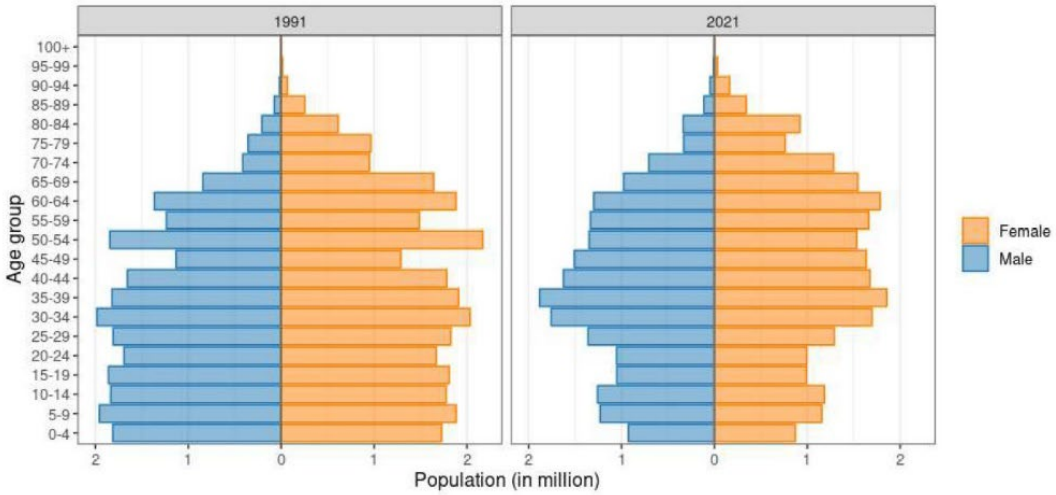
- Regarding the distribution of contaminated areas, 98% of the contaminated areas are reported in the frontline Oblasts, including 80% of the unharvested areas. About 14% of the unharvested areas are reported in the central Oblasts, with the remainder in the western Oblasts.
- In the frontline Oblasts such as Chernihivska, Dnipro, and Donetska, about 32% reported partial contamination due to unexploded ammunition, landmines, and debris, which corresponds to about 22% of the total cultivated land. About 11% of the affected agricultural companies reported that they could not harvest a part of the contaminated areas, which is equivalent to 4.5% of the cultivated land.
- Regarding the crops in contaminated and unharvested areas, 96.7% of the contaminated unharvested areas were grains and oil crops, while the remaining areas were cultivated with pasture and legumes.
- Farms affected by land contamination reported an increase in production costs of up to 62%, and farms that could not harvest a part of the contaminated areas reported a production cost increase of 51.4%.

Given these serious soil contaminations, there are concerns that they will be a hindrance to Ukraine's crop production and agricultural exports in the future, including damage to reputation. Thus, Kyiv National University has proposed the use of “phytoremediation”, a method of absorbing heavy metals from the soil into plants, in the aforementioned research paper.

2.6.3 Damages Relating Human Resources

(1) Situation before the Conflict

Ukraine's population reached its zenith at 51.7 million in 1994 but has since been declining at an average rate of 500,000 individuals annually. The United Nations estimates the population to have been 43.3 million as of January 2022. This nearly three-decade-long demographic downturn in Ukraine is largely due to a diminishing birthrate coupled with an increase in emigration. While the 1980s saw an annual birth figure of approximately 800,000, this number plummeted to 336,000 by 2021. The convergence of a declining birthrate, an elevated death rate, and extensive emigration has markedly altered Ukraine's population structure, as depicted in Figure A2.6.2.



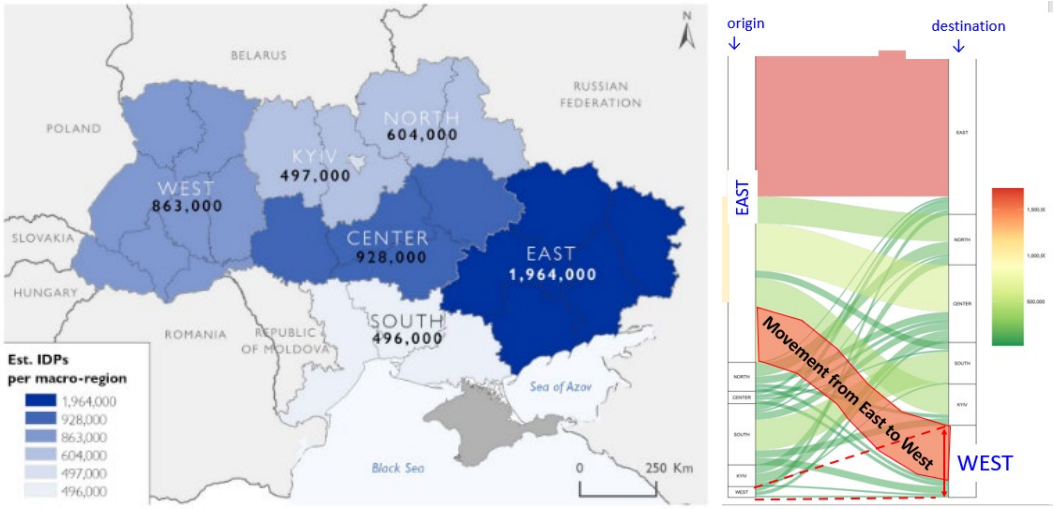
Source: United Nations Population Division (2022) World Population Prospects

Figure A2.6.2 The Population Pyramid of Ukraine (Year 1991 and Year 2021)

(2) Post-conflict Situation

Internal Displacement due to the Conflict:

The figure provided depicts the distribution and regional dispersal of Internally Displaced Persons (IDPs) due to the ongoing conflict. Predominantly, these IDPs have sought refuge in the central and western regions of the country. In particular, the central region has experienced a population surge of 17%, while the western region has seen an 8% increase, directly resulting from the IDP influx. As the conflict persists, addressing the welfare and livelihoods of these IDPs has become increasingly critical. Furthermore, the southeast will remain uninhabitable for return until comprehensive clearance efforts remove all unexploded ordnance and landmines. This situation underscores the importance of bolstering the central and western regions' capacity to accommodate IDPs, which entails providing ample employment opportunities.



Source: Internal Displacement Report by IOM (Round12, Jan 2023)

Figure A2.6.3 Distribution and Movement Patterns of IDPs

Effects of Population Decline since Pre-conflict:

The EC has made population forecasts considering past trends and the impact of the conflict. Based on a qualitative migration scenario for international refugees, the population for the years 2027 and 2052 is predicted as shown in Table A2.6.5.

Table A2.6.5 EC's Scenario of Forecasted Population in Ukraine

Scenarios (Qualitive)	Ukraine's Total Population (million)			Changes (million)
	2022	2027	2052	
Long War and Low Return Due to the prolongation of the war, the number of international displaced persons continues to increase, and due to delays in economic recovery, the number of refugees returning to Ukraine decreases. (9 million refugees emerge.)	43.3	35.4	29.9	-13.4
Permanent Emigration The war ends in the short term, and the majority of international displaced persons return within the next 10 years. However, economic recovery is delayed, the return rate is low, and a high percentage of emigration persists for a long time.	43.3	39.2	31.5	-11.8
Circular Migration The war ends in the short term, and the majority of international displaced persons return within 10 years. However, it remains a country of emigration, and due to policy changes in major EU countries, there is a high proportion of circular migration.	43.3	39.3	33.0	-10.3
Migration Transition The war ends, and economic growth, politics, and society stabilize. Following the path of Eastern European countries, supported by proactive immigration policies, there is also a significant hiring of foreign workers.	43.3	39.3	34.3	-9.0

Source: EC・Joint Research Centre (JRC)'s Population Forecast Report (Mar.07, 2023)

As shown in the above table, the rapidly progressing population decline is expected to become a serious obstacle to the economic activities of Ukraine in the near future. After the end of the conflict, including international refugees, it is an important responsibility for the government's recovery and reconstruction to create an environment where farmers can return to rural areas and confidently engage in crop production, and to build a safety net. While it is an issue that the government as a whole should tackle, the Ministry of Agrarian Policy and Food needs to cultivate new producers with the minimum required knowledge and skills in both management and technology related to agricultural production.

In light of Ukraine's demographic decline and the repercussions of the conflict, the anticipated role and significance of women in agricultural production activities are set to evolve and intensify. As indicated in Annex 2.6.1, in contexts where male laborers are absent due to the conflict, women have historically stepped into roles traditionally occupied by men. This pattern, observed across various countries, is expected to persist in Ukraine, both presently and in the future. Traditionally, Ukrainian agriculture has been male-dominated, leaving women with less farming knowledge and experience. Moreover, considering the physical demands and the need to juggle household responsibilities and childcare, the promotion of women's involvement in agriculture requires thoughtful planning and consideration of the added labor burden.

2.7 Trends in Japanese Companies

2.7.1 Trends in Japanese Enterprises

(1) General Trends of Japanese Enterprises Related to Ukraine

a) Japanese Enterprises Related to Ukraine

Currently, the Japanese Chamber of Commerce and Industry in Ukraine is comprised of 30 member companies and organizations, including prominent Japanese trading companies and key machinery manufacturers.

Table A2.7.1 Members of the Japan Chamber of Commerce and Industry in Ukraine

No.	Company Name	No.	Company Name
1	Panasonic Ukraine Ltd	16	Mitsui & Co., Ltd.
2	KAMUI LLC	17	Deloitte
3	Mitsubishi Corporation	18	Mitsui Sumitomo Insurance Co., Ltd.
4	MMC Ukraine LLC	19	JETRO
5	Sumitomo Corporation	20	Third Wave Corporation SDGs
6	Sumy Tech Ukraine	21	Japan International Cooperation Agency
7	Toyota Ukraine	22	SPECTR-AGRO LLC
8	Itochu Corporation	23	Mitsui O.S.K. Lines, Ltd.
9	Auto International	24	Deutsche Bank
10	Marubeni Corporation	25	ZAMine Service Ukraine LLC
11	Subaru Ukraine	26	Nippon Koei Co., Ltd.
12	Makita Ukraine	27	YKK Poland Sp. z o.o.
13	Sojitz Corporation	28	Tokio Marine & Nichido Fire Insurance Co., Ltd.
14	JT International (Japan Tobacco)	29	PADECO Co., Ltd. (Polish entity)
15	PricewaterhouseCoopers Ukraine	30	Yanmar (Turkish subsidiary)

Source: List of the Chamber

Furthermore, Japanese enterprises that have local subsidiaries in Ukraine are as shown in the following table, totalling 14 companies.

Table A2.7.2 List of Japanese Companies with Local Subsidiaries in Ukraine (as of March 2022)

No.	Company Name	Industry Type	Business Name	Business
1	Outsourcing	Service	LLC Otto Workforce	Consulting business, contract work
2	Sojitz	Wholesale	Subaru Ukraine LLC	Subaru car import sole agency in Ukraine
3	Takeda Pharmaceutical	Pharmaceutical	Takeda Ukraine LLC	Pharmaceutical sales
4	FUJIFILM HLD	Chenist1Y	FUJIFILM Ukraine LLC	Electronic imaging product sales
5	Konica Minolta	Electrical Equipment	Konica Minolta Ukraine	Copier, material sales, etc.
6	Sumitomo Electric Industry	Non-famous Metals	SE Bordnetze-Ukraine TOV	Manufacturing & sales of automotive wiring harnesses
7	Makita	Machinery	Makita Ukraine LLC	Electric tool sales, etc.
8	Panasonic	Electrical Equipment	Panasonic Ukraine Ltd.	Consumer electronics, system 10duct sales
9	Yokogawa Electric	Electrical Equipment	Yokogawa Electric Ukraine Ltd.	Industrial instruments, measuring instrument sales & engineering
10	Canon	Electrical Equipment	Canon Ukraine LLC	All business product sales
11	Itochu Corporation	Wholesale	Auto International	Import, wholesale, retail & service o Mazda & Suzuki vehicles
12	Sumitomo Corporation	Wholesale	Sumitec Ukraine	Komatsu construction machinery- & Toyota forklift agency in Ukraine
			LLC Summit Motors Ukraine	Retail sales & repair services of Toyota automotive products in Ukraine
			Toyota Ukraine	Import, wholesale, & retail of Toyota automotive products in Ukraine
			TOV Spektr-Agro	Sales of agricultural materials such as pesticides, seeds, fertilizes, dc.
13	Mitsubishi Cooperation	Wholesale	MMC Ukraine LLC	Import & sales of vehicles
14	Yazaki Corporation	-	Yazaki Ukraine LLC	Manufacturing of automotive wiring harnesses

Source: “Kaisya Shikiho Online”(https://shikiho.toyokeizai.net/news/0/514449)

b) Results of the Japanese Enterprise Trend Survey by JETRO

The Japan External Trade Organization (JETRO) conducted a survey in October 2022, eight months following Russia's military incursion into Ukraine, revealing growing business expansion expectations among Japanese companies operating there. Key insights from this survey are as follows:

- Regarding the business outlook for the next six months to a year, "expansion" was 44%, "unknown" was 31%, "maintaining the status quo" was 19%, "reduction" was 6%, and "withdrawal" was 0%. In a survey conducted immediately after Russia's military advance from February 28 to March 2, "unknown" was the highest at 62%, while "maintaining the status quo" was 23%, and "reduction" rose to 15%. Both "expansion" and "withdrawal" were 0%.
- The choice of "expansion" was primarily motivated by "expectations for post-war demand" and "anticipated sales growth as the market recovers smoothly." The reasons for

uncertainty and maintaining the current situation were "the unpredictability surrounding Russian forces' withdrawal and the war's conclusion." The rationale for "reduction" included an increased frequency of air raid warnings and the expectation of the prolonged conflict.

- The percentage of Ukrainian employees who were evacuated from the country and have already returned to Ukraine was "less than 25%" (38%) the most, followed by "unknown" (25%), "more than 75%" (19%), "more than 50%" (13%), and "100%" (6%).
- Concerning interest in Ukraine's post-war reconstruction and economic recovery, 94% expressed interest, while 6% did not. Areas of specific interest included infrastructure, urban development, architecture, housing, and other reconstruction-related fields, as well as vehicle sales and maintenance, decarbonization, heating equipment, IT, consumer goods, property and casualty insurance, shipping, logistics, and more.
- Measures needed for Ukraine's full-fledged efforts in the future (multiple answers allowed) included a review of the Ministry of Foreign Affairs' danger level (63%), normalization of transport infrastructure (50%), information for Japanese companies to participate in the Ukrainian government's reconstruction plan (44%), liberalization of overseas movement for male Ukrainian staff (25%), and smoother customs procedures (25%).

2.7.2 Trends in Western Companies

One way to forecast the future actions of Japanese firms involves examining the investment patterns of Western companies in Ukraine, which may provide insightful precedents. A JETRO survey from April 2023 on investment trends in Russia and Ukraine reveals that numerous European companies have either withdrawn or paused their operations in Russia, with some relocating to neighboring countries. Concurrently, several European entities are making wartime investments in Ukraine, anticipating the post-war reconstruction phase.

Notably, there were instances of significant investments, such as high-speed railway projects, hotel developments in Lviv to accommodate anticipated increases in human mobility, agriculture and food sector investments reflective of Ukraine's status as an agricultural hub, and initiatives to implement energy-saving and decarbonization technologies in response to the demand for heating solutions. These European companies are embracing the risks to support Ukraine and, with an eye on the post-war reconstruction period, are capitalizing on emerging business opportunities. Japan may witness similar investment trends in the future.

For further insight, JETRO's April survey detailing European investment cases in Ukraine is summarized in the table below.

Table A2.7.3 Investment Trends of Western Companies in Ukraine

Type	Country	Period	Amount	Descriptions
Construction	Poland	2022-2024	Undisclosed	The architectural design company Czirlobicz & Associates has designed a four-story hotel with a conference center near Mitzkevich Square, a major road leading to Lviv's Old Town. It is expected to be completed in 2024 (Source: Czirlobicz & Associates' website).
Construction	Ireland	June, 2022	200 million Euros	Kingspan, a building materials manufacturer, announced plans in June 2022 to build a new factory in Ukraine (location being considered in the west). The new factory plans to produce insulation materials and district heating products that contribute to improving the energy efficiency of buildings (energy-saving and decarbonization). Expected to be completed within five years, it is projected to create employment for over 600 people (Source: Kingspan's announcement dated June 7, 2022).
Agriculture	Germany	November 2022 - April 2023	60 million Euros	Pharmaceutical and chemical giant Bayer announced in November 2022 that they will make significant investments over the next ten years to support the reconstruction of the country's agricultural system. In collaboration with the United States Agency for International Development (USAID), they will address short-term and long-term needs for corn seeds from farmers in Ukraine and other countries dependent on Ukraine through the Agricultural Resilience Initiative Ukraine (AGRI-Ukraine) (Source: Bayer's announcement dated November 29, 2022). Initially, Bayer will invest 60 million Euros in its seed processing plant in Potchuyki starting 2023 to expand drying equipment capacity, procure additional agricultural machinery, and build new storage facilities, creating new jobs (Sources: Bayer's announcements dated November 29, 2022, and April 5, 2023).
Food	Switzerland	December 2022	40 million Swiss francs	Nestlé announced in December 2022 its plans to establish a new factory in Smolihu, Volyn State, in the western part of Ukraine, to enhance pasta production capacity in the country. The new factory, in conjunction with the existing plant in nearby Torchyn, will serve as a food production hub for Nestlé in Europe, supplying products to Ukraine and other European countries. The hub is expected to employ 1,500 people (Source: Nestlé's website).
Hotel	France	December 2022	Undisclosed	Major hotel chain Accor Group has opened an Ibis hotel on Shehevich Street in western Lviv (Sources: Accor Group's TikTok and various reports).
Railway	Poland	January 2023	Undisclosed	The new Central Communication Port (CCP) in Poland and Ukraine Railways signed a three-year cooperation agreement in Warsaw in January 2023. The primary goal of the agreement is to build a railway line (with a track width of European standard 1,435 millimeters) connecting Poland and Ukraine. They plan to jointly conduct a feasibility study for the construction of a high-speed railway line (expected to reach speeds of up to 250 km/h) connecting Warsaw, Lviv, and Kyiv (Source: CCP's announcement).

Type	Country	Period	Amount	Descriptions
Food & Daily Goods	UK	March 2023	20 million Euros.	Unilever announced plans to establish a new factory in Kyiv. Construction is set to commence in 2023, with the opening anticipated in 2024. The new facility will produce personal care products for brands like Dove, Axe, TRESemmé, and Clear, including shampoos and shower gels. The workforce is estimated to be around 100 employees. Although primarily intended for the Ukrainian market, there's potential for future exports to the European market (Source: Unilever's announcement dated March 16, 2023).

Source: arranged by JICA team based on the JETRO's material(https://www.jetro.go.jp/biz/areareports/2023/572f80f01d590592.html)

2.8 JICA's Related Studies and Trends of Other Organizations: Possibility of Collaboration with JICA Projects

2.8.1 JICA Related Studies and Projects

Below is a summary of key ongoing and completed projects by the Japanese government and JICA aimed at supporting Ukraine.

(1) Preparatory Study for Infrastructure Reconstruction and Recovery for Ukraine

i. Project Objective: a) To confirm and analyse the situation and damage to social infrastructure and services in major cities and sectors in Ukraine before and after the Russian invasion. b)To collect information on trends among other donors, international organizations, and international NGOs. c) To organize the information as data to be shared with stakeholders for full-fledged reconstruction.

ii. Project Period: November 8, 2022, to May 31, 2023 (total of 7 months)

iii. Target Area and Activities:

- All of Ukraine: Collect information and identify damage in the following infrastructure fields covering all of Ukraine.
- Kiev, Odesa, Mykolaiv, Kharkiv, Dnipro: Collect information and identify damage in a wide range of sectors specified by these five cities.

iv. Target Fields: Resources and Energy, Transportation, Urban and Regional Development, Environmental Management, Water and Sewerage, etc.

v. During this survey, 262 generators have been supplied in total as emergency support materials in December 2022 (25 units) and January 2023 (237 units).

(2) Project for Emergency Recovery and Reconstruction

i. Project Objective: To contribute to the establishment of a foundation for full-fledged recovery and reconstruction of destroyed urban infrastructure in crisis-ridden Ukraine through emergency infrastructure recovery projects and planning support.

ii. Project Period: Planned from February 2023 to February 2025 (total of 24 months; currently ongoing)

iii. Target Area: All of Ukraine (especially targeting Odesa, Mykolaiv, Kyiv, Kharkiv, Dnipro, and Kherson as the main target cities)

iv. Target Fields: Resources and Energy, Transportation, Urban and Regional Development, Environmental Management, Water and Sewerage, etc.

v. Outcome: Emergency recovery of infrastructure will take place and planning for recovery and reconstruction of infrastructure in the target cities will be facilitated.

(3) Provision of Equipment and Materials: Grant Aid for "Ukraine Emergency Recovery Plan Phase 1 and 2"

On March 2, 2023, the governments of Japan and Ukraine signed an Exchange of Notes for a grant aid of 22.44 billion yen aimed at procuring the necessary equipment and materials for emergency recovery in nine fields (mine and UXO countermeasures, debris and disaster waste management, transportation, power and energy, water supply, sewerage, healthcare, education, and agriculture). A grant contract between JICA and the Government of Ukraine was also concluded on March 9. Additionally, another Exchange of Notes for a grant of 53.072 billion yen was signed on March 29, 2023, for "Emergency Recovery Plan (Phase 2)" aiming to procure necessary equipment and materials for emergency recovery in ten fields (including public broadcasting and municipal public facilities). A grant contract between JICA and the Government of Ukraine was concluded on April 14. Further details on the provision of equipment in the agricultural sector will be elaborated below.

For Phase 1 in the agriculture sector, equipment will be supplied to the three organizations listed in the next table. Types of equipment include centrifuges and refrigerators for plant inspection to the Plant Variety Testing Institute, soil component analyzers for the Soil Protection Institute, and equipment and seeds for performance testing of agricultural machinery to the Leonid Pohorily Institute. For more details about the supplied equipment, refer to the attached Table B2.8.1.

Table A2.8.1 Organization to be Received (Phase-1)

No	Organizations
1	Ukrainian Institute for Plant Variety Examination
2	Ukrainian Research Institute of Forecasting and Testing of Equipment and Technologies for Agricultural Production named after Leonid Pohorily
3	Institute of Soil Protection of Ukraine

Source: JICA Survey Team

For Phase 2, a list of desired equipment has already been submitted from the other party. According to the current plan, the two organizations shown in the table below are candidates for equipment provision, and the specific equipment and its specifications will be determined in the future, taking into account needs and local conditions. For details about the equipment that is currently being considered for provision, please refer to Annex B2.8.2.

Table A2.8.2 Organization to be Received (Phase-2)

No	Organizations
1	Nemishaieve Professional College of the National University of Life and Environmental Sciences of Ukraine
2	State Agency of Melioration and Fisheries of Ukraine

Source: JICA Survey Team

In addition to the equipment provision through the non-grant financial cooperation of Phases 1 and 2 mentioned above, the first round of emergency material provision has been implemented in March 2023 as follows, to support the distribution of corn and sunflower seeds for the spring cultivation in 2023.

- **Supplies:** Locally available corn seeds (4,500 bags for 4,500 ha of land) and sunflower seeds (3,700 bags for 9,250 ha of land). The total area where these seeds will be sown is 13,750 ha.
- **Distribution locations and targets:** 455 small-scale farmers in Kharkiv state who own land under 500 ha and have applied through the State Agrarian Registry.
- **Reason:** Kharkiv state was chosen because it is a land with a climate and soil suitable for cultivating corn and sunflowers, and it is also one of the areas greatly affected by the Russian invasion. Comparing the sowing seasons of 2021 and 2022, the total area of corn in the state has reduced from 287,000 ha to 136,000 ha, and that of sunflowers from 575,000 ha to 250,000 ha.

(4) Information collection and confirmation survey related to the development of IT talents in Ukraine through PJAIT in Poland.

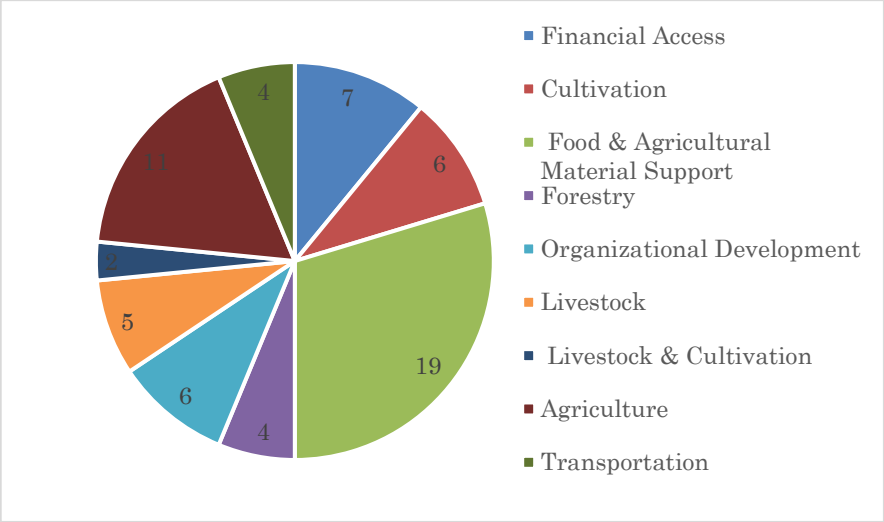
- Business purpose: In this project, we collect and confirm the basic information needed to support the education and training in the IT field for Ukrainian refugees in Poland, which hosts a large number of Ukrainian refugees. In addition to medium- and long-term planning, immediate support such as IT literacy improvement training for refugees through PJAIT (pilot training) is being carried out to verify its effectiveness.
- Implementation period: Scheduled from February 2023 to September 2023 (currently in progress for 7 months)
- Overview of activities: a) Collection of basic information (confirmation of short-term support needs and planning of medium- and long-term support for IT human resource development for Ukrainian refugees), b) Implementation and verification of immediate pilot training, c) Collection and proposal of information on third-country training through PJAIT.
- Outcome: Basic information needed to support education and training in the IT field for Ukrainian refugees in Poland, which hosts a large number of Ukrainian refugees.

(5) Ukraine National Humanitarian Landmine and UXO Capacity Improvement Project

- Business Purpose: To contribute to Ukraine's recovery and reconstruction by enhancing and expanding the capacity for landmine and UXO countermeasures through the provision of urgently needed equipment and technical guidance.
- Implementation period: Scheduled from January 2023 to August 2024 (currently in progress for 1 year and 7 months)
- Implementing organization: State Emergency Service of Ukraine (SESU)
- Project Content: Implementation of training for mine removal procedures, provision of equipment (ALIS mine detectors and trucks with cranes for transporting UXOs).

2.8.2 Trends of Other Donors/Organizations

Numerous international organizations and donor countries are offering assistance to Ukraine. As of August 2023, there are 64 initiatives spanning various countries and organizations within the agricultural sector (refer to Annex 2.8.1). A frequency analysis and compilation of these initiatives by sub-category are presented in the next figure. As shown, under the banner of emergency support, 'Food and Agricultural Material Supplies' lead with 19 activities, followed by 'Financial Access Support for Agriculture' with 7. Given the conflict conditions, efforts that are either urgent or can be conducted remotely are primarily emphasized.



Donors	Activities	Donors	Activities
FAO	Forestry 1, Livestock 2, Food & Agricultural Materials Support 1	USAID	Financial Access 2, Organizational Development 1, General Agriculture 1
EU	General Agriculture 1, Financial Access 2, Organizational Development 3, Food & Agricultural Materials Support 1, Livestock 1, General Agriculture 2	Swiss Embassy	Financial Access 1, Cultivation 1, Food & Agricultural Materials Support 1, Livestock & Cultivation 1
GEF*	Forestry 1	World bank	Organizational Development 1, General Agriculture 1
OECD	General Agriculture 1	Canada	Distribution 1, Livestock 1, General Agriculture 1
Germany	General Agriculture 1, Cultivation 2, Organizational Development 1, Forestry 2, Financial Access 1, Distribution 2, Livestock 1, Food & Agricultural Materials Support 1	Japan	Food & Agricultural Materials Support 6, General Agriculture 1, Cultivation 2
UNOCHA	Food & Agricultural Materials Support 4, Livestock & Cultivation 1	UNDP	General Agriculture 2
Turkey (General Agriculture 2), Belgium (Distribution 1), Australia (Cultivation 1), France (Food & Agricultural Materials Support 2), Norway & Ireland & LD Fund (Food & Agricultural Materials Support 1 each).			

* GEF = Global Environmental Fund

Source: JICA Survey Team based on material of Agriculture Sector Donar Meeting (2023.08)

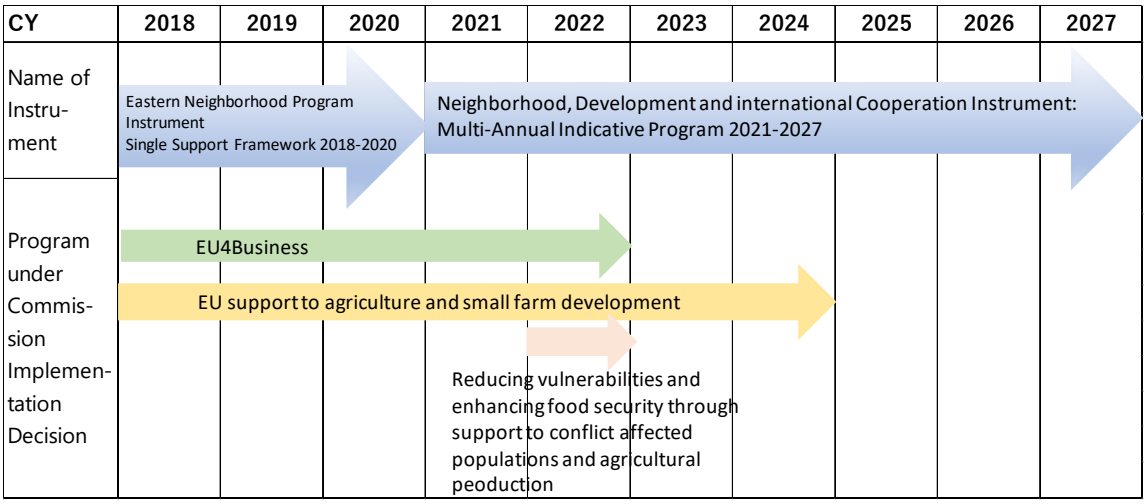
Figure A2.8.1 Summary of Support Activities by Various Donors in the Agricultural Sector

(1) European Union (EU)

(a) Overview

The EU's assistance to Ukraine is based on the Association Agreement, which was signed in June 2014 and entered into force in 2017, and the Deep and Comprehensive Free Trade Area under the Agreement. Assistance to Ukraine is handled by the Directorate General for European Neighborhood Policy and Enlargement Negotiations of EC, which is the administrative executive body of the EU.

EU has established a multi-year support policy framework, based on which specific implementation plans are drawn up and implemented on an annual basis. Figure A2.8.2 illustrates the relationship between the planning period for Instruments and the program for each year as determined by the Committee.



Source: Prepared by JICA Survey Team based on EC's website

Figure A2.8.2 Instruments and Programs based on Commission Decision

The current framework of assistance to Ukraine is the 2021-2027 Multi-year Indicative Program of the Neighborhood Development and International Cooperation Instrument, which was announced at the EU Ukraine Summit[70] held in October 2021. The 2021-2027 Multi-Year Indicative Program has identified five priority areas (Table A2.6.22), providing a comprehensive framework for the EU 's assistance to Ukraine, not just in the economic sector.

Table A2.8.3 2021-2027 Multi-Year Program Priority Areas

Priority area 1 A resilient, sustainable, and integrated economy
Priority area 2 Accountable institutions, rule of law and security
Priority area 3 Environment and climate resilience
Priority area 4 A resilient digital transformation
Priority area 5 A resilient, gender equal, fair and inclusive society

Source: Prepared by JICA Survey Team based on Neighbourhood Development and International Cooperation Instrument: 2021-2027 multi -year indicative program

Based on this program, an Economic and Investment Plan was formulated. Economic Investment Plan stipulates the following major initiatives: (Table A2.8.4)

[70]The Neighbourhood Development International Cooperation Instrument brings several previously separate regional funding mechanisms together. It has functions including grants, blended finance and debt guarantees.

Table A2.8.4 Main Initiatives of Economic Investment Plan

Initiative	Content
1. Support for a sustainable, innovative, green and competitive economy: Direct support for 100,000 SMEs	Supporting business incubators and improving access to finance for SMEs. The goal is to support 100,000 SMEs and self-employed people
2. Economic transition for rural areas, assistance to over 10,000 smallholder farmers	Supporting the introduction of partial debt guarantees for more than 10,000 smallholder farmers to facilitate the provision of affordable loans and the purchase of farmland.
3. Improved connectivity by upgrading border crossing points	Improving physical infrastructure, introducing intelligent systems for heavy trucks and IT systems
4. Promoting digital transformation: Modernizing public IT infrastructure	Modernization of digital infrastructure of Ukrainian government, strengthens cybersecurity
5. Increased support for energy efficiency improvements for renewable hydrogen	Improving the energy efficiency of multi-apartment buildings, saving household energy bills, financing projects to reduce energy loss, and supporting renewable hydrogen development

Source: Prepared by JICA Survey Team based on Neighbourhood Development and International Cooperation Instrument: 2021-2027 Multi-year Indicative Program

Of the major initiatives, the policy items related to the survey are "1. Support for sustainable, innovative, environmentally friendly, and competitive economies" and "2. Economic transition for rural areas, assistance to over 10,000 smallholder farmers". These supports are the continuation of the support for SMEs and smallholder farmers that has been implemented under the 2018-2020 Eastern Neighbourhoods Program Instrument Single Support Framework (hereinafter "Single Support Framework").

The year 2021, the first year of the multi-year program of the Neighbourhood Development and International Cooperation Instrument, did not provide assistance directly related to farmers' access to finance. On the other hand, in the implementation plan for 2022[71], in the wake of Russia's invasion to Ukraine, the content of assistance is repositioned as support for strengthening national resilience to reinforce humanitarian assistance, and a budget support named "Reducing Vulnerability and Enhancing Food Security through Support to the conflict affected population and agricultural production in Ukraine"was implemented. The implementation plan of this support was revised three times in 2022[72], including the revision on July 1, which aims to ensure domestic food security and economic recovery through continued food production and provision of working capital to smallholder farmers. For that purpose, through the State Agrarian Register (SAR) implemented by the Ukrainian government, a Production Support Grant will be provided to small-scale farmers (100 Euro per 1ha for the cultivated area less than 120 ha, and 170 Euro per cow). It is estimated that about 10,000 small-scale farmers will be supported[73]. EC intends to encourage farmers to register with the SAR, especially unregistered small-scale farmers through the provision of grant aid for production support under this implementation plan. The aid amount was originally €500 million in July 2022, but was increased to € 566 million with the revision on 29 January 2022, together with the budget of other assistance items.

"Reducing Vulnerability and Enhancing Food Security through Support to the conflict affected population and agricultural production in Ukraine".

[71]Commission Implementation Decision of 16.3.2022 on the financing of the individual measure in favor of Ukraine for 2022
[72]April 12th, July 1st, November 29th
[73]Action Document for "Reducing vulnerability and enhancing food security through support to conflict affected population and agricultural production in Ukraine", OPSYS business reference NDICI-GEO-NEAR/2022/ACT 61256

i.	Supporting the livelihoods needs of the conflict affected population through capacity building of Ukrainian public institutions
ii.	Housing supply for internally displaced people and returnees
iii.	Providing working capital to registered farmers and individual farmers to continue agricultural and food production, improve the financial situation of agricultural producers, and encourage the use of SAR

Source: Prepared by JICA Survey Team based on EC materials

May 2022, EC proposed the establishment of the "Ukraine Reconstruction Platform" for the reconstruction and reconstruction of Ukraine[74] in conjunction with the establishment of the National Council for Recovery by the Ukrainian government. A multi-donor collaborative platform was established in January 2023. A proposal has been made for EU and Ukraine to co-chair the "Ukraine Reconstruction Platform", and it is believed that EU will play an active role in the reconstruction phase as well.

For financial support related to the EU, details are provided in the section 2.5 on Financial Access. Please refer to that section.

(b) EU Support after the Russian Invasion

According to the October 2023 edition of "UN Solidarity with Ukraine", in 2022, the assistance provided from the EU budget reached 11.6 billion Euros, of which 10.5 billion Euros have been actually spent. This includes 7.2 billion Euros for macro-financial assistance, 2 billion Euros in grants provided directly by the European Commission, and 2.4 billion Euros in loans enabled by the EU budget from European financial institutions. Furthermore, in 2023, the EU has offered an unprecedented support package to Ukraine amounting to 18 billion Euros, of which 13.5 billion Euros have already been disbursed.

The breakdown, as shown in the table below, indicates that the most substantial support is in financial assistance. Other forms of support include humanitarian aid, school reconstruction, measures for internally displaced persons, mine clearance, and nuclear safety support. However, the term "agriculture" is not found in the mentioned document.

Table A2.8.5 EU's Support to Ukraine by Sector in 2022-2023

Amount (€)	Description
25.2 billion	Macro-financial assistance for Ukraine to address local emergency needs (including a new package of up to 18 billion Euros in 2023)
2.6 billion	Loans and guarantees by the EIB, EBRD, and other international financial institutions, guaranteed by the EU. Support for responding to Ukraine's financial needs, assisting strategic state-owned enterprises, repairing damaged infrastructure, and securing municipal services
588 million	Bilateral cooperation to enhance Ukraine's resilience and support reforms
620 million	Budgetary support from the EU to assist Ukraine in addressing local emergency needs
685 million	Humanitarian aid

[74] COM (2022) 233 final Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: Ukraine Relief and Reconstruction

Amount (€)	Description
330 million	Support for internally displaced persons, municipalities, health care, recovery of critical infrastructure, media, and cybersecurity
192 million	Allocating to ongoing projects to address local emergency needs
114 million	100 million Euros for school reconstruction and 14 million Euros for school buses
94 million	EU grants for mixed projects with other financial institutions like EIB and KfW
143 million	Crisis response measures
31 million	Civil society activities
202 million	Connecting Europe Facility for Solidarity Lanes
16 million	Cooperation for nuclear safety
21.5 million	Humanitarian demining

Source: UN Solidarity with Ukraine (Oct. '23)

(2) United States Agency for International Development (USAID)

(a) Overview

The current support strategy of USAID for Ukraine is a development cooperation strategy covering January 2019 to January 2024. Support for agriculture is positioned as one of the intermediate objectives within one of the four developmental goals: inclusive and sustainable market-driven economic growth, through market institutions to improve the productivity of agricultural SMEs. For this purpose, the development of SMEs, legal environment preparation, value chain strengthening, and resource utilization are stipulated. It is recognized that in Ukraine, large-scale agriholdings are suppressing small and medium-sized agricultural enterprises. With the conflict with Russia making exports to the Russian market impossible, there is a need to strengthen ties with the EU and other countries for the economic revitalization of small and medium-sized agricultural enterprises and rural areas[75].

USAID support for Ukraine is based on the above strategy, but since Russia's invasion on February 24, 2022, it has been conducted in both military and financial dimensions. As of the end of July 2023, according to the information on the website (https://www.usaid.gov/ukraine), since Russia's invasion in February 2022, the US government's development and humanitarian support for Ukraine has reached a total of 9.88 billion USD.

Within this, especially for the agricultural sector, the "Agriculture Resilience Initiative – Ukraine (AGRI-Ukraine)" initiative has been established and is operational. AGRI-Ukraine is an initiative launched to support Ukraine's agricultural production and exports and to mitigate the global food security crisis worsened by Putin's aggression against Ukraine. In July 2022, USAID provided 100 million USD to start AGRI-Ukraine, with an additional 250 million USD from partners, raising a total of 350 million USD. The main components are as follows:

1 USAID’s Agriculture Growing Rural Opportunities (AGRO)
2 Credit for Agriculture Producers (CAP)
3 Economic Resilience
4 Activity (ERA)

[75] USAID Country Development Cooperation Strategy 2019-2024, p.29

Particularly, AGRO (1) and CAP (2) are detailed in “Sections 2.2 Irrigation” and “Section 2.5 Financial Access” respectively and should be referred to for more information.

(b) USAID Support after the Russian Invasion

According to the Ukraine Complex Fact Sheet No. 21 dated September 7, 2023, USAID's total support inside Ukraine for 2023 amounts to 954 million USD from USAID/BHA (USAID’s Bureau for Humanitarian Assistance) and 158 million USD from State/PRM (U.S. Department of State’s Bureau of Population, Refugees, and Migration), totaling 1,112 million USD. The breakdown is shown in the table below. This shows that the vast majority of the support is focused on food assistance, health, and humanitarian coordination/information management/assessment (HCIMA), with agricultural sector support accounting for only about 0.5% of the total, indicating minimal engagement.

Table A2.8.6 USAID’s Support to Ukraine in 2023

Activity	USD (Million)	Number of Projects	Percentage (%)
Agriculture	6	1	0.5%
Education	6.5	1	0.6%
ERMS*	100.2	1	9.0%
Food Assistance	333.2	2	29.9%
HCIMA*	387.57	11	34.8%
Health	265.1	10	23.8%
Logistics	1.08	1	0.1%
Power	0.82	1	0.1%
Program Support	1.56	1	0.1%
Protection Policy	2.77	1	0.2%
WASH*	5.25	1	0.5%
Unspecified	5	1	0.4%
Total	1,115.05		

* ERMS: Early Recovery and Market Systems, MCIMA: Humanitarian Coordination, Information Management, and Assessments. WASH: water Sanitary and Health

Source: Prepared by JICA Survey Team based on data of Ukraine Complex Fact Sheet No21

(3) World bank

(a) Overview

The lending strategy of the World Bank is compiled as the Country Partnership Framework (CPF), within which candidate projects are selected. The current CPF covers the period from 2017 to 2021, and as of now, a successor CPF has not been published.

This CPF was developed in response to a decade-long economic stagnation and the economic crisis caused by the pro-Russian forces' conflicts in Donetsk and Luhansk regions during 2014-2015, aiming to achieve sustainable and inclusive economic growth. The CPF outlines four pillars: 1) better governance, anti-corruption measures, and public participation; 2) market function enhancement; 3) financial and fiscal sustainability; and 4) efficient, effective, and inclusive service delivery. Of these, the agricultural sector is related to market function enhancement, and the financial sector is related to financial and fiscal sustainability. Land reform is highlighted as a policy item related to the agricultural sector under market function enhancement. Due to issues like inadequacies in land registration and the lack of a functioning land market, as well as opaque land transactions involving unregistered state-

owned agricultural land, the CPF discusses land reform aimed at opening up land transactions, envisioned at the time of its formulation. It states that land reform would make land transactions more transparent and contribute to regional development. The CPF also includes support for private sector-driven agricultural market-related infrastructure, crop receipts, reviews of irrigation needs, strengthening of water user associations, improvements in agricultural warehousing, and support for the development of agribusiness.

(b) World Bank Support after the Russian Invasion

The amount of project support from the World Bank from the Russian invasion in February 2022 until October 2023 is summarized in the following table.

Table A2.8.7 World Bank's Support Project to Ukraine (USD million)

	Project name	USD mil.
1	Financing of Recovery from Economic Emergency in Ukraine (FREE Ukraine)	2,252
2	Public Expenditures for Administrative Capacity Endurance (PEACE)	23,426
3	Ukraine Relief, Recovery, Reconstruction and Reform Trust Fund (URTF)	1,126
4	Contributions to Health Enhancement and Lifesaving (HEAL) Project	114
5	Special Transfer through US Single Donor Trust Fund	1,700
6	Ukraine Relief and Recovery Development Policy Loan (DPL)	1,500
7	Other World Bank Lending (Restructurings & Current Portfolio)	922
8	IFC	608
9	MIGA	64
10	Support Under Preparation	6,435
11	Total Disbursed to Date	29,626
World Bank Group Total Credit		**38,146**

Source: https://www.worldbank.org/en/country/ukraine/brief/world-bank-emergency-financing-package-for-ukraine

In the table above, details for the two projects with significant amounts, 1. FREE Ukraine and 2. PEACE, are provided below.

(i) Financing of Recovery from Economic Emergency in Ukraine (FREE Ukraine)

"The Financing of Recovery from Economic Emergency in Ukraine (FREE Ukraine) project is an emergency funding package to support the recovery from economic emergencies in Ukraine. Through this project, the aim is to support the stabilization and recovery of Ukraine's economy and to meet the financial needs of the country.

The funding for this project consists of several parts, mainly including funding from the World Bank, supplementary budget support (FREE: Financing of Recovery from Economic Emergency in Ukraine), bilateral guarantees, and others. The specific amounts are as follows:

- Total funding from the World Bank: USD2,252 million
- Supplementary budget support (FREE): USD350 million
- Bilateral guarantee: USD134 million
- Bilateral grants: USD1,168 million
- Parallel budget support from Japan: USD1,168 million
  (Japan Parallel Budget Support Linked World Bank FREE)

Furthermore, this support is provided in the proportions shown in the following diagram, supporting four sectors: banking system support, public services, ports/maritime transport, and social security."

(ii) Public Expenditures for Administrative Capacity Endurance (PEACE) in Ukraine

The PEACE Ukraine project was established to assist the Ukrainian government in maintaining vital government services and fundamental government functions within the country. Through the funding of the project, it aims to support the continuation of government operations, provide essential public basic services, thereby significantly reducing the cost of economic reconstruction and recovery, and aiming to decrease the number of people falling into poverty.

As of June 22, 2023, approximately 20 billion USD have been mobilized through the PEACE project. The main beneficiaries of the PEACE project are as follows:

- 10 million pension recipients
- 500,000 educators
- 145,000 government employees
- 56,000 emergency response personnel
- Over 3 million social assistance recipients and internally displaced persons (IDPs).

Furthermore, the PEACE project contributes to the continuation of school openings and the maintenance of health services. In 2022, according to data from Ukraine's Ministry of Education and Science, some 12,817 schools that depend on remote operations, face-to-face teaching, or blended modes have remained open. Additionally, 2,431 health service providers continued their operations throughout 2022.

The PEACE project, in collaboration with other international donor organizations, enables swift and predictable support, assisting the Ukrainian government in providing necessary services to over 13 million Ukrainians since the Russian invasion.

(4) International Finance Corporation (IFC)

IFC lending is implemented based on the "Strategy and Business Outlook" created every three years and the annual budget based on it. Although the "Strategy and Business Outlook" is IFC's unique strategic document, as a member of the World Bank Group, it is prepared in alignment with the World Bank's CPF framework. The "Strategy and Business Outlook" undergoes an annual review during the target years. The budget to materialize the "Strategy and Business Outlook" is allocated from policy items, target sectors, and regional perspectives. As of this research, the "Strategy and Business Outlook Update FY23-25" serves as the basic strategic document. The document outlines regional policies, and one of the pillars of policy is "inclusivity", with lending to the agricultural sector in Ukraine mentioned as a specific item.

(5) Federal Republic of Germany

Germany's assistance consists of projects formulated and implemented by the Federal Ministry for Economic Cooperation and Development itself, projects implemented by its subordinate KfW Development Bank, and projects implemented by the German Development Corporation (GIZ).

The support policy for Ukraine by the Federal Ministry for Economic Cooperation and Development is implemented within the framework of the European Commission's European Neighborhood Policy and Eastern Partnership. The currently disclosed support from the ministry focuses on emergency responses since Russia's invasion. The published support policy on the ministry's website does not specify an agriculture-focused support program, but rather envisions agricultural enterprises benefiting within the framework of SME support.

In addition to the framework of the Federal Ministry for Economic Cooperation and Development, the Federal Ministry of Food and Agriculture is implementing a project titled German-Ukrainian Agricultural Policy Dialogue. This project covers agricultural policy and legal and regulatory preparations in the agriculture and rural development sectors, advice on land administration, research in the agricultural sector, and agricultural policy dialogue between Germany and Ukraine.

(6) United Nations Food and Agriculture Organization (FAO)

FAO's support for Ukraine in 2022, following the Russian invasion, was implemented based on the "Ukraine Rapid Response Plan March–December 2022". Its main activities are as follows:

Outcome 1: Maintenance of critical food production systems

1.1 Providing inputs and cash for spring vegetable and potato production - seeds, fertilizers, plant protection inputs

1.2 Providing inputs and cash for grain crop production (wheat and oilseeds) - seeds, fertilizers, plant protection inputs

1.3 Provision of livestock production inputs and health services - mineral/vitamin supplements, feed, feed inputs

Outcome 2: Support for agrifood supply chains, value chains, and markets

2.1 Promote agribusiness through grants and provide technical support services to household-level and small-scale producers

2.2 Provide support to specific private farms and associations through grants to maintain key supply and value chains

2.3 Partnership with the Ministry of Agricultural Policy and Food to maintain blocked food stocks.

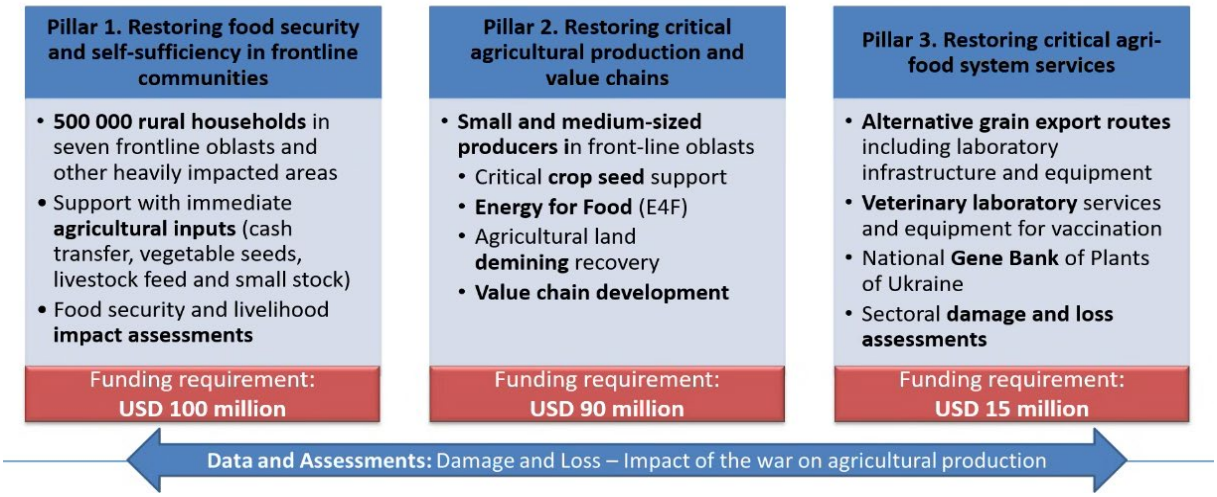


Figure A2.8.3 FAO Emergency Response Plan 2023

Source: Material in Ukraine's Donar Meeting

2.8.3 Possibilities for Collaboration with JICA Projects JICA

As it stands, the opportunities for collaboration within the Japanese government's agricultural sector support are considerable. The following table compiles a list of agencies with significant potential for collaboration, along with their respective strategic orientations.

Table A2.8.8 Possible Collaboration with JICA's projects

Agencies	Ongoing Activities	Collaboration Strategy
FAO	Coordination among Donors in the Agricultural Sector	FAO acts as a traffic controller in the Ukrainian national agricultural sector, necessitating coordination with other countries and donors through FAO for all agricultural sector support to be implemented by the Japanese government in the future.
USAID	AGRO Program	USAID is currently working on strengthening water user associations related to irrigation facilities. For future activities leveraging Japan's strength in PIM etc. for enhancing these associations, harmony and coordination with USAID's AGRO project, a leading agency, are essential to avoid confusion in Ukrainian national government agencies.
	Credit for Agriculture Producers (CAP) Project	While providing funding to small-scale agricultural producers through credit unions, the project is implementing support for female agricultural entrepreneurs. By using CAP's methods in regions not covered by CAP, it is possible to implement uniform support nationwide. In addition, the CAP Project requires additional funding, which will allow for expansion of the scope by incorporating unenrolled credit unions and lending to small farmers through existing channels.
World bank	"Rapid Damage and Needs Assessment	The agricultural sector of the World Bank's Rapid Damage and Needs Assessment includes the reconstruction of irrigation facilities. It is possible to coordinate with future World Bank projects for the reconstruction of these facilities. Investing in the Ukraine's Partial Risk Guarantee Fund through foreign investment and loans will enable expansion of lending to SMEs in the agricultural sector. (The EU is also investing in the Partial Risk Guarantee Fund.)
EBRD, EIB, IFC	Partial Risk Guarantee"	Provide two-step loans for damaged agricultural machinery purchases, grain tower repairs, and other export-oriented farmer loans through BDF. Note that two-step loans through BDF tend to target medium and large enterprises.

Source: JICA Survey Team

2.9 Directions for Short-term and Medium- to Long-term Support and Their Agreements

On April 16, 2023 (arrival in Japan), and April 22, 2023 (departure), the first invitation activities for senior officials of Ukraine's Ministry of Agricultural Policy and Food were conducted (for details, refer to Chapter 3). During this time, discussions were held concerning support from the Japanese government to Ukraine's agricultural sector, and an agreement was reached based on the following points, taking into consideration the intentions of the counterpart government.

Outline of JICA's Support Policy

Based on the current state of the agricultural sector, the policy is to provide short-term support, as well as medium- to long-term support aimed at improving the income of small-scale and marginal farmers and restoring and reconstructing the agricultural production system. The scale, content, and scope of the support are yet to be determined. It is essential to consider future Japanese government policies. For efficient and effective agricultural reconstruction support, information will be collected and coordination will be carried out with the United Nations and other donors, and the specifics of the support targets/regions will be considered.

(1) Short-term Support (Emergency support under the current wartime conditions)

Implement the provision of materials and equipment, and conduct projects in Japan (invitations, training; remote if appropriate).

(2) Support After Risk Reduction (Support after the conflict ends or is in a state very close to ending)

Mainly targeting small-scale and marginal farmers, implement support for strengthening production and value chains (horticultural crops, etc.), and support for irrigation facility maintenance and system development.

** Both will target all of Ukraine, but dangerous areas such as combat zones will be excluded from the target areas.*

(3) Support After the Clearance of Landmines and Unexploded Ordnance and Soil Contamination Removal (Mid- to Long-term Support)

For landmine-contaminated areas, information on the condition of agricultural landmines will be collected in coordination with landmine removal support by UN agencies such as FAO/WFP and landmine support by JICA. After confirming that support activities can be safely carried out, full-scale support for the two activities described in (2) will be considered.

CHAPTER 3 SHORT-TERM SUPPORTING INTERVENTIONS

3.1 Short-term Support in the Survey (Provisidin of equipment)

(1) Selection of Equipment and Purpose of Use

It was a requirement to provide equipment to the Ministry of Agrarian Policy and Food of Ukraine as short-term support in the Survey. For this reason, through discussions with the Ministry of Agrarian Policy and Food of Ukraine, it was decided to procure IT equipment such as laptop computers based on their request. Procurement of laptop computers will enable staff of the Ministry to continue their work when it will experience power outages or evacuation to shelters under war. It will improve their work efficiency and responsiveness. The purpose of providing equipment is to contribute to the Survey and promotion of agricultural reconstruction policies in Ukraine.

(2) Outline of Procured Equipment

Regarding the equipment to be procured, we confirmed the requested equipment, quantity, and detailed specifications through remote meetings and emails with the Ministry. Overview of the procured equipment is shown in Table A3.1.1.

Table A3.1.1 Overview of Procured Equipment

No.	Equipment	Q'ty
1	Laptop Computer (Preinstalled basic software)	70
2	Wi-Fi Router	18
3	External SSD	70

Source: JICA Study Team

(3) Procurement Policy

The budget is less than 15 million yen in the procurement of goods and equipment under the contract of consulting services. If the procurement costs will exceed 3 million yen, it will be required to procure through "competitive bidding" according to the Guideline. However, this is short-term support, and it was required to implement for emergency purposes. We consulted with JICA supervisors through web meetings and e-mails, and we decided to procure them through a "comparing of quotations" after obtaining of JICA's approval.

(4) Overview of Procurement

During the Survey Team's February study in Poland, the details of the equipment and specifications were yet to be finalized. A comprehensive price survey was conducted at computer stores, where it was confirmed and agreed upon that estimation prices for computers and related equipment could be submitted by three computer shops. Quotations were then acquired from these shops, with a summary of the results presented in Table A3.1.2.

Table A3.1.2 Summary of Results

No.	Computer shop	Summary	Results
1	Shop A	Non-compliance with payment terms and quote request item terms	Not adopted
2	Shop B	Quotation declined because requested item and quantity could not be prepared	Not adopted
3	Shop C	It can be submitted an amount suitable for the quotation and specification conditions	Adoption

Source: JICA Study Team

3.2 Invitation Program to Japan

3.2.1 Outlines of Invitation Program to Japan

As a pilot project of the survey, the JICA survey team organized invitation programs to Japan for Ukrainian staff of the Ministry of Agrarian Policy and Food. A summary of the pilot projects under the survey is presented in the table below:

Table A3.2.1 Summary of the Pilot Projects under the survey

Results			
Pilot Project	**Summary of Activities**	**Timing**	**Remarks**
Training (a)	Invitation to Japan	Middle of April 2023	− High-level officials from the Ministry of Agrarian Policy and Food of Ukraine were invited to discuss and validate not only the short-term assistance but also the overall support measures by Japanese government for the recovery and reconstruction of agricultural sector in Ukraine.
Training (b)	Merged with training (c)	-	− Training (b) and (c) have been merged because the need to improve the O&M capacity of the equipment provided has diminished since the equipment provided is PCs.
Training (c)	Invitation to Japan	Mid to late July 2023	− Discussion and confirmation of the direction and needs of medium- and long-term support measures for the working level officials of the Ministry of Agrarian Policy and Food of Ukraine. − Established an invitation program that includes training in smart agriculture (e.g., automated machinery), biogas plants, etc., in relation to equipment and materials that may be provided in the future. − Due to the above, some of the programs were implemented separately based on the specialty of the officials, and the number of participants and total dates of the invitation program were increased from original plans.
Provision of equipment (Short-term)	Procurement of small-scale equipment for supporting administration capacity of the Ministry of Agrarian Policy and Food	End of September 2023	− PCs were provided under the survey since the construction equipment, seeds and fertilizers, etc. were provided under a separate scheme.
Provision of equipment (Mid-term)	Trial of procurement of equipment for provision of equipment (mid-term)	Not implemented during the survey (proposal only)	-

Source: JICA Survey Team

As summarized above, since the coronavirus infection situation has calmed down, the invitation program to Japan was conducted. Training (a) was conducted as an invitation program for high-level officials of the Ukrainian government. Training (b) and (c) were merged, and another invitation program was conducted for working-level officials of the Ukrainian government. The outlines and results of these invitation programs to Japan are described in the following sections.

3.2.2 Results of First Invitation Program to Japan

(1) Outline of First Invitation Program to Japan

The first invitation program to Japan was organized for five high-level officials from the Ministry of Agrarian Policy and Food of Ukraine from Thursday, April 13 to Sunday, April 23, 2023. The following table provides an outline of the first invitations program and the itinerary.

Table A3.2.2 Outline of the first invitations program to Japan

Objectives:		− To learn from the experience of recovery from the Great East Japan earthquake disaster and discover advanced technologies in agriculture and irrigation sectors of Japan. − To inspire ideas for the formulation of post-war reconstruction measures in Ukraine. − To discuss on support measures by Japanese government for the recovery and reconstruction of agricultural sector in Ukraine.		
Participants:		Five high-level officials from the Ministry of Agrarian Policy and Food of Ukraine, and One Food and Agriculture Organization (FAO) staff		
Period:		Thursday, April 13 to Sunday, April 23, 2023, total 11 days		
Date	Day	Region	Key Point	Schedule
4/13-4/15	Thu-Sat	—	—	Travel (Kiev - Warsaw - Helsinki - Narita)
4/16	Sun	—	—	Arrival at Narita airport, Orientation meeting
4/17	Mon	Tokyo	Japanese agricultural policy, agricultural infrastructure development	Courtesy call to JICA, Courtesy call to Ministry of Agriculture, Forestry and Fisheries (MAFF), Courtesy call to Ministry of Foreign Affairs, Courtesy call to Embassy of Ukraine 1) Lecture of agriculture in Japan by MAFF (Japanese agricultural policy after WW II, accumulation of farmland, human resource development for agriculture, recovery from the Great East Japan Earthquake, environmentally friendly agriculture, promotion of smart agriculture, etc.)
4/18	Tue	Miyagi	Recovery from the Great East Japan Earthquake, activities by local government and Land Improvement District	2) Site visit to Sendai 3/11 Memorial Community Center (inclusive of courtesy call to Sendai City) (Recovery experience in agricultural sector) 3) Site visit to Sendai East Land Improvement District (Farmers' Organization) 4) Sharing of earthquake recovery experience by Sendai East Land Improvement District (Farmers' Organization) (Recovery experience in agricultural sector, operation maintenance of irrigation facilities, Build back better)
4/19	Wed	Miyagi	Recovery from the Great East Japan Earthquake, activities by Land Improvement District, Agricultural production	5) Site visit to an irrigation scheme recovered from the earthquake disaster in Ishinomaki City (Kitakami River Coast Land Improvement District) (Recovery experience in agricultural sector, operation maintenance of irrigation facilities, Build back better) 6) Site visit to Ignaru Farm (advanced agriculture farm / smart farming). (Advanced agriculture technologies, smart agriculture, recovery experience in agricultural sector)
4/20	Thu	Miyagi	Agricultural production	Sharing of earthquake recovery experience by Miyagi prefectural assembly member 7) Site visit to Yamamoto Strawberry Farm (advanced agriculture farm / value-added agriculture)

4/21	Fri	Kanagawa	Agricultural production, recovery support with private sector	8) Site visit to Hiramoto Farm (advanced agriculture farm / smart farming) 9) Business meeting with Japanese companies for cooperation in Ukrainian agriculture Wrap-up meeting with JICA
4/22-4/23	Sat/ Sun	—	—	Departing from Haneda Airport Travel (Haneda - Helsinki - Warsaw - Kiev)

Source: JICA Survey Team

(2) Participants of First Invitation Program to Japan

Participants of the first invitations program to Japan are listed in the table below:

Table A3.2.3 Participants of First Invitation Program to Japan

No.	Name	Position	Organization
1	Mr. Markiyan Dmytrasevych	Deputy Minister	Ministry of Agrarian Policy and Food of Ukraine
2	Mr. Vitaliy Golovnya	Deputy Minister	Ministry of Agrarian Policy and Food of Ukraine
3	Mr. Maksym Kobzystyi	Head of the Directorate for Agricultural Infrastructure	Directorate for Agricultural Infrastructure, Ministry of Agrarian Policy and Food of Ukraine
4	Ms. Viktoriia Shumeiko	Acting Head of the Department for Legal Support	Department for Legal Support, Ministry of Agrarian Policy and Food of Ukraine
5	Ms. Polina Ivashchenko	Head of the Division for Coordination of International Technical Assistance	Division for Coordination of International Technical Assistance, Ministry of Agrarian Policy and Food of Ukraine

Source: JICA Survey Team

(3) Business Meeting with Japanese Companies for Cooperation in Ukrainian Agriculture

During the first Invitation Program to Japan, JICA held a meeting for exchange of opinions between Japanese companies interested in Ukrainian agriculture and the Ministry of Agricultural Policy and Food of Ukraine. A total of 11 Japanese companies, including trading companies, manufacturers, and companies related to agricultural equipment and materials, participated in the meeting. At the beginning of the meeting, the Ukrainian representative explained possible areas of cooperation between Japan and Ukraine, and introduced agricultural machinery, bioenergy, and agro-processing of fruit trees as potential areas. After that, each of the participating companies introduced their companies and explained the possible areas of cooperation for restoration and reconstruction for agricultural sector in Ukraine.

(4) Discussion on Recovery Measures of Agricultural Sector in Ukraine

At the first invitation program, discussions were held with Ukrainian government officials on the direction of support measures planned by JICA for the recovery and reconstruction of agricultural sector in Ukraine. Through the discussion, JICA explained and discussed with the Ukrainian government official on: 1) the understanding of the current situation in the agricultural sector in Ukraine, which is important for the establishment of medium and long-term support measures, and 2) the outlines of the draft medium and long-term support measures planned by JICA. As a result of the discussion, the Ukrainian side expressed the following opinions.

- It is certainly true that there are many small and medium-sized farmers in Ukraine, and they are concentrated in the central and western regions of the country. However, it is also important to support the southern and eastern regions, which were affected by the war, and there are also many small and medium-sized farmers in the southern and eastern regions.
- It is correct to recognize that many irrigation facilities are not functioning properly, and it is necessary to support not only horticulture but also the rehabilitation and reconstruction of irrigation facilities for grain.
- Based on the above, JICA should consider that the beneficiaries and the target area of JICA's support measures for the recovery and reconstruction of the agricultural sector in Ukraine include the whole of Ukraine.

As a result of the discussions, JICA has reached a common understanding with the Ukrainian side on the direction of the following JICA support measures for the recovery and reconstruction of the agricultural sector as of April 2023.

Table A3.2.4 Outline of JICA's support measures for the Recovery and Reconstruction of Agricultural Sector in Ukraine as of April 2023

Outlines	− JICA has policy to support the agricultural sector in Ukraine with short-term support with consideration of current situation of agriculture in Ukraine, and medium and long-term support in order to increase income of small and marginal farmers and recovery of agricultural production as follows. The scale, content, and scope of the support are yet to be determined and will depend on the future policy of the Japanese government. In order to provide efficient and effective support for the recovery and reconstruction of the agricultural sector in Ukraine, JICA will consider specific targets and regions to be supported in cooperation with the UN and other donors.
(1) Short-term Support	− Conduct 1) provision of agricultural equipment and/or materials and 2) activities in Japan (invitation or training program. Utilize remotes as needed).
(2) After reduction of safety risks	− Support for 1) production and value chain strengthening (horticultural crops, etc.) and 2) improvement of irrigation facilities and system, mainly for small and marginal farmers. *All areas of Ukraine are targeted, but combat areas and other dangerous areas are excluded from the target areas.
(3) After the landmines and unexploded ordnance have been cleared and the soil has been decontaminated, etc.	− In cooperation with landmine clearance support activities by FAO/WEP, UN organizations, JICA will collect information about situation of contamination in agricultural land by landmines. JICA will consider irrigation facility reconstruction and rehabilitation and agricultural support after confirming safety conditions of target area of support activities in contaminated area by landmines.

Source: JICA Survey Team

3.2.3 Results of Second Invitation Program to Japan

(1) Outlines of Second Invitation Program to Japan

The second invitation program to Japan was organized for eight working-level officials from the Ministry of Agrarian Policy and Food of Ukraine from Wednesday, July 5 to Friday, July 21, 2023. The following table provides an outline of the second invitations program and the itinerary.

Table A3.2.5 Outlines of the Second Invitations Program to Japan

Objectives:		− To understand the characteristics, activities, and good practices of Japanese agriculture through lectures on Japanese agriculture in general, land improvement districts, JA, and PIM, − To learn operation and maintenance of irrigation facilities through site visit to Land Improvement Districts and irrigation facilities, − To learn about the recovery from the Great East Japan Earthquake, especially about environmental recovery after radiation damage, − To learn about advanced agricultural technologies and high value-added agriculture, which are the strengths of Japan, through site visit of smart agriculture, − Through the above, to study ideas for post-war recovery and reconstruction measures in Ukraine.		
Participants:		Eight working-level officials from the Ministry of Agrarian Policy and Food of Ukraine		
Period:		from Wednesday, July 5 to Friday, July 21, 2023, total 17 days		
Date	Day	Region	Key Point	Schedule
7/5-7/8	Wed-Sat	—	—	Travel (Kiev - Warsaw - Narita)
7/9	Sun	—	—	Arrival at Narita airport, Orientation meeting
7/10	Mon	Tokyo	Japanese agricultural policy, agricultural infrastructure development	Invitation program briefing meeting Courtesy call to JICA, Courtesy call to Ministry of Foreign Affairs, Courtesy call to Embassy of Ukraine 1) Lecture of agriculture in Japan by MAFF (Japanese agricultural policy after WW II, accumulation of farmland, human resource development for agriculture, recovery from the Great East Japan Earthquake, environmentally friendly agriculture, promotion of smart agriculture, etc.)
7/11	Tue	Tokyo, Fukushima	Japanese agricultural policy, operation and maintenance of irrigation facilities	2) Lecture on Land Improvement District (LID, Water Users Association in Japan) (Organizations and institutions related to land improvement in Japan, operation and maintenance of irrigation facilities) 3) Lecture on agricultural cooperatives (JA) in Japan (Organizations and institutions of agricultural cooperatives (JA) in Japan) Courtesy call to Mayor of Koriyama City
7/12	Wed	Fukushima	Recovery from the Great East Japan Earthquake, activities by local government	4) Sharing of earthquake recovery experience of Fukushima 5) Lecture on outlines of agriculture in Fukushima 6) Site visit to soil reclamation and reuse project in Iidate village
7/13	Thu	Fukushima	operation and maintenance of irrigation facilities, Recovery from the Great East Japan Earthquake, advanced agricultural technologies	7) Site visit to Asaka-Sosui Land Improvement District office Irrigation Team 8) Site visit to irrigation infrastructures managed by the Land Improvement District 9) Site visit to hydroelectric power plant of the irrigation system Farm Management Team 10) Lecture on functions and activities of JA and recovery from earthquakes: Fukushima Sakura and Site visit to direct sales shop of JA Fukushima Sakura 11) Site visit to an advanced agriculture farm (soil improvement, utilization of drones, automated operation etc.)

7/14	Fri	Fukushima, Tokyo	Japanese agricultural policy, operation and maintenance of irrigation facilities	12) Site visit to horticulture promotion center in Koriyama city (Lectures on agriculture in Koriyama city and recovery from the Great East Japan Earthquake) 13) Lecture on Participatory Irrigation Management (PIM) Wrap-up meeting on experience in Fukushima
7/15	Sat	―	―	Off
7/16	Sun	Hokkaido		Travel (Tokyo - Obihiro)
7/17	Mon	Hokkaido	Advanced agricultural technologies	14) Site visit to a biogas power plant 15) Site visit to an advanced agriculture farm (e-kakashi)
7/18	Tue	Hokkaido	Advanced agricultural technologies	16) Site visit to a circular agriculture farm (mixed farming and solar panel)
7/19	Wed	Tokyo	Japanese agricultural policy, agricultural infrastructure development, Recovery from WW II	Preparation of the Action Plan Courtesy call to Ministry of Agriculture, Forestry and Fisheries (MAFF), Wrap-up meeting with JICA
7/20-7/21	Thu/ Fri	―	―	Departing from Narita Airport Travel (Narita - Warsaw - Kiev)

Source: JICA Survey Team

(2) Participants of Second Invitation Program to Japan

Participants of the second invitations program to Japan are listed in the table below:

Table A3.2.6 Participants of Second Invitation Program to Japan

No.	Name	Position	Organization
1	Olha Pazynych	Head of Department for Regulation of Agrarian Resources	Department for Regulation of Agrarian Resources, Ministry of Agrarian Policy and Food of Ukraine
2	Liudmyla Tolok	Head of the Division for Agriculture and Crop Production	Division for Agriculture and Crop Production, Ministry of Agrarian Policy and Food of Ukraine
3	Yana Burduk	Chief expert of the Division for Coordination of International Technical Assistance	Chief expert of the Division for Coordination of International Technical Assistance, Ministry of Agrarian Policy and Food of Ukraine
4	Maryna Hlukhova	Chief expert of the Division for Development of Livestock Industries	Division for Development of Livestock Industries, Ministry of Agrarian Policy and Food of Ukraine
5	Bohdan Khmara	Chief expert of the Division of Agriculture and Crop Production	Division of Agriculture and Crop Production, Ministry of Agrarian Policy and Food of Ukraine
6	Ihor Siryi	Head of the Melioration Engineering Division	Melioration Engineering Division, State Agency of Melioration and Fishery of Ukraine
7	Serhii Tkachuk	Deputy Head of the Division for Management of the Reclamation Cadastre and Support of the Organization of Water Users	Division for Management of the Reclamation Cadastre and Support of the Organization of Water Users, State Agency of Melioration and Fishery of Ukraine
8	Iryna Ovcharenko	Head of the State Institution "Ukrainian Hydromelioration Systems"	State Institution "Ukrainian Hydromelioration Systems"

Source: JICA Survey Team

(3) Action Plan for Recovery Measures of Agricultural Sector in Ukraine

The Ukrainian participants of the Second Invitation Program discussed ideas for the recovery and reconstruction of the agricultural sector in Ukraine based on the Japanese agricultural technology studied during the visit under the program and summarized in an Action Plan. The Action Plan was prepared through a workshop. In the workshop, the feedback from the survey team on the current situation for agricultural recovery and reconstruction in Ukraine was provided to the participants, and ideas for contributing to the recovery and reconstruction of the agricultural sector in Ukraine, including the support needs of JICA, were discussed. The results of the discussion for the preparation of the Action Plan are summarized in the table below and attached in Annex 3.2.1:

Table A3.2.7 Results of the Discussion for the Preparation of the Action Plan

Field	Priority Areas for the Recovery and Reconstruction of the Agricultural Sector in Ukraine	Remarks
Irrigation & Water Management	1. To ensure the continued operation of existing irrigation systems during the war. 2. To rehabilitate, modernize, and improve the efficiency of malfunctioning irrigation systems. 3. To strengthen long-term support for farmer enterprises	− It is necessary to conduct a study through a process to identify and prioritize target irrigation infrastructure for reconstruction and rehabilitation. − At present, the following six oblasts are considered as priority areas for the reconstruction and rehabilitation of irrigation facilities: 1) Odessa, 2) Poltava, 3) Dnipropetrovsk, 4) Cherkasy, 5) Zhytomyr, and 6) Mykoxlaiv. Odessa is the oblast with the highest priority. − In the medium to long term, it is desirable to implement a large-scale irrigation reconstruction and rehabilitation project with the participation of Japanese engineering companies. − It is necessary to construct and rehabilitate irrigation facilities with high energy efficiency to reduce water fees. − In the short term, the Government of Ukraine need to continue to implement changes to the irrigation management system currently being implemented under the USAID initiative in the water management sector. − In the medium to long term, the Government of Ukraine aims to establish a modern monitoring system, train irrigation engineers and automate irrigation management with the participation of Japanese engineering companies.
Farm Management	1. To provide national assistance to farmers whose farmland is no longer available because of the war. 2. To promote agricultural production with advanced technologies (increased yields, improved energy efficiency, circular agriculture). 3. To rehabilitate the soil of contaminated farmland in areas close to the war front.	− It is necessary to strengthen government support and insurance program for agriculture to provide support to farmers. − Due to the occupation and contamination of farmland by the Russian invasion, the area of arable land has been reduced from pre-war levels. It is important to secure farmers' livelihoods by improving productivity and adding value to the limited arable land. − The Government of Ukraine will promote not only domestic consumption but also exports to the world market by increasing productivity through smart agriculture, extending the storage period of agricultural products by introducing storage facilities equipped with modern refrigeration functions, and improving the quality of agricultural products, including processed agricultural products. − Providing equipment to survey soil contamination due to the war, remediation projects based on survey results, and agricultural land restoration are also high priorities.

Source: JICA Survey Team

3.2.4 Needs for Recovery of Agricultural Sector in Ukraine through the Invitation Programs

Through the pilot project of invitation programs to Japan, the following needs for support for the recovery and reconstruction of the agricultural sector in Ukraine have been identified as areas where Japanese technology and experience can be utilized.

- Support for marginal, small and medium-sized farmers and promotion of horticulture

  The perspective of supporting small and medium-sized farmers and promoting horticulture, which is the direction of JICA's support for the recovery and reconstruction of the agricultural sector in Ukraine, is important. On the other hand, small and medium-sized farmers are scattered throughout the country. In addition, damage to irrigation facilities is severe in areas where fighting is taking place. Therefore, it is necessary to consider the target areas of JICA's support for the whole of Ukraine, considering the security situation.

- Efficient use of existing and recovered agricultural facilities and land

  It is an important issue to determine how to utilize the existing agricultural facilities and land due to increase of unavailable facilities and land by Russian invasion both from irrigation and farm management perspective. There is a short-term need for continued operation of existing irrigation facilities and a medium- and long-term need to rehabilitate irrigation facilities into energy-efficient facilities to reduce operation and maintenance costs, as pump irrigation is the main type of irrigation in Ukraine. There is also a need in farm management for improving the productivity of agriculture by introducing smart agriculture, and improving the quality and high value addition by promoting horticulture, introducing agro-processing, promoting exports, etc.

- Establishment of Master Plan for rehabilitation and reconstruction of the irrigation facilities in all of Ukraine

  The Government of Ukraine needs to identify priority irrigation facilities for rehabilitation and reconstruction throughout Ukraine based on technical and economic feasibility. There is a need for a study to identify priority irrigation schemes and to examine technical and economic issues based on the prioritized oblasts by the Government of Ukraine. Some facilities have a high level of technical difficulty, and these facilities require technical assistance for rehabilitation and reconstruction.

- Improvement of efficiency and modernization of operation and maintenance of the irrigation facilities

  It is recognized that the management of irrigation facilities needs to be transferred to farmers and that ownership should be promoted. There is a medium- and long-term need for automation of irrigation management, introduction of modern monitoring systems, and training of irrigation technicians in order to promote farmer ownership of management of irrigation and improve the efficiency of operation and maintenance of irrigation facilities.

- Use of renewable energy and introduction of circular agriculture

  In both irrigation and agriculture sectors, there is a need to improve energy efficiency and reduce

the environmental impact of agriculture through the use of renewable energy (e.g., biomass energy) and the introduction of circular agriculture.

- Soil remediation, especially soil contamination surveys
  There is a need to deal with contamination of agricultural land in various forms such as gasoline, heavy metals and landmines caused by combat activities. There is a need for surveying equipment and surveys to determine the status of soil contamination.
- Efficient use of human resources in agriculture sector
  The Russian invasion has resulted in a decrease in human resources for agriculture, so it is necessary to increase the productivity of agriculture and expand the number of people who can work in agriculture (expand agricultural practices to facilitate the employment of women and other workers).

3.3 Pilot Projects for Horticulture Promotion in Ukraine

3.3.1 Implementation Plan

The pilot project was carried out aiming at verification of viability of the proposed support program for capacity building in the horticulture of Ukraine. The JICA study team formulated its implementation plan to examine both needs of assistance and effective approaches of the horticultural capacity building for local farmer. The JICA study team prepared and submitted the proposed implementation plan to JICA for their scrutiny. Based on approval by JICA, the study team explained the proposed plan to Ministry of Agrarian Policy and Food of Ukraine on 13 September 2023 and it was agreed to implement the pilot project as planned.

Pursuant to the above agreement, the JICA study team carried out the pilot projects, namely Online Seminar Introducing Japan's Horticulture and Women Horticulture Training in Collaboration with High Educational Institutions, over a six-month period from October 2023 to March 2024. At the end of the women horticulture training, the wrap-up workshop was held for assessment of the results and identification of further needs. The performance and lesson learned of the pilot project are summarized below.

3.3.2 Online Seminar Introducing Japan's Horticulture

(1) Objectives

The online seminar aimed at sharing the information around recent horticulture industry in Japan with the stakeholders of Ukraine in order to help deepening their understandings about the technical capabilities and development efforts for resolving the problems around the horticulture industry in Japan, which will also be useful for future growth of the horticulture industry in Ukraine.

(2) Participants of seminar

Prior to the online seminar, the JICA study team prepared a pamphlet describing purpose, content, schedule, etc., and distributed it to the stakeholders with whom partnership has been kept through the JICA study. As a result, the study team received some 100 responses who were interested in participating in the said seminar. They belong to Ministry of Agricultural Policy and Food, industry organizations, agricultural higher education institutions, organizations of agricultural finance and service providers, women's support organizations, and university students. However, responses from farmer organizations and individual

farmers were limited. A series of the online seminar was held once a month during six months with a total of 467 participants or approximately 80 participants on average.

(3) Lectures and topics

The seminar invited the Japanese experts as lecturers with professional backgrounds of agricultural policy, technical research and development, marketing promotion, and human resource development. They provided the presentations about the topics concerned and their challenges to accelerate the growth of horticulture industry of Japan. With each lecturer, the pre-meeting was held to discuss and select the topics to be focused on in the seminars. In parallel, the reminding email was distributed to all the registered persons. The lecturers and topics of the seminars are summarized in Table A.3.3.1

Table A3.3.1 Lecturers and Topics of Online Seminar

No.	Date	Topics	Lecturers
1	20 October 2023	Agriculture of Japan and its policy	Mr. Shigeo Kanimata, Technical Advisor, Agricultural Development Consultants Association (ADCA)
		The report of inspection tour in Japan	Ms. Olha Pazynych, Head of Agrarian Resources Management, Ministry of Agrarian Policy and Food, Ukraine
2	17 November 2023	Data-driven agriculture to improve productivity by introducing the new technology of "e-kakashi"	Takashi Togami, Ph.D., Deputy Director/e-kakashi Business Director, Business Planning Promotion Department, SoftBank Corp.
3	13 December 2023	Winter vegetable cultivation in unheated greenhouses	Mr. Tomoaki Noda. Researcher, Production Group, Research Department, Kamikawa Agricultural Experiment Station, Hokkaido
4	10 January 2024	Promotion of regional agriculture centred on roadside stations	Mr. Fumio Kato, Advisor, Chiba Minamiboso Co., Ltd.
5	9 February 2024	Role models of women horticulture farmers	Ms. Sachiho Otowa, Head of Agricultural Human Resources Development Division, My Farm Co., Ltd.
6	15 March 2024	Greenhouse cultivation and plant factory in Japan	Koji Ishikawa, Ph.D., Professor, Tamagawa University, College of Agriculture Japan

Source: JICA Study Team

Each presentation was given in Japanese language with consecutive translation into Ukrainian language for a total of 120 minutes including question and answer session.

(4) Lecture content and participants' comments

The topic, purpose and background, question and answer session, summary of lecture content, and results of the training session are as follows.

1st Session on 20 October 2023	
[Training theme] Agriculture of Japan and its policy	Participants：110
[Lecturer] Mr. Shigeo Kanimata, Technical Advisor, Agricultural Development Consultants Association (ADCA)	
[Objectives and background] The lecturer outlined the history of land reform in Japan in order to share the information how individual farmers have been supported and the agriculture sector has grown. Nowadays, however, the agricultural sector of Japan faces the chronic constraints of shortage of agricultural workers due to declining birthrate and aging population which are similar constraints the agriculture sector of Ukraine is facing. The purpose of this session was to deepen understanding of the policies implemented by the Japanese government that contribute to maintaining	

the food self-sufficiency rate and the agricultural workforce.

[Summary of lecture]

Based on the historical background from the Meiji Restoration in 1868 to the present day, the share of agriculture in the national economy, the history of agricultural policy and the challenges and measures were summarized. In 2009, there were a total of 2.5 million farmers, of whom 1.5 million (60%) were over 65 years old. In 2019, the number of farmers decreased to 1.7 million, and the proportion group over 65 years old increased to three-quarters of the total. Substantial portion of farmers are too old to take care of their farmland properly resulting in degraded farmlands increased from 133,000 ha in 1976 to 396,000 ha in 2010. The food self-sufficiency rate on a calorie basis decreased from 73% in 1965 to 37% in 2020. Although the rice self-sufficiency rate is almost 100% supported by higher import tariffs. It is crucial in Japan to improve the efficiency of farm management. Every effort is directed to expand the farming scale of rice farmers by introduction of land leasing system. For this purpose, farmland intermediate management organizations, namely farmland bank, have been nation-widely established since 2014. Although the agriculture sector faces many problems, the government always attaches higher priority to the sector taking into consideration its extremely important role as stable food supply and increasing employment opportunities especially in rural areas far from urban areas.

[Q&A]

1) Japan's experiences of agricultural reconstruction in post-war and post-earthquake were interesting.
2) Information of the history of the agriculture sector of Japan related to the policy of agrarian reform was helpful.
3) The land leasing system seemed effective measures to prevent decreasing farmland areas.
4) It is significant for us to learn more the agricultural technologies of Japan such as farmland conservation and soil fertility restoration, pesticide and fertilizer use techniques, and information systems to analyze and support crop production cycle management.
5) More information about the marketing system of farm products produced by small-scale farmers in Japan is needed.

[Achievement]

Despite of the online basis, it was clearly recognized that the participants were aware that Japan faces similar constraints as Ukraine also does. There were many comments saying that they were able to learn what they didn't know about Japanese agriculture before. Agrarian land reform in Japan has a long history, and efforts have been made to free up farmland and protect farmers in parallel. With the current situation in Japan similar to Ukraine, where agricultural workers are decreasing, the seminar provided a good chance to share the mutual understanding necessity to encourage the participation of new workers in the agriculture sector.

[Training theme] The report of inspection tour in Japan	Participants：110

[Lecturer]

Ms. Olha Pazynych, Head of Agrarian Resources Management, Ministry of Agrian Policy and Food, Ukraine

[Objectives and background]

JICA invited the seven (7) government officials of Ministry of Agrarian Policy and Food to Japan for the inspection tour in July 2023. Ms. Olha Pazynych, the mission leader, made her report aiming at sharing what the mission observed and studied in Japan so as to help deepening the familiarity of Japanese agriculture among the participants.

[Summary of lecture]

The inspection tour in Japan was held over 12 days from 9 to 20 July 2023. Following a courtesy call to the JICA Headquarters, they visited Koriyama City, where they received the presentation from the mayor about the reconstruction projects following the Great East Japan Earthquake that occurred on 11 March 2012, and then visited and inspected the following projects.

1) Reclamation project of radioactively contaminated farmland in Iitate village carried out by the Ministry of Environment

2) Asaka Canal land improvement project to develop the water resources of Lake Inawashiro.
3) Research and development of soil improvement, vegetable seedling production under greenhouse, smart agriculture technology, etc. for the horticulture promotion,
4) "AGRIA" is a direct sales store for local agricultural products promoted jointly by the local government and the local community.
5) Circular agricultural system of the beef production industry, which produces beef for sale and process and use compost for managed grazing land and pasture production.
6) Model plant for biogas power generation.
7) After visiting Koriyama City, the delegation moved to Obihiro City of Hokkaido and visited the farm for which data-driven agriculture with new technology of "e-kakashi" is operated (see the lecture content of the 2nd training session for details).

During their visit to Japan, the mission observed public works projects promoted by the Japanese government and local governments as well as environmentally friendly businesses by private companies. Besides, they gained insight into the problems faced by Japanese agriculture and efforts to resolve them. The mission concluded that some of them would be applied to immediate use in Ukraine.

[Achievement]
There were several comments from the participants indicating their high level of interest in the Great East Japan Earthquake. They were particularly interested in decontamination projects in which the government and local governments collaborated with private companies for circular agriculture.

2nd Session on 17 November 2023	
[Training theme] Data-driven agriculture to improve productivity by introducing the new technology of "e-kakashi"	Participants：89

[Lecturer]
Takashi Togami Ph.D., Deputy Director/e-kakashi Business Director, Business Planning Promotion Department, SoftBank Corp.

[Objectives and background]
Women's participation in agriculture is one of the key issues as a means of alleviating the lack of workers facing agriculture in Ukraine. In Japan, a diversity of smart agricultural technologies is developed and rapidly introduced to assist unskilled farmers to meet manpower shortage on farm. The session aimed at introduction of e-kakashi, developed and disseminated by Softbank Corp., as a good example of an advanced technology that is already at the implementation stage.

[Summary of lecture]
In rural areas of Japan, where the population is decreased and aging, rationalization of agricultural activities is being promoted. Instead of farming techniques that relies on the ample experience and intuition of skilled farmers, innovative methods are rapidly developed to quantify the appropriate farming practices and support new participants in farming activities. The e-kakashi installs small sensor devices in the fields, continuously monitors environmental data where crops grow, analyzes the collected environmental data from a plant science perspective, and determines the appropriate timing for agricultural operations such as irrigation, fertilization, and harvesting. The technology is recognized as a successful example of data-driven agriculture that creates a notification mechanism. Through the lecture, several examples of implementation were introduced.

[Q&A]

1) e-kakashi is understood as innovative technology linking advanced technology and academic knowledge to manage streamlines crop cultivation management, including irrigation water supply, and contributes to improving crop yield and quality.
2) It is noted that the functions of e-kakashi are developed for the purpose of automating crop maintenance and management processes.
3) It is important for us to face up to the reality that farmers are aging, and challenge is urgently required for the agricultural sector.
4) It is interesting to apply e-kakashi under the diverse climate of Ukraine.
5) Software for selecting crops and varieties suitable for specific natural conditions are needed.
6) More information about software used in agriculture and land management are required.

[Achievement]

The Ukrainian government has positioned the improvement of the people's ICT literacy as an urgent policy, and it is expected that smart agriculture, such as unmanned tractors, agricultural drones, and farmland management using satellite data, will become widespread and utilized in the near future. Since this is an area in which Ukraine excels, it is important to continue to seize every opportunity to introduce ICT and smart agriculture to Ukraine.

3rd Session on 13 December 2023	
[Training theme] Winter vegetable cultivation in unheated greenhouses	Participants：66

[Lecturer]

Mr. Tomoaki Noda. Researcher, Production Group, Research Department, Kamikawa Agricultural Experiment Station, Hokkaido

[Objectives and background]

To popularize greenhouse horticulture in Ukraine, it is essential to reduce initial investment and crop production costs. The cost saving of heating equipment is particularly important. In Japan, the pragmatic research is going on for cultivation of winter vegetables under non-heating greenhouses in Hokkaido, the northern island of Japan, for several years. Since northwestern Ukraine has a cool climate typical of the Carpathian region, this cultivation technique is considered to have potential.

[Summary of lecture]

The lecturer introduced a farming method that strengthens the heat retention equipment and snow resistance of agricultural greenhouses according to the weather characteristics of Hokkaido, and grows leafy vegetables without heating in the fall, winter and early spring. It becomes possible to grow vegetables without heating, and by incorporating it into the annual cropping plan, it will become possible to grow vegetables year-round in Hokkaido. The unheated greenhouse has a triple-layered structure with a tunnel (mulch) covering the double-covered greenhouse. During the harsh winter months, non-woven fabric is added to make the room four-layered, further regulating the indoor temperature. There is a track record where the temperature difference with the outside temperature exceeds 20℃. The system will be able to introduce a year-round crop production and secure stable income.

[Q&A]

1) Useful life of greenhouse materials and equipment in Hokkaido is
2) Irrigation water supply and split fertilizers application seem difficult due to multilayered greenhouses.
3) Slow plant growth without heating is worried.
4) It is interesting to verify possibility to heat inside greenhouse by utilizing water of hot spring (geothermal) in western region of Ukraine where vegetables are cultivated from fall to spring.
5) The Japan's technical cooperation for greenhouses cultivation is highly expected.
6) Spinach production in unheated greenhouse seems more expensive than using normal cultivation methods. It seems more economical to import food from other regions than to produce it locally during winter.

[Achievement]

Some agricultural producers expressed interest in trying unheated greenhouse cultivation. Temperature, solar radiation and snowfall in winter in Ukraine are favorable conditions for greenhouse cultivation compared to Hokkaido. There are hopes that some private companies and farmers will introduce unheated greenhouses on a trial basis.

4th Session on 10 January 2024	
[Training theme] Promotion of regional agriculture centered around roadside stations	Participants：86
[Lecturer] Mr. Fumio Kato, Advisor, Chiba Minamiboso Co., Ltd.	

[Objectives and background]

In Ukraine, vegetables are grown by individual farmers mainly for their own consumption, and their surplus is sold to the limited scale. Although there are some possibilities to supply more produces to local markets by accessing existing supply chains, few women farmers embark on commercial activities due to limited knowledge and skills. Roadside stations, so-called Michi-no-Eki in Japan, play pivotal roles for promotion of the regional agriculture by direct selling, processing, diversifying, processing and expanding agricultural produce of local communities in connection with promotion of other local activities such eco-tourism. The session aimed at introduction of organizational set-up and activities to the Ukrainian participants.

[Summary of lecture]

The lecturer took up "Loquat-Club" that is broadly known as one of the most successful roadside station. Currently, 2,000 roadside stations are operated nation-widely. In general, roadside stations are built by municipalities and rented out to private management entities. Roadside stations had initially functioned as facilities for convenience of drivers and residents of vicinities, while their functions become more and more multi-layered in recent years. They attract more visitors by use of Internet and sell their specialty products. "Loquat Club" has so far developed over 50 products. The development of specialty products also leads to increased employment and sales. It is noted that these activities have generated employment opportunities in the rural areas, where population has declined and aged. Japan's knowledge of rural development through roadside stations has been introduced to Southeast Asia. Regardless to the size of facility of roadside stations, it is crucial to analyze local needs and appropriate management system and to set up the development goals of their activities for successful roadside stations.

[Q&A]

1) It is imagined that farmers are generally reluctant to sell vegetables through official marketing channels because they are subject to tax. Are economic activities within the roadside stations taxable?
2) Who is responsible for quality control of fresh vegetables and processed products which are directly brought into roadside stations from farms. Are there any standards for quality control of products sold by farmers at roadside stations?
3) It seems important to set rules regarding the sale of vegetables and processed products between roadside stations and farmers. Are the farmers themselves selling their produce, or are they selling it on consignment?
4) The fruit picking experience has become a new added value for commercial farms. Is it possible to experience picking agricultural produces like strawberries and loquats at the roadside station?

[Achievement]

Facilities similar to roadside stations already exist in Ukraine. They serve only the basic functions of rest areas for drivers and long-distance bus terminals, but Japan's roadside stations have been developed to provide new functions for revitalization of local agriculture. Participants had many questions about contractual relationships in product sales, and demarcation of responsibility for quality control and assurance. The participants showed high interest in the marketing of agricultural products.

5th Session on 9 February 2024	
[Training theme] Role models of women horticulture farmers	Participants：68

[Lecturer]

Ms. Sachiho Otowa, Head of Agricultural Human Resources Development Division, My Farm Co., Ltd.

[Objectives and background]

In recent years, women horticulture farmers have been increased in Japan. They often organize the producer groups, which develop as startup company and start commercial horticulture business. More than 1,000 women's groups have started up across the country under Agricultural Women's Project, which has been supported for last 10 years by Ministry of Agriculture, Forestry and Fisheries of Japan. In Ukraine, some women farmers participating in the on-going JICA's pilot project expressed their desire to keep the network among the trainees for horticulture business after the training. Taking into consideration such future potential, the role models of women farmer entrepreneurship in Japan were introduced.

[Summary of lecture]

My Farm Co., Ltd. operates promotion of crop production and sale, consulting services for agricultural business, young farmers' training and so on. The lecturer is responsible for implementation of training courses under Agricultural Innovation College established by the company and other related activities for Ministry of Agriculture, Forestry and Fisheries, local governments, and private companies. Based on these experiences, the network with successful models of horticulture business has been expanded. The first model introduced was the strawberry farmer as an example of business diversification ideas and corporate efforts to realize year-round cultivation of strawberries through smart agriculture technologies, and to pursue new added value as a tourist farm for processed products and strawberry picking. Secondly, Agriculture Women's Project was introduced by taking up the following three role models.

1) Quality cherry tomatoes: Started business in 2014, practices water-saving cultivation of high sugar and nutritional content tomato for 0.5ha with 30 employees of which 80% are women.
2) Processing of edible rose products: Cultivate pesticide-free edible roses for 0.5 ha, develop processed foods and cosmetics with focus on reducing flower loss and diversification of supply chains by women group.
3) Commercialization of asparagus: Started a seedling company in 2006 and cultivation, processing and sale of asparagus and dressings in 2019 with 28 (26 are women) employees cultivate asparagus for 3ha.

[Q&A]

1) A woman who runs a vineyard commented that she was inspired by hearing about a Japanese women's group that is working on developing processed agricultural products.
2) The presentation helped imagining the activities of horticulture women's group/
3) Horticulture farming generally requires a large initial investment. Is it possible to receive financial support from Japan?

[Achievement]

It was recognized that there are also many women farmers in Ukraine, who grow and sell vegetables and fruits, and sell processed agricultural products such as jams, pickles, cosmetics, etc. The topic of the lecture was easy to understand, and the participants were more interested in realizing the product. More meaningful results would be obtained if discussion about women's strengths in developing a horticultural business or the significance of forming a women's group were focused on.

6th Session on 15 March 2024	
[Training theme] Greenhouse cultivation and plant factory in Japan	Participants：55

[Lecturer]

Koji Ishikawa. Ph.D., Professor, Tamagawa University, College of Agriculture Japan

[Objectives and background]

The session aimed at introducing current positions of greenhouse cultivation in Japan and overall information about greenhouse and plant factory with reference to the existing types of facilities.

[Summary of lecture]

A lecturer is specialized with the international cooperation in the agriculture sector by applying Japanese agricultural technology in cultivation, business management and greenhouse horticulture. He summarized the current situation of agriculture in Japan along the policies of promotion of "strong agriculture" and "aggressive agriculture" as a new growth industry by referring to status of agriculture in general and by using case studies of history of greenhouse horticulture and plant factories.

Greenhouse and plant factories are defined as facilities to allow year-round cultivation and harvesting in a highly controlled environment. Japan has extremely high technology in solar and artificial light facilities even compared to other countries in the world. The roles and possibilities of greenhouse horticulture and plant factories in agricultural production in Japan are summarized. There are key points in operating greenhouse horticulture from the producer's and consumer's perspectives. From the producer's perspective, environmental control is utmost important. The environment in this context include light, temperature, humidity (saturation difference), CO_2, air flow rate, and hydroponic cultivation system to maximize plant material production activities such as photosynthesis, transpiration, and translocation. Using various examples, it was described how to minimizes energy costs (including precisely controlled underground environments, etc.), and conclude based on the experimental results of the actual plant factory being operated at Tamagawa University.

[Q&A]

1) Percentage of organic farming in greenhouse cultivation in Japan
   The percentage is unknown. In recent years, in order to obtain Global Gap (GGAP) certification, an increasing number of farmers and organizations are practicing organic cultivation and expanding their cultivation not only within Japan but also overseas. The Tokyo Olympics were one of the triggers for this, and the initiative is aimed at exporting Japanese agricultural products to the world. Additionally, equipment costs for greenhouse cultivation are higher than for outdoor cultivation, and the selling price is also higher. Even if the price is high, consumers tend to be satisfied with the purchase if it has acquired GGAP.
2) Characteristics of Dutch greenhouse cultivation and differences from Japanese greenhouses
   Glass houses are common in Europe, including the Netherlands. On the other hand, Japan is characterized by the widespread use of vinyl greenhouses.

3) Technology and experience that Japan introduced from other countries
From a global perspective, the Netherlands is well-equipped with greenhouse horticulture, and the country is working on it, so Japan has looked to the Netherlands as a reference. For example, Japanese private companies developed products for greenhouse cultivation based on Dutch glasshouses. When Dutch or Japanese technology is used in other countries, problems may arise such as the price and technology level being too high. Therefore, in Southeast Asia, Japan provides support for building facilities suitable for Southeast Asia.
4) Subsidy system for agricultural greenhouse procurement and non-national project implementing organizations.
Approximately 90% of greenhouse farmers receive subsidies of about 50% of procurement costs.
5) The reason why Japan mainly uses vinyl houses and few glass houses
In Japan, there are typhoons and snowfall. In a greenhouse, damage can be avoided by rolling up the vinyl to make only the skeleton. On the other hand, this is difficult to do in a glass house. Although glass houses are possible in Japan, vinyl houses are preferred.
6) Management status of greenhouse cultivation farms in Japan
Many farmers are in the red for three to five years due to loan repayments related to house procurement. When growing high-value crops such as strawberries, the period may be shorter.

[Achievement]
This information provided evidence that Japan's horticultural and agricultural technology is at the highest level in the world. The session resulted in confirming trust and expectations of the participants for Japanese horticultural technology. It is understood that the selection of technology and facilities to properly control the environment in greenhouse horticulture is the key for its success.

(2) Lessons learned

1) Needs of women's participation in horticulture and introduction of Japanese technology suitable for women horticulture

Decreasing workers is recognized as an issue of the agriculture sector of Ukraine. Through the online seminars the participants were aware that Japan is also facing similar constraints caused by decreasing population, declining birthrate, and aging population. It is urgently required for Ukraine to introduce advanced cultivation techniques and agricultural materials and equipment that mitigate labor shortage and to support newly participating farmers. On the other hand, it is also crucial for Japan as a donor country to extend reliable technical cooperation by using advanced technologies developed by joint efforts by public and private sectors.

2) Necessity of capacity building to promote investment in greenhouse horticulture

The seminar participants were interested in expansion of greenhouse horticulture in Ukraine. It is important for farmers to realize that greenhouse horticulture is speculative agriculture that is susceptible to changes in the market environment. Investment is required to start greenhouse horticulture, but detailed analysis is needed for decisions making to access financing schemes. The participants expressed interest in Japan's financial scheme, which 90% of horticultural farmers are getting financial support. To obtain financial supports from the government, farmers are requested to prove the capacity to repay on the basis well-prepared business plan and detailed financial analysis based on sufficient data. For this purpose, the capacity building for financial analyses based on preparation of business plan and among horticulture farmers is urgently required.

3) Optimization of specifications of facilities and farming techniques in horticulture of Ukraine

In Ukraine, glass greenhouses modeled by Dutch technology were introduced. On the other hand, vinyl film is generally used as the covering material for greenhouses in Japan to avoid direct damages from typhoons and heavy snowfall, and easy ventilation. However, vinyl materials need to be renewed every three to five years. It is important to select suitable type of greenhouses and farming techniques taking into consideration local conditions in Ukraine from both technical and financial viewpoints.

4) Need of low-cost heating technologies in greenhouse cultivation

The seminar participants expressed their interest in cost-saving techniques for heating in greenhouse. The research activities in Japan for unheated greenhouse cultivation for winter vegetables was introduced in the seminar as effective cost-cutting measure. Although target crops are limited to leafy vegetables for which demand is low in Ukraine, further research will verify possibilities for cultivation of other vegetables in winter. On the other hand, there was a question from an agro-holding regarding use of geothermal energy in greenhouses. Reducing heating costs in greenhouse horticulture is one of the most crucial aspects and requires continued efforts for research and development.

5) Application of innovative technologies for saving labor and cost

In the session, e-kakashi was introduced as a good example of Japan's smart agricultural technology. There are other advanced technologies suitable for environmental control such as temperature, humidity, moisture of seedbed, and carbon dioxide concentration inside the greenhouse. The participants also asked questions regarding introduction of agricultural drones. Introduction of useful smart agricultural technologies would be proactively continued to the Ukrainian farmers taking any possible opportunities including exhibit and demonstration.

6) Need of in-depth discussion of each issue in horticultural industry

It is valuable for diverse stakeholders in the horticulture industry to come together and exchange views on the same topic. However, the discussion between participants with different fields of expertise cannot be deepened. In-depth discussion would be realized by around 10 to 20 participants of same expertise such as government officials, agro-holdings and farmers, agricultural financial institutions, importers and distributors of agricultural machinery and equipment, and agricultural processors and exporters. Appropriate grouping will enable participants to identify constraints prevailing against their activities and to discuss alternative directions toward effective solutions.

3.3.3 Women Horticulture Training in Collaboration with High Educational Institution

(1) Objectives and performance

In view of rapidly decreasing population in Ukraine, more women and young people are expected to actively participate in economic activities. In the agricultural sector as well, it is of great significance for women to participate in farming practices and management. Although there are unavoidable difficulties of remote supports from Japan, an intensive short-term training program were implemented for woman horticulture farmers by joint efforts with the national universities. The pilot project focused on verification of appropriate approaches to exploit women's potentials for horticulture farming. It was also expected to know traditions and customs among local societies. The information thus obtained will be taken into consideration when the medium- to long-term support projects will be implemented in future.

(2) Training program at Polissia National University

The JICA study team have interviewed with the Chairperson of the Ukrainian Berries Association and the researcher of Polissia National University in Zhytomyr Oblast in Poland in June 2023. They provided some views about the current position of the horticulture industry of Ukraine and discussed constraints and potential solutions. Both experts pointed out such technical issues as crop diversification and quality improvement in horticultural crops, as well as the need to promote women's participation in agricultural management. Referring to insufficient agricultural extension services in Ukraine, they suggested the collaboration with higher education institutions, i.e. universities in the regions, in agricultural human resources development. Paying particular attention to effective use of professional knowledge and deep experiences accumulated at local universities, the JICA study team prepared the proposal of the horticulture training program in collaboration with the university and compiled the draft implementation plan of the pilot project. On 13 September 2023, the JICA study team explained the draft implementation plan to Ministry of Agrarian Policy and Food of Ukraine, and it was approved to conduct the women horticulture training at Polissia National University according to the implementation plan.

The JICA study team requested the Polissia National University to prepare a training curriculum and select trainees. Although the university's policy was respected, the university was requested to pay particular attention to ensuring accountable process in selection of trainees to meet the purpose of the training. In response, the university selected 23 trainees with the cooperation of Agricultural Development and Economic Policy Department of Zhytomyr Oblast Military Administration, which has ample information of local communities. As for the training curriculum, the university was also asked to prioritize the essential information that horticulture farmers should have and the overall picture of the supply chain of horticulture business in region. As a result, the topics in the curriculum covered crop selection and cultivation techniques, advantage and disadvantage of organic farming, introduction to micro-farming, i.e. one of urban agriculture practices in which vegetable cultivation is carried out in limited space such as rooftops, indoors, and balconies, post-harvest techniques and storage system, biological products such as natural pesticides and medicinal plants, access to the agricultural fund sources and organic certification, and visits to agribusiness companies. The training course was implemented as a short-term intensive program lasting 10 days from 9 October to 20 October 2023 as summarized below.

Table A3.3.2 Daily Activities of Horticulture Training at Polissia National University

No.	Date	Topics	Activities
1.	9 Oct (Mon)	Opening ceremony of training course	Professor Oleh Skydan, the Rector, gave the opening address and noted that this training was of great significance as the burden on rural women has increased due to the war. Deputy Director of the Zhytomyr Oblast Agricultural Industry Development and Economic Policy Department said that the training will contribute to the national agriculture. The Dean of the Faculty of Information Technology and Economics and Finance emphasized the specificity, characteristics and prospects of agribusiness development and the need for non-governmental subsidy programs. The Director of the Center for Education and Science in Ecology and Environmental Protection spoke about the prospects for EU partnership in the agriculture sector.
2.	10 Oct (Tue)	Special characteristics of horticulture	Dean of Faculty of Soil Science and Crop Agriculture outlined the outlook for agribusiness including urban farming for growing healthy foods on open spaces and indoors, seeds for medicinal and niche crops, and promising forage crops. In

No.	Date	Topics	Activities
			addition, Associate Professor of the same faculty introduced outdoor cultivation of vegetables, fruits and berry cultivation that has been proven in the Polissia region, i.e. Slavic culture region covering northern Ukraine, eastern Poland and southern Belarus, and farm management using *vermibiota* (vermicompost production technology).
3.	11 Oct (Wed)	Appropriate crop selection and cultivation techniques	Comprehensive analysis of crop selection based on natural conditions of soil and climate and traditional cultivation techniques and characteristic of the Polissia region. After a lively discussion on profitable crop cultivation, the participants learned how to determine soil particle size composition and visited the Soil Science Museum and Pesticide Laboratory.
4.	12 Oct (Thu)	Advantages and disadvantages of Organic Farming	The principles and advantages and disadvantages of organic farming were explained. Participants had lively discussion on control of weed, pest and disease, risks of organic farming, and the need for government supports for organic farming.
5.	13 Oct (Fri)	Visit to a private agribusiness company	Visited IMPAK, a private agribusiness. An overview of the know-how that will lead to successful agribusiness, and a tour of the perennial crop variety testing and research facility. The study tour were extended to vineyards, wineries, and nut orchards. Drip irrigation was observed.
6.	16 Oct (Mon)	Introduction to Microgreen Farming	Microgreen Farming has received worldwide attention in recent years. Introducing technical points to keep in mind, such as sowing and care after germination, as well as a list of suitable crops. Explanation of 12 types of seeds, fertilizers, natural pesticide formulations, etc. for demonstration cultivation provided by the JICA study. Each trainee conducted cultivation experiments at home during the winter period.
7.	17 Oct (Tue)	Crop post-harvest storage system	With distribution of agricultural products disrupted by the war, lack of storage systems is an urgent issue for agricultural producers, especially small-scale farmers. Information on technical methods of preserving vegetable products, in particular temperature control, humidification and gas mixtures that extend the shelf life. The marketing of horticulture crops were also discussed.
8.	18 Oct (Wed)	Biological products (natural pesticides, medicinal plants)	Invited the state's agricultural company "BTU-CENTER" to hold a practical seminar "Integration of biological products in organic farming and crop cultivation technology". Describe ecologically safe, selective, and effective biological products (natural pesticides and medicinal plants). The trainees visited the university's botanical garden and observed plants with remarkable medicinal properties.
9.	19 Oct (Thu)	Overview of official to funds and organic certification	The Zhytomyr Oblast Agricultural Industry Development and Economic Policy Department explained the state subsidy program for women farmers. The details of creating and submitting application form were explained. In addition, an organic certification expert will explain how to formulate a business plan and create a business plan for the development of agribusiness, the certification process, and effective marketing tools. There was a lively discussion among the participants.
10.	20 Oct (Fri)	Wrap-up workshop	Many key officials from the state government participated, including the Deputy Director of the State Government's Department of Ecology and Natural Resources. The participants expressed their gratitude to Polissia National University, JICA and the Agricultural Development and Economic Policy of the Regional Military Bureau for giving the women the opportunity to participate in the training course. The comments by the participants are presented at the end of this chapter.

Source: JICA Study Team

		
Greetings from Professor Oleh Skydan	Trainees at the opening ceremony	Lecture scene
		
Visit to private company IMPAK	Medicinal plants at the botanical garden	Wrap-up workshop

(3) Training Program at Four (4) Institutes

Referring to the performance of the training at Polissia National University, the JICA study team proposed to expand the activities of the short-term horticulture training for women farmers to four (4) educational institutes, namely Polissia National University in Zhytomyr oblast, Dnipro State Agrarian and Economic University in Dnipro oblast, Uman National University of Horticulture in Cherkasy oblast, and Institute of Agriculture of Carpathian Region (National Academy of Agrarian Sciences of Ukraine) in Lviv oblast.

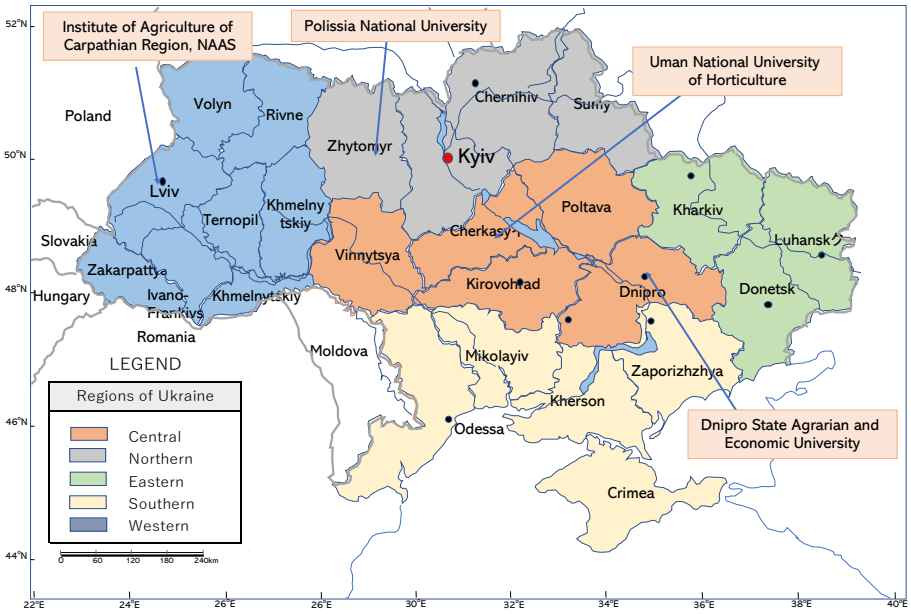
The kick-off meeting was held among the above-mentioned stakeholders from 10am to noon Ukrainian time on 12 January 2024. The four (4) institutes and JICA study team discussed how to implement the proposed training program and attained mutual consent. All the attendants agreed with the followings.

(1) Objective: The pilot project aimed at assessment of development needs through small-scale trial operation in situ and identification of appropriate methods for effective support measures.

(2) Operation Period：1 February 2024 to 20 March 2024.

(3) Training：Polissia National University（PNU）has already carried out the 1st phase operation for 10 days in net from 9 to 20 October 2023. Referring to its successful results, it was decided to proceed to the 2nd phase operation for 12 days in net from 8 to 23 February 2024. As well, the other three institutes would also carry out the training program for local women farmers for 12 days. It was requested to complete all the training activities by 15 March 2024.

(4) Organizational set-up: The selected four (4) educational institutions were to be coordinated for execution of the pilot project. PNU was supposed to play the pivotal role as representative body among the selected four (4) educational institutions. In collaboration with the JICA study team, PNU would directly support the other institutes for smooth operation of the pilot project.



Source：JICA Study Team

Figure A3.3.1 Location Map of the Four (4) Institutes

1) Trainees: The main targets of the pilot project were women farmers. Each institute would select 20 to 30 trainee candidates. Selection criteria of trainees (educational background, age, family structure, etc.) would be set up by each institute.
2) Training curriculum: Since agriculture in Ukraine are practiced according to the regional conditions, the structure of the training curriculum would be determined by each institute. It was advised that daily lecture would be provided for two hours each in the morning and afternoon, respectively. The outdoor programs were to be also recommended to give the trainees opportunities to visit advanced horticulture farmers, agricultural processing industries, and green markets.
3) Selection of lecturers: Lecturers would be selected after setting up the training curriculum.
4) Documents submitted in advance: The four institutes would submit the documents to the JICA study team by 10 February 2024.
5) Daily Activity Record: Lecturers would prepare daily reports of 1 to 2 pages that describe summary of the lectures, questions and answers, and other topics.
6) Wrap-up Workshop: To be held on the last day of the training course. The 20 trainees would be divided into four groups in the morning. In each group, the trainees would exchange their opinions on (1) their impressions of participating in the training, (2) new knowledge they would gain through the training, (3) topics they would like to learn more about in the future, and (4) their vision for the future of horticulture in their state of residence. In the afternoon, each group would make a presentation. After that, the representative of the institute would provide a general review. The results would be recorded.
7) Outputs of the Training Program: Each institute will submit the following outputs by 31 March 2024, i.e. daily activity report, wrap-up workshop report, attendance record of trainees, training materials or handouts used in the lectures, and picture files of jpg showing the training activities.
8) The training curriculum differs depending on each institute. Each institute would list up training materials such as textbook, stationary, farm inputs, farming tools, rental cars, etc. necessary for training.

9) Other expenses such as trainees' transportation expenses (bus fare, vehicle's fuel), drinks and snacks, and lunch and dinner are not subject to refund.
10) PNU would provide some of essential supports to the other institutes on behalf of the JICA study team. Related expenditures such as personnel expenses and transportation expenses related to these operational supports would be paid by the JICA study team.
11) If other outstanding issues arise, an online meeting between the JICA study team and the four (4) institutes would be held promptly, and all the efforts would be directed to the earliest settlement.

(4) Selection and attributes of trainees

Since it would be difficult for the JICA study team to be directly involved in the selection of trainees, it was left to the autonomy of each institute, with the condition that fairness was given top priority. Specifically, the details are as follows.

1) Polissia National University: 23 trainees were selected with the cooperation of the Agricultural Development and Economic Policy Department of the Zhytomyr Oblast Military Government Bureau because of their understanding of the situation of local farmers participated in the first training (October 2023). Since the second training (February 2024) is different from the training curriculum of the first training, many of the participants of the first training strongly requested to participate in the second training, but at the end, the second training session was held with 25 trainees including 11 trainees attended in the previous training and two new commers.
2) Institute of Agriculture of Carpathian Region: The selection was conducted by the Technology Transfer and Intellectual Property Department of the institute and the Lviv Oblast Agricultural Development Department. Of the 34 persons preliminarily nominated, 31 persons finally selected after excluding 3 persons who requested online participation. Includes one employee of the institute who has no agricultural education but hopes to work in agriculture in the future.
3) Uman National University of Horticulture: Two instructors who have experience in advance of similar participants in the ongoing "Norway-Ukraine. Professional Adaptation. Integration into the State System" (NUPASS) were selected, and 20 trainees were selected among 31 applicants/
4) Dnipro State University of Agriculture and Economics: The university's International Public Relations Department made an open call on the university's website. The university received 59 applications for 30 seats. Under the condition that trainees could participate in all the lectures throughout the training period at the university, not participate online. Finally, 32 trainees were selected including 13 graduates or students of the university.

Except the trainees of the Dnipro University, no one has to the institutes. In addition, the trainees of Polissia National University appeared to have other income sources. At all four (4) institutes, the trainees replied to some fundamental questions concerning their attributes. Of the 109 respondents, 83 (74%) were between 20 and 49 years old as presented below.

Table A3.3.3 Ages of Trainees

No.	Range of Age	Polissia	Carpathia	Uman	Dnipro	Total	(%)
1	below 20	0	0	0	6	6	6
2	20 to 29	4	2	5	8	19	17
3	30 to 39	6	12	8	9	35	32
4	40 to 49	4	11	4	8	27	25
5	50 to 59	7	1	2	2	12	11
6	Over 60	4	1	1	0	6	6
7	unknown	2	-	-	2	4	4
Total		27	27	20	35	109	100

Source：JICA Study Team

Only Dnipro University was able to obtain answers regarding educational background of the trainees. Of 35 participants, 19 were university graduates, 6 were junior college graduates, and 8 were high school graduates. Although there were trainees who have income sources from their jobs or as employees of organizations, it was not possible to ascertain accurate information. However, among 74 trainees of Polissia University, Carpathia Institute, and Uman University, the trainees replied with clear answers were 7 teachers, 3 law professionals, 3 financial institutions, 2 nurses, 1 dentist, and 1 veterinarian. On the other hand, out of 35 trainees of Dnipro University, 11 trainees work for private companies and 3 for government agencies.

Of the 103 respondents, 86 (83%) were married. The largest number of people living together in a household was three (43%). The presence or absence of the household head could not be ascertained. The breakdown of marital status and number of household members sharing household finances is shown in the table below.

Table A3.3.4 Marital Status

No.	Status	Polissia	Carpathia	Uman	Dnipro	Total	(%)
1	Unmarried	6	2	0	10	18	17
2	Married	15	25	20	22	82	79
3	Widow	4	0	0	0	4	4
Total		25	27	20	32	103	100

Source：JICA Study Team

Table A3.3.5 Number of Persons per Household

No.	Persons/HH	Polissia	Carpathia	Uman	Dnipro	Total	(%)
1	1	1	2	1	0	2	5
2	2	2	3	4	7	4	18
3	3	3	12	7	13	11	43
4	4	4	5	7	0	7	19
5	5	5	2	5	0	3	10
6	6	6	1	2	0	4	7
7	7	7	0	1	0	0	1
8	8	8				2	2
Total		25	27	20	32	103	100

Source：JICA Study Team

Of the 107 respondents, 66 persons (62%) were farmers whose land area was less than 10 ha. Although land system reform has made it possible for individual farmers to own up to 100 ha of land, only 6 trainees (3%) own land exceeding 100 ha.

Table A3.3.6 Land Holding Size

No.	Land (ha)	Polissia	Carpathia	Uman	Dnipro	Total	(%)
1	< 1.0	5	10	0	23	38	36
2	1.1 - 10.0	3	6	14	5	28	26
3	10.1- 50.0	12	1	6	3	22	21
4	50.1 - 100.0	5	1	0	1	7	7
5	100.1 <	2	0	0	1	3	3
6	No reply	0	9	0		9	8
Total		27	27	20	33	107	100

Source：JICA Study Team

Regarding the crops currently being cultivated, each state lists more than 30 crops. As for horticultural crops, vegetables such as tomatoes, onions, cucumbers, potatoes, cabbage, and carrots occupy the top positions. On the other hand, fruits are followed by apples, grapes, pears, and plums. It is noteworthy that eight of 20 trainees grow strawberries. The top 20 selected crops are shown in the table below.

TableA3.3.7 Crop Selection (Top 20)

No.	Crops	Polissia	Carpathia	Uman	Dnipro	Total
1	Grains not specified			20	21	41
2	Tomato	2	4		20	26
3	Fruit trees not specified			20		20
4	Industrial crops not specified			20		20
5	Onion		4		16	20
6	Cucumber				20	20
7	Potato	1	1		17	19
8	Cabbage	3	1		14	18
9	Carrot				18	18
10	Rapeseed	1	7	5	3	16
11	Sunflower	7			9	16
12	Apple		2		11	13
13	Grape				12	12
14	Pear		2		8	10
15	Currants		4	5		9
16	Soybean	8			1	9
17	Plum		2		7	9
18	Strawberries			8		8
19	Blackberries		5	2		7
20	Herbs	3	2			5

Source：JICA Study Team

Regarding the reasons for participation of horticulture trains were answered descriptively, only keywords in each answer were extracted. The results are as shown in the table below.¥

Table A3.3.8 Reason for Participation in Training

No.	Keyword	Polissia	Carpathia	Uman	Dnipro	Total
1	Knowledge	12	15	7	0	34
2	Interest	5	1	0	20	26
3	Learn	9	1	3	0	13
4	Skill	2	3	6	2	13
5	New	3	8	1	0	12
6	Business	1	6	4	0	11
7	Develop	2	2	4	0	8
8	Experience	6	2	0	0	8
9	Desire	0	7	1	0	8
10	Recommended	0	0	0	7	7
11	Improve	5	2	0	0	7
12	Income	0	0	1	6	7
13	Professional	2	0	3	0	5

Source：JICA Study Team

(5) Polissia National University – Phase 2 Training

Table A3.3.9 Training Curriculum at Polissia National University

No.	Date	Activities
1.	8 Feb (Thu)	Training course objectives and overview, agribusiness structure, sustainable farm management, agricultural finance overview
2.	9 Feb (Fri)	Problem statements and decision making, management training for business development and value-added generation, management of crop production companies (lean management concepts), experience with EU agricultural policy: issues and priorities of women farmers
3.	12 Feb (Mon)	Selection and use of production materials such as seeds, fertilizers, protective equipment, etc., organization and characteristics of berry cultivation
4.	13 Feb (Tue)	Organization and characteristics for growing flowers and ornamental plants, organization and characteristics for the production of microgreens and wheatgrass
5.	14 Feb (Wed)	Agroecological strategies for sustainable weed management in major European crops, mechanisms and characteristics of mushroom cultivation, organization and characteristics of medicinal plant cultivation
6.	15 Feb (Thu)	Selection of greenhouse type and greenhouse equipment. How to grow in a greenhouse. Market analysis and project documentation preparation. Profitability and recovery rate calculations
7.	16 Feb (Fri)	Inspection of an agricultural greenhouse owned by a greenhouse horticulture company in Zhytomyr Oblast
8.	19 Feb (Mon)	Selection and characteristics of agricultural machinery for specific crops, use of unmanned aircraft in agricultural production, software for accounting and taxation in agricultural management
9.	20 Feb (Tue)	Record-keeping and taxation for individual entrepreneurs, accounting and taxation for individuals and corporations, and the respective characteristics of accounting for single-tax entrepreneurs. Legal principles of protection of rights and interests of farm subjects: analysis of laws and court practices
10	21 Feb (Wed)	Product and marketing strategies: development and implementation on farms, marketing channels for agricultural product distribution: farm identification, advertising in agricultural sales channels, etc.
11	22 Feb (Thu)	Visit of agricultural machinery service providers in Zhytomyr Oblast
12	23 Feb (Fri)	Wrap-up workshop

Source：JICA Study Team

Opening speech by Dr. Oleh Skydan

Trainees attending the course

Exhibition of agricultural drones

Visit to the greenhouse (cucumbers)

Visit to the greenhouse (hydrangeas)

Wrap-up workshop

(6) Institute of Agriculture of Carpathian Region

Table A3.3.10 Training Curriculum at Institute of Agriculture of Carpathian Region

No.	Date	Activities
1.	19 Feb (Mon)	Objective and overview of the training course
2.	20 Feb (Tue)	Formation and pruning of fruit trees (practical edition)
3.	21 Feb (Wed)	Pests of vegetable, pear, nut and berry crops and their control measures
4.	22 Feb (Thu)	Analysis of potato varieties suitable for the soil and climate of the Carpathian region, pre-cropping of potatoes in crop rotation, optimal soil for cultivation, cultivation techniques, fertilizers, pest control, "borscht set" vegetables, basics of organic vegetable cultivation
5.	23 Feb (Fri)	Landscaping techniques and maintenance of ornamental plants
6.	26 Feb (Mon)	Nut production technology, a wide variety of nut crops, ② cultivation technology (walnuts, hazelnuts), nut crops, propagation methods
7.	27 Feb (Tue)	Features and techniques of fruit cultivation, characteristics of fruit crops and prospects for development, seed varieties of fruit crops (cultivation techniques), creation and organization of orchards (preparation, care, harvesting)
8.	28 Feb (Wed)	Visit to agricultural enterprises in Lviv province
9.	29 Feb (Thu)	Visit to agricultural enterprises in Lviv province
10.	1 Mar (Fri)	Analysis of the range of current fruit and berry crops. The role of variety in fruit production. Common and promising varieties of cereals, common and promising varieties of major stone fruit crops, and best varieties of berry crops. Distribution of the catalog "The best varieties of fruit and berry crops". Fruits of different varieties of apples and pears (tasting).
11.	4 Mar (Mon)	Introduction to business plan formulation methods
12.	5 Mar (Tue)	Wrap-up workshop

Source：JICA Study Team

<table>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Opening speech by Deputy Director Panakhyd Halyna</td><td>Lecture scene (apple varieties)</td><td>Lecture scene</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>Study tour to the orchard company</td><td>Closing workshop</td><td>Closing workshop</td></tr>
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(7) Uman National University of Horticulture

Table A3.3.11 Training Curriculum at Uman National University of Horticulture

No.	Date	Activities
1.	19 Feb (Mon)	Purpose and outline of the training course, advanced technology for growing fruit tree seedlings
2.	20 Feb (Tue)	Formation and pruning of fruit trees (practical edition)
3.	21 Feb (Wed)	- Current status, characteristics, and prospects of grape cultivation (theory edition) - Characteristics of grape vine propagation and cultivation techniques for planting materials (theory) - Formation and pruning of vines (theory)
4.	22 Feb (Thu)	- Vineyard care (practical edition) - Harvesting technology. Vineyard restoration and reconstruction (practical edition) - Basics of grape variety identification (practical edition) - Selection of planting location. Specialties of the establishment and management of intensive orchards.
5.	23 Feb (Fri)	Visit to an advanced horticulture farm
6.	26 Feb (Mon)	Small business accounting, reporting and taxation
7.	27 Feb (Tue)	A technique for storing pears, nuts, berries, grapes, etc.
8.	28 Feb (Wed)	Lectures on farm maintenance, sales channels, and management of fruits such as blueberries, raspberries, plums, and apples, walnuts, and hazelnuts at an agricultural company's orchard.
9.	29 Feb (Thu)	Berry production: from variety selection to marketing success A practical approach to growing and selling berries
10.	1 Mar (Fri)	Visit to an advanced horticultural farm, Uman Arboretum Sofiyivka Nursery Garden Center Zelenadolina
11.	4 Mar (Mon)	Functional principles of ornamental plant nurseries
12.	5 Mar (Tue)	Wrap-up workshop

Source：JICA Study Team

Greetings from Vice President Mykhailo Malyovanyi

Lecture on fruit tree pruning

Field practice for fruit tree pruning

Study tour to the orchard company

Visit to company's greenhouse for ornamental plant cultivation

Participants with certificate for the JICA training course

(8) Dnipro State University of Agriculture and Economics

TableA3.3.12 Training Curriculum at Dnipro State University of Agriculture and Economics

No.	Date	Activities
1.	27 Feb (Tue)	Purpose and outline of the training course, soil as the basis of life and agribusiness, soil characteristics for fruit cultivation
2.	28 Feb (Wed)	Features of growing vegetable crops under drip irrigation, water quality and irrigation technology for vegetable crops
3.	29 Feb (Thu)	Comprehensive protection of vegetable, fruit and berry crops, mineral nutrition and fertilization of vegetable, fruit and berry crops,
4.	1 Mar (Fri)	The key to success in modern vegetable production, characteristics of microgreens and growing microgreens in healthy nutrition
5.	4 Mar (Mon)	How vertical farming will change the future of agriculture: key benefits and secrets to success
6.	5 Mar (Tue)	Fruits and berries and prospects for their cultivation in Ukraine, features of growing hazelnuts in unstable humid regions
7.	6 Mar (Wed)	Workshop on how to prepare planting material for flower beds, fruit formulations
8.	7 Mar (Thu)	How to Preserve Vegetables and Fruits: Science and Practice. workshop
9.	8 Mar (Fri)	Tour of facility cultivation (tomatoes and cucumbers) by agricultural companies in the state
10.	11 Mar (Mon)	Current status of nut production, crops, cultivation techniques (walnuts, hazelnuts), seed production techniques for nut crops
11.	12 Mar (Tue)	Characteristics and development prospects of fruit crops, seed varieties of fruit crops (cultivation techniques), creation and organization of orchards (preparation, care, harvesting)
12.	13 Mar (Wed)	Closing workshop

Source：JICA Study Team

Opening ceremony of horticulture training session

Lecture

Lecture on advanced farming technologies

Lecture

Hydroponics at plant factory in Dnipro

Flip charts for Wrap-up Workshop

(9) Results of Wrap-up Workshop

The wrap-up workshop was held on the last day of the 12-day training at each institute. The participants were divided into 4 to 6 groups and exchanged their comments about overall views of the training, the new knowledge they gained, what they would like to learn more and their vision of future of horticulture in their regions. The comments of the workshop participants are summarized below.

1) Polissia National University: Phase 1 training in October 2023
   - It seems difficult for women's participation to intervene the horticulture industry. The JICA's horticulture training encouraged women farmers and changed their mindset by showing opportunities to join the horticulture production.
   - Useful information obtained through the training would be helpful for our future business. Although the time was limited, we are aware that the university is highly functional for human resource development.
   - Farmers do not know where to access to resolve their problems. It seems a good idea that the university would provide necessary information to farmers. Currently, many internally displaced persons (IDP) from other regions to Zhytomyr region fleeing the war. Some IDP have sufficient experiences of crop production but do not know how to resume their farming. The university is expected to provide opportunities those people reintegration into society and overcome the psychological problems usually associated with participation in military operations.
   - After completing the training, the participants expressed their hope to organize a kind of women farmers association.

2) Polissia National University: Phase 2 training in February 2024
   - Greenhouse cultivation for vegetables and flowers attracted the trainees' intent. They asked whether the Ukrainian government would provide the supports for the small greenhouse with farming techniques suitable for individual farmers rather than large-scale glass greenhouses.
   - Soils in southern Ukraine have been contaminated with chemicals and heavy metals due to the war. We need to quickly adapt and reorient other areas to growing vegetables and fruits. The Polissia region is the most promising region in terms of soil and climatic conditions. Strengthening the training function for farmers in this region is highly promising.
   - Knowledge about agricultural product pricing, marketing, packaging, branding, PR, etc. can greatly improve the sales ability. It is necessary to know not only farming technology but also laws regarding land leases and collateral setting, and international laws regarding cooperation with foreign capital.
   - It was proposed among the trainees to establish a cooperative or form an association of women farmers. Forming groups will facilitate communication. By preparing a business plan for crop cultivation, the group can expect to learn about appropriate technology, sales promotion, marketing strategy, and economic efficiency.
   - As one of the smart technologies, unmanned aerial vehicles (UAVs) equipped with multispectral cameras will be effective to collect environmental data and information of the farmland. I would

like to participate in training course for drones.

3) Institute of Agriculture of Carpathian Region

- Inspired by new ideas for agricultural development, the training course provided a diverse of the information for horticulture cultivation techniques and issue of certificate and product quality control. More lectures would be needed with respect to the post-harvest techniques such as cold storage and processing. The business planning based on agricultural production costs and profits is another important issue.
- Women farmers have future prospect for greenhouse cultivation and learned about subsidy programs to support farmers. The knowledge about grant applications and business plans are essential. Moreover, the legal knowledge will be required about business operations, local governments support small-scale farmers, stabilize, and improve food self-sufficiency, promote consumption of local products, and support and encourage young people to participate in agriculture.
- The development of the agricultural sector in Lviv has been greatly affected by war and climate change. Due to the war-ravaged southern regions of Ukraine, many motivated farmers moved to the western parts of the country and started farming. Due to climate change, crops that were previously grown only in the southern regions can now be grown in the west. Substantial areas of vacant land have been left in the west.

4) Uman National University of Horticulture

- Since this horticulture training was held in the winter, the fruits production was focused on. Significant time was devoted to the technical transfer of fruit tree management including irrigation and nutrient management to optimize both growth and yield of fruit trees, berries and grapes. They also learned more about Integrated Pest Management (IPM) systems and alternative solutions to protect crops from pests, diseases and weeds without relying too heavily on chemical treatments.
- The business plan and management of horticulture business are necessary for a successful business performance. In particular, such skills as accounting, reporting and taxation are utmost important for the financial management of small and medium-sized enterprises. Following the lectures, the trainees visited experienced farmers and entrepreneurs and exchanged their experiences of not only vegetable production but also ornamental gardening and plant nurseries.
- Subsidies and financial programs in the agricultural sector were introduced in the lecture. The participants learned how to prepare business plans and application forms, which are essential for securing funding. By the end of the training, the lecture covered both technical and business aspects of horticulture, in which the analytical method of business plans and the method of operation and management methods to increase productivity were dealt with.
- In view of climate changes, it is recognized to pay special attention to drought- and flood-resistant crop varieties and strategies to achieve expected productivity. Advanced techniques in organic farming, especially those that can increase yields while maintaining soil health and biodiversity will also be important.
- Post-harvest techniques and facilities are essential knowledge for those involved in the horticulture business in future. Besides, the strategies of distribution and marketing of fruit and vegetable by e-

commerce will largely expand opportunities to reach markets and increase direct-to-consumer sales.

5) Dnipro State University of Agriculture and Economics

- Many of the trainees preferred the field training to accumulate practical skills. For easy participation, it is better to shorten the duration of the training course, e.g. 3 to 5 days for individual topic. We can learn deeply about the subject matter and be able to narrow down the destinations to visit on the study tour.
- It is useful to hear about innovative agricultural techniques, product certification, quality control, Japanese vegetable cultivation, climate change, Zero-Waste, maintaining soil fertility, etc. It is also valuable to know agribusiness financial models, agribusiness and farmland lease law, grain and craft processing, beekeeping combined with vegetable and fruit cultivation, green tourism and garden therapy.
- (Contrary to the above) Some topics were too academic. While information such as adjusting mixed fertilizers and know-how on greenhouse horticulture may be useful to certain trainees, information about apples and other fruit trees would have been more important to many trainees. It would be a good idea to take a preliminary survey from the trainees and select the topics for the training session.
- Some women hope that universities will hold agricultural rehabilitation activities for veterans and environmental protection activities. Additionally, it was difficult for women who could not attend university to participate, and accommodation facilities for participants were considered necessary. It would be helpful if JICA offered a grant program to support women in agriculture.

(10) Results of Women's Horticulture Training

1) Overall performance of the pilot projects

The horticulture training was carried out at four higher education institutions according to the Memorandum of Understanding signed with the JICA study team. A total of 107 women farmers (1,300 person-days) participated in the horticulture training at the four institutions. According to the interview results by the institutes, 74% of the trainees are between 20 and 49 years old, 79% are married, 80% have 2 to 4 household members, and 64% own land of 10.0 ha or less. Furthermore, 36% of the trainees owned less than 1.0 hectares of land. The fact suggests that there are considerable portions of farmers are not able to keep make a living from agricultural income alone. As for the trainees of Dnipro University, 33 trainees out of 35 trainees have educational background of high school graduation or higher, and most of them have other jobs.

The training curriculum were generally of interest to the participants, and there were not crucial gaps between the difficulty level of the lectures and the level of the trainees understanding as far as classroom lectures are concerned. On the other hand, the field training was limited only to the pruning practice for orchards since the training was held in winter season. It was needed to verify whether the institutes are capable to provide on-farm technical training for farm maintenance during the cropping seasons.

Many trainees expressed their positive opinion that they would like to continue working in agricultural management. However, further in-depth analyses based on impact assessment are needed to assess overall results of the training. There were also some comments regarding the methodology of the training concerning duration of training course, method of selecting themes, etc. Although it was operated remotely, the data collection had to be carried out to evaluate changes before and after the pilot project.

It is remarkable that the attendance rate of the training was over 90% in total. Although the training was held during the wartime and 93 air raid warnings were issued in Dnipro city during the training period from 27 February to 13 March 2024, the attendance rate at Dnipro University exceeded 90%, indicating the trainees' strong desire to enter the horticulture business in the future.

2) Advantage of agricultural training provided by local universities

The agriculture extension services in Ukraine are to be deployed under the responsibility of local administration. However, according to the trainees, it is hard for local farmers to access to necessary advice from the network of agriculture extension services. Local farmers receive necessary advice concerning crop cultivation occasionally from seed and fertilizer distributors as needed. In Ukraine the agroecological conditions are widely ranged by region and, therefore, the training themes selected by the universities were consequently diversified by institute as seen under the pilot project. With knowledge and experiences locally accumulated at the universities, they are in preferable positions to provide prompt and detailed technical advice to meet urgent needs of local farmers. It is desirable to discuss new mechanisms of the agricultural extension services by utilizing the resources of the local universities between Ministry of Agricultural Policy and Food and the Ministry of Education and Science.

3) Addressing cross-regional dissemination issues and applying digital technology

Technical guidance on financial analyses followed by consecutive training is recognized to be one of the nation-widely required aspects for unskilled farmers who wish to join horticulture business in near future. In general, young farmers have little experience in producing and selling cash crops and are not accustomed to realistic analysis of farm management one the basis of business plan. The business plans are prepared based on the price mechanism of crops in markets and the production costs including loan repayments, facilities maintenance costs, input procurement costs, equipment renewal costs, etc. Apart from the region-oriented training aspects, the cross-regional issues such as skill up of management ability should be covered by the agriculture extension services. In this regard, the use of digital technology is promising from the perspective of cost performance. The digital technology currently available are widely ranged. They include local and international market information, portal sites for agricultural materials and equipment, remote diagnosis of pests and weeds, agricultural e-learning, and e-commerce, and should be introduced as supporting tools for agriculture extension.

4) Short-term training sessions and budgetary measures at universities

Apart from classroom lectures, it would be effective to organize a series of short-term seminars for farming practices corresponding to sequence of growth stage of crops in line with the official agricultural calendar recommended by Ministry of Agrarian Policy and Food. For instance, in case of or vegetables of growth period of 2 to 4 months, farming practices include 1) input selection and field preparation, 2) sowing/seedling raising, pest control, 3) fertilization/transplanting, 4) additional fertilization, weeding and pest control, and 5) harvesting, post-harvesting and marketing. For each practice, the training session of 2- or 3-day will be held at university. Farmers will be enable to participate selectively in the seminars that interest them and also immediately apply the appropriate practices to their own fields. As some trainees criticized that the training period of 12 days was too long and some of topics were of little interest to them.

By encouraging group training at universities, another positive effects are expected by expanding opportunity of group activities among trainees for purchasing the farm inputs and joint marketing of harvest. On the other hand, in terms of the management by universities, it is necessary to strengthen the capacity of instructors among the staff and to prepare budgets for training courses. Since the universities cannot cover all these costs, it is also necessary to consider collecting a tuition from the participants.

5) Formation of rural communities through agricultural training

Many opinions were expressed at the wrap-up workshop, and a community of trainees was formed through the training sessions at both Polissia University and Dnipro University. It was proposed that the network among the trainees will be preferably maintained even after the training for the purpose of continuous business activities such as exchanging market information and selling products within the community. Additionally, the trainees of both universities expressed that training sessions at the universities would play an important role in future for mental rehabilitation of returning soldiers ensuring their earlier reintegrate into society. Although this training session targeted women farmers, it is expected that the agriculture activities by group should be encouraged not only for agricultural purposes but also contribution to stabilizing the livelihoods of rural communities during wartime.

3.4 Soil Survey Aimed at Understanding the Current State of Heavy Metal Contamination in Soil

The following table presents an overview of the survey on heavy metal contamination in agricultural soil, as conducted by civil engineering consultants.

Table A3.4.1 Outline of Sublet Contract：Soil Survey (PLT Labo Ltd.)

Objective	・ To understand the current state of heavy metal contamination in agricultural soil and ・ To use this information to formulate soil improvement action plans using phytoremediation* in the future.
Period	November 12, 2023, to February 28, 2024
Target Area	Target 5 Oblasts (Kyiv, Sumy, Chernihiv, Zhytomyr, and Dnipropetrovsk). *Locations within bombed areas were selected where sample collection could safely be conducted.

Sample method	・ Soil samples from the top 0-15 cm layer were collected at 0 m, 50 m, 100 m, 200 m, and 500 m from the bombing sites at 10 locations (5 Oblasts × 2 sites each), 50 samples in total. At Location 5, preliminary surveys were conducted at varying intervals: 0 m, 10 m, 30 m, 50 m, and 100 m.
Measurement Items	・ Concentrations of 14 heavy metals (Cd, Cr, Zn, Hg, Se, Pb, As, F, B, Cu, Co, Mn, Ni, and Sb) were selected based on the Japanese Soil Contamination Countermeasures Act, the Act on the Prevention of Soil Contamination in Agricultural Land, and the key heavy metals of the European Soil Data Centre (ESDAC). ・ Soil texture distribution (Sand, Silt, and Clay), humus content, and chemical properties (pH, Ng (hydrolytic acidity), organic matter, medium content, NH4, NO3, Mass fraction of carbon, S, P_2O_5, K_2O, Ca, Mg, Na, Sum of absorbed bases, Electrical conductivity) were measured, with measurements taken only from samples within 500 m of bombing sites.

* A technology that utilizes the ability of plants to absorb water and nutrients through their stomata and roots to absorb and decompose pollutants in soil, groundwater, and the atmosphere.

Source: JICA Survey Team

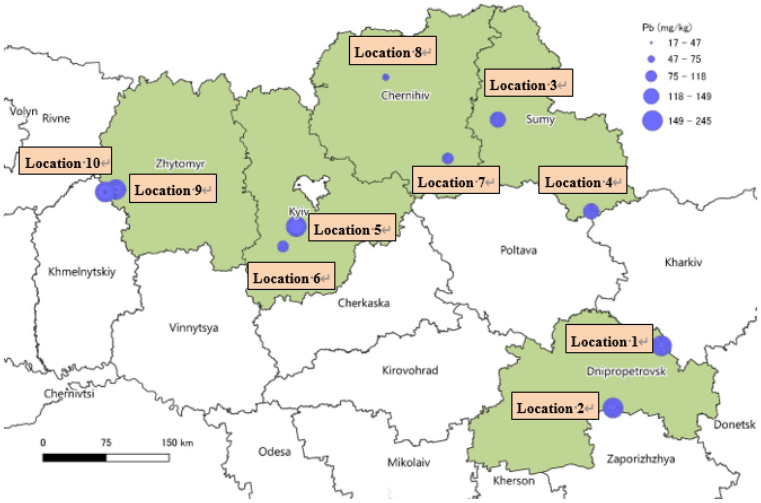
Additionally, regarding the 14 types of heavy metals targeted in this study, the general effects on the human body when concentrations exceed acceptable levels are listed below:

- Cadmium (Cd):
  Accumulation in the body can cause kidney damage and weakening of bones (Itai-Itai disease) among other health problems.
- Chromium (Cr):
  Particularly hexavalent chromium is carcinogenic, and long-term exposure is known to increase the risk of dermatitis, damage to the nasal mucosa, and lung cancer.
- Zinc (Zn):
  Excessive intake of zinc can cause digestive system problems, copper deficiency, and a decrease in immune function.
- Mercury (Hg):
  Highly toxic to the nervous system, particularly concerning for the neurodevelopment of children and foetuses. High levels of exposure can cause sensory impairments, speech disorders, and vision problems.
- Selenium (Se):
  While a moderate amount is an important antioxidant, excessive intake can cause dermatitis, abnormal nail conditions, and peripheral neuropathy.
- Lead (Pb):
  Can cause developmental disorders, learning disabilities, and behavioral problems in children. In adults, it may cause high blood pressure and kidney damage.
- Arsenic (As):
  Long-term exposure can lead to skin lesions, neurological problems, respiratory issues, and even skin or internal cancers.
- Fluoride (F):
  Essential for the development of teeth and bones, but excessive intake can cause dental fluorosis (staining of teeth) and skeletal deformities.

- Boron (B):
  Necessary in adequate amounts, but excessive intake can cause skin irritation, digestive disorders, and kidney damage.
- Copper (Cu):
  Necessary for many enzyme reactions in the body, but excessive intake can cause liver and kidney damage and gastrointestinal disorders.
- Cobalt (Co):
  An important part of vitamin B12, but excessive intake can cause heart problems and thyroid dysfunction.
- Manganese (Mn):
  An essential trace element, but excessive exposure can cause neurological damage and symptoms like Parkinson's disease.
- Nickel (Ni):
  Can cause skin allergies in some individuals and long-term exposure is known to increase the risk of lung and nasal cancer.
- Antimony (Sb):
  High-level exposure can cause lung damage, heart problems, and digestive disorders, particularly discussed as a health risk in occupational settings.

(1) The Impact of Bombings/explosions on Soil Heavy Metal Contamination in Each Oblast

Based on the GPS location information of the sampling sites, the concentration of Pb in the soil at each location is shown in the figure below. The concentration of Pb in Chernihiv (Location 7, Location 8) was lower compared to other locations, indicating that the impact of soil contamination due to bombings was relatively small. For the five heavy metals (Cd, Ni, Zn, Cu, Cr), the concentrations in the soil were higher in Kyiv, Dnipropetrovsk, and Zhytomyr compared to Chernihiv and Sumy, indicating a relatively high impact of heavy metal pollution due to bombings (see Annex 3.4.1).



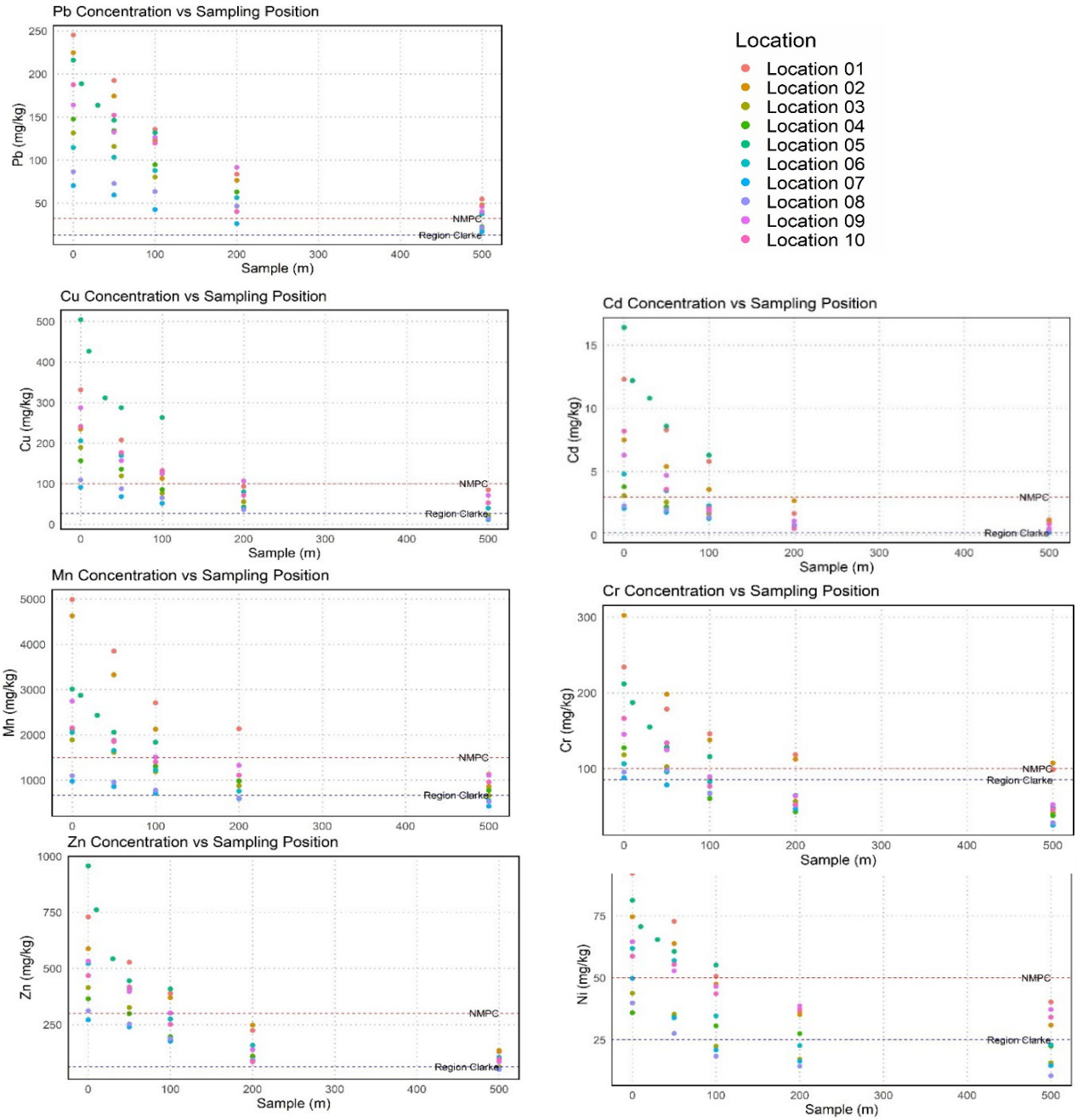
Source: JICA Survey Team

Figure A3.4.1 Soil Pb Concentration at Each Sites

(2) The Distance from Bombing Sites and Soil Heavy Metal Concentration at Each Sites

Based on the heavy metal concentration data sampled from soil at 10 locations, scatter plots were created to analyze the relationship between the distance from the bombing sites and the concentrations of various heavy metals. Concentrations exceeding the Norms of the Maximum Permissible Concentration (NMPC, mg/kg) were observed at the bombing sites for seven heavy metals (Cd, Cr, Cu, Pb, Zn, Ni, Mn) (Figure A3.4.2), indicating a tendency for soil concentrations to decrease as the distance from the bombing site increases. This suggests that soil heavy metal contamination has progressed due to bombings. In particular, Pb concentrations exceeded the NMPC at all locations within 0-100 m from the bombing sites and at half of the locations even at 500 m, suggesting that the impact of bombings on Pb concentration is higher compared to other heavy metals. The results for other heavy metals are shown in Annex 3.4.1.

Furthermore, as introduced in the previous section 2.6.2, "The Potential Risks to Key Crops from Lead (Pb), Nickel (Ni), Chromium (Cr), and Copper (Cu) in Soil," the results of soil testing in the survey have consistently confirmed the presence of these four heavy metals, aligning with the findings of the Kyiv National University investigation.



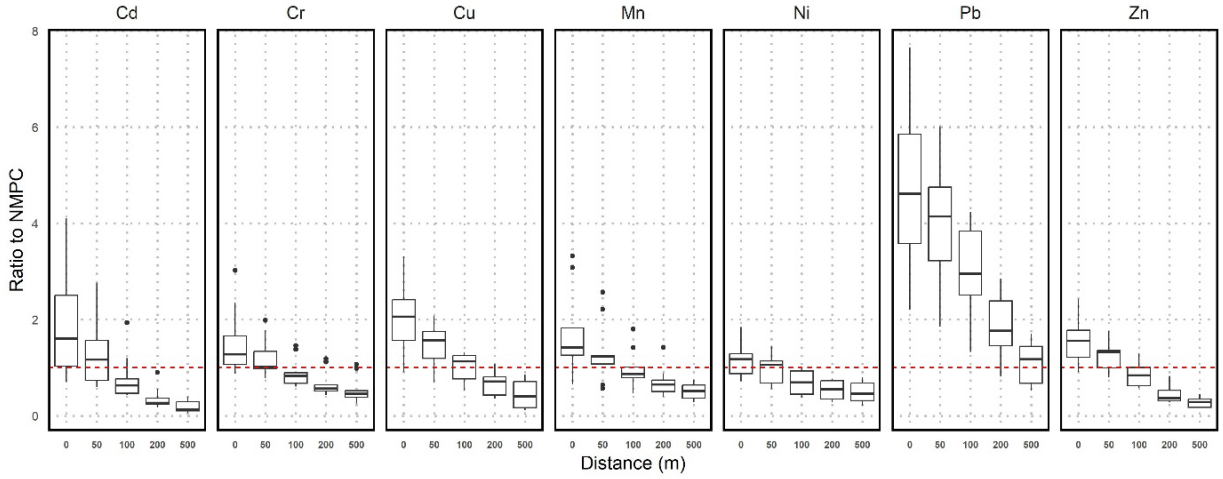
*Only data for heavy metals whose concentrations in the soil at the bombing sites exceeded the NMPC are shown.
*Regional Clarke indicates the concentration of elements naturally present in the soil of the region.
Source: JICA Survey Team0

Figure A3.4.2 The distance from the Bombing Sites at Each Sites and the Concentration of Heavy Metals in the Soil

Furthermore, a comparison of the distance from the bomb sites and the degree of heavy metal contamination (ratio of NMPC for each heavy metal) for the seven heavy metals is shown in Figure 3. At the bombing sites, the concentration ratios to NMPC were highest for Pb, approximately 4-6 times, followed by Cu and Cd at about 2 times, and Cr, Mn, and Zn at about 1.5 times, with Ni being slightly above 1. Although there is variability in the values for Pb and Cd across locations, it suggests that the impact of soil contamination at the bombing sites is significant.

Additionally, summarizing the relationship between the distance from the bomb site and NMPC, the following points are indicated:

- For Cd, Cr, Mn, Ni, and Zn, the ratio to NMPC is above 1 at the bomb site, but the average value decreases to below 1 within 100 meters. Therefore, for these metals, remediation is generally required within a range of 100 meters from the bomb site.
- For Cu, the concentration decreases to acceptable levels between 100 and 200 meters, indicating that slightly broader area measures are necessary compared to the above five metals.
- For Pb, due to the extremely high contamination levels at the bomb site, the concentration does not decrease to acceptable levels even at distances of 500 meters away, indicating that the impact extends over a very broad area centered on the bomb site. Compared to other metals, Pb should be considered the most critical metal to address.



*The red line in the figure indicates the NMPC ratio = 1 (the standard value) for each heavy metal.
Source: JICA Survey Team

Figure A3.4.3 Distance from Bombing Sites and Heavy Metal Contamination

Next, the reduction rate of heavy metal contamination at 0 m and 500 m from the bombing sites is compared. The reduction rate for Cd was the highest at approximately 90%, followed by Zn at about 82%, Cu at about 80%, and Pb at about 78%.

Table A3.4.2 NMPC Ratio and Reduction of Heavy Metals at Bombing Sites and 500 m Locations

Metals	A NMPC ratio@0 m	B NMPC ratio@500 m	{(A-B)/A}×100 Reduction Ratio (%)
Cd	1.87	0.19	89.94
Zn	1.56	0.28	81.97
Cu	2.05	0.43	79.19
Pb	4.76	1.07	77.59
Mn	1.68	0.52	69.25
Cr	1.54	0.54	64.91
Ni	1.16	0.51	56.14

*A and B represent the average values from 9 locations, excluding Location 5.
Source: JICA Survey Team

(3) The Impact of Each Heavy Metal on Agriculture during Post-War Reconstruction

Among the 14 heavy metals analyzed, concentrations exceeding the permissible levels (NMPC) were observed at the bombing sites for seven heavy metals (Cd, Cr, Cu, Pb, Zn, Ni, Mn). Therefore, it is necessary to take some measures for these heavy metals in soil treatment after the war.

Furthermore, from the perspective of each heavy metal's NMPC ratio and reduction rate, the following table organizes the degree of impact these metals have on agriculture during post-war reconstruction.

Table A3.4.3 The Impact of Each Heavy Metal

Metals	NMPC ratio@0 m	Variation in NMPC Ratios at Each Sites	Reduction ratio (%)	Impact
Cd	Medium	High	High	Relatively small
Zn	Medium	Small	High	Relatively small
Cu	Medium	Medium	High	Relatively small
Pb	**High**	**High**	**Medium**	**Serious**
Mn	Medium	Medium	Medium	Somewhat serious
Cr	Medium	Medium	Small	Somewhat serious
Ni	Small	Small	Small	Relatively small

Source: JICA Survey Team

Pb is considered to have the highest impact from bombings because it shows a high NMPC ratio at the bombing sites and a moderate reduction rate at 500 m compared to other heavy metals, indicating that its effect spreads over a wide area. As shown in Figure 3 previously, considering that the concentrations of heavy metals other than Pb generally decrease to acceptable levels within a distance of 100m from the bomb site, it is thought that physical soil replacement methods like "topsoil stripping" could be effective in simultaneously removing multiple harmful substances within this range during post-war soil treatment, due to the high likelihood of various contaminants being present. On the other hand, the observation of Pb contamination exceeding permissible levels even at locations 500m away from the bomb site suggests that treatments specialized in washing Pb, especially from 100 to 500m (and possibly beyond) from the bomb site, could be economically viable. Specific treatments could include the application of phytoremediation using plants that adsorb Pb or spreading agents that detoxify Pb.

This analysis and consideration are based on an extremely limited dataset of only 10 samples. Additionally, despite extensive research, no previous studies or literature on similar analyses could be found, indicating a general lack of data regarding the contamination of soil by heavy metals from explosives and its extent. Therefore, it is risky to draw definitive conclusions from this analysis alone; it should rather be regarded as

reference data indicating trends. Consequently, it is necessary to mention that detailed policies for soil remediation should be based on further analysis and consideration, incorporating results from a larger number of sample surveys.

CHAPTER 4. SHORT AND MID-LONG TEAM SUPPORT PLANS

4.1 Consideration of the JICA's Support Policy based on the Challenges, National Strategy, and Needs of Ukraine

4.1.1 Possible Direction for JICA's Support to Ukraine's Agricultural Sector

The Japan International Cooperation Agency (JICA) has provided support to Ukraine and its neighbouring countries through the following three pillars:

i. Support continuance of government functions

ii. Assist neighbouring host counties and Ukrainians displaced by the invasion

iii. Conduct recovery and reconstruction support

Under the third pillar, special emphasis is placed on: "(i) Laying a Foundation for a Smooth Recovery", "(ii) Improving Livelihoods and Environment", "(iii) Industrial Recovery and Export Promotion", and "(iv) Strengthening Democracy and Governance". JICA's efforts range from providing emergency humanitarian assistance to engaging in recovery and reconstruction development. This involves both leveraging existing projects and initiating new ones that capitalize on Japan's distinctive technologies and expertise.

Source: JICA's website

Figure A4.1.1 JICA's 4 Priority Strategy for Ukraine

The support for the agricultural sector considered in this survey can particularly contribute to "3. Industrial Recovery and Export Promotion" among these four policies.

Supporting the agricultural sector can facilitate the prompt reconstruction and revival of the irrigation and agricultural product distribution systems , which are essential for exporting agricultural products, especially grains. It is expected this effort not only substantially aids in stabilizing the livelihoods of Ukrainian citizens but also immensely benefits the extensive populations of related and neighboring countries, who depend on Ukrainian grain.

4.1.2 Reconstruction Priorities and Development Strategy in the Agricultural Sector of the Ukrainian Government, and Support Needs

In July 2023, discussions during overseas invitation programs highlighted the Ukrainian government's support needs, confirming seven crucial areas (see Section 3.2 for details):

i Support for micro-, small- and medium-sized farmers and promotion of horticulture

ii Efficient use of existing and recovered agricultural facilities and land

iii Establishment of Master Plan for rehabilitation and reconstruction of the irrigation facilities in all of Ukraine

iv Improvement of efficiency and modernization of operation and maintenance of the irrigation facilities

v Use of renewable energy and introduction of circular agriculture

vi Soil remediation, especially soil contamination surveys

vii Efficient use of human resources in agriculture sector

These support needs align with the "Ukraine National Reconstruction Plan 2022" outlined by the Ukrainian government (see Section 2.1 for details), indicating a strategic approach to addressing the challenges faced by the agricultural sector amid the ongoing conflicts and recovery efforts. A summary of the related matters for each is shown in the table below.

Table A4.1.1 Summary of Various Reconstruction Strategies and Needs

Agriculture Priority Projects in Ukraine National Recovery Plan 2022	Needs agreed in Overseas Invitation Program
Develop agri processing (starch, corn syrup, gluten, lecithin, protein) in alignment with EU Green Deal principles	-
Build 1 million ha irrigation system in compliance with EU directives	ii) Efficient use of existing and recovered agricultural facilities and land iii) Establishment of Master Plan for rehabilitation and reconstruction of the irrigation facilities in all of Ukraine iv) Improvement of efficiency and modernization of operation and maintenance of the irrigation facilities
Comprehensive planning of spatial development and land use in the communities	
Development of reclamation systems	
Develop high-value-add agri produce (vegetables, fruits, berries, seeds)	i) Support for marginal, small and medium-sized farmers and promotion of horticulture ii) Efficient use of existing and recovered agricultural facilities and land vii) Efficient use of human resources in agriculture sector
Bioenergy independence	v) Use of renewable energy and introduction of circular agriculture
Maintaining the agricultural sector in the context of the seaport blockade	-
Recultivation of damaged land	-
Increase meat and milk production and processing	-

Agriculture Priority Projects in Ukraine National Recovery Plan 2022	Needs agreed in Overseas Invitation Program
Promoting the transition of the agri-food sector to "green" growth (by enabling precision farming)	-
Fast restoration after the war of 10.5k agricultural enterprises	-
Mapping Ukraine and implementation of the National Geospatial Data Infrastructure	-
Development of seed production: construction of factories for the production of hybrid seeds	-

Source: JICA Survey Team based on the Ukraine National Recovery Plan 2022

4.2 Issues and Support Measures in Ukraine's Agricultural Sector

4.2.1 Enhancing the Importance of Small-Scale Horticulture and Female Farmer

- Ukraine's population and labor force have experienced a significant decline in recent years, highlighting an anticipated shift and increased significance in the role of women in agricultural production due to demographic changes and the impacts of the ongoing conflict with Russia (Refer to Section 2.6.3). As documented in Annex 2.6.1, in a scenario where male labor is scarce because of the conflict, women will gradually assume roles traditionally held by men. This trend, observed globally, is expected to persist in Ukraine, affecting both current and future agricultural labor situation. While this shift places additional burdens on women, it also prompts a reassessment of societal gender roles and stereotypes, potentially enhancing women's agency and decision-making power. Acknowledging the challenges, it's vital to view this as an opportunity for positive change and to emphasize the diversification of women's roles in agriculture as part of the Build Back Better initiative.
- Financial access remains a challenge for small-scale farmers, notably the lack of collateral for credit (Chapter 2.5). The partial land law reforms in July 2021, which lifted restrictions on individual land ownership up to 100ha, have improved the potential for securing collateral for small-scale farmers (Section 2.1.5). With these legal changes, financial support conditions for small-scale farmers are improving. Additionally, the Swiss government's support for the Crop Receipts project aims to broaden financial access by including a wider range of crops managed by small-scale farmers (Section 2.5.3(4)). This program aims to expand the target from grains to horticultural crops, barley, buckwheat, raspberries, blueberries, etc., handled by small-scale farmers. Given these developments in financial access, it is also necessary to improve the financial literacy of small-scale farmers, which, when combined with agricultural technology guidance, is expected to produce even greater effects.
- As detailed in Section 2.1.6, "Definition and Classification of Farms," agriculture in Ukraine has a two-tier structure consisting of large-scale and small-scale farms. "Individual and family farms" are overwhelmingly numerous and occupy 45% of the total arable land area. These lands are mainly used for vegetable and fruit production and small-scale livestock farming.

The production value of these "individual and family farms" also accounts for more than 41% of Ukraine's total agricultural GDP.

- As detailed in Section 2.3.4 "Crop Production," "large and medium-sized agricultural enterprises" mainly produce grains such as maize, sunflowers, wheat, and barley, and are widely distributed around the Dnipro River and in the south and east (see Figure A2.3.2). On the other hand, individual and family farms mainly produce vegetables and fruits and are widely distributed throughout Ukraine (refer to Figure A2.1.2, Table A2.3.5, Figure A2.3.3, etc.). The horticultural sector in Ukraine has a high export potential and ranks among the top three in Eastern Europe in terms of production volume.
- The conflict has driven many internally displaced persons (IDPs) to the central and western regions of Ukraine, indicating a need for targeted support in these areas to assist farmers displaced from the southeast (Figure A2.6.3)
- Given these circumstances, there is a pressing need for capacity-building support in horticultural farming technology for small-scale operations, particularly focusing on women. Such a capacity-building support should be commenced in the central and western regions, which are considered to be relatively safe, and gradually extend nationwide, incorporating diverse training packages. Furthermore, enhancing agricultural financial literacy for small- and medium-sized farmers with limited financial access is critical and should proceed alongside horticultural technology assistance.

4.2.2 Structural Challenges and War Damages in the Irrigation Sector

- Structural Challenges and War Damage in the Irrigation Sector: Following the Russian invasion, agricultural facility damage has predominantly occurred around Kyiv and in southern and eastern regions like Kherson, Zaporizhia, Donetsk, Luhansk, and Kharkiv (refer to Figure A2.2.8). Restoring and reconstructing these irrigation sources, focusing on immediate, short-term measures, is estimated to cost around 200 million US$.
- As indicated in Section 2.2.6, the irrigated area in Ukraine accounts for about 1% of all farmlands. Despite this low irrigation rate, as mentioned in Chapter 2.3, the agricultural sector has significantly contributed to the country's economic development, mainly through exports to the Global South. Given that the country had about four times the current irrigated area during the Soviet era, post-war recovery and significant expansion of new irrigated areas could greatly increase agricultural income.
- Path to Early Post-War Recovery: The fastest and most straightforward method to strengthen Ukraine's industrial and export sectors, and achieve Build Back Better, is by recovering and developing irrigation agriculture, a method well-known and utilized by farmers in the Soviet era.
- On the other hand, the causes that led to the deterioration of irrigation facilities in the past, as indicated in Sections 2.2.5 and 2.2.6, were mainly a) land ownership issues (collateral issues

and reluctance for private investment in leased land), and b) facility management issues. However, a) has been resolved by lifting the land ownership moratorium in July 2021, allowing land ownership by ordinary citizens and corporations, and b) has been revamped by the water users association Law enacted in February 2022. Therefore, the main causes of irrigation facility deterioration have already been removed, and now is an excellent opportunity to repair and restore these facilities. Therefore, restoring irrigation facilities represents a promising avenue for swift post-war recovery and growth. A comprehensive national survey for an irrigation and agricultural product distribution facility renovation master plan, along with support in both hardware and software, is essential.

- Strengthening Water Users Associations: Water users associations are still halfway to being strengthened under the new legal system. Furthermore, the lack of design drawings and operational data from the Soviet era, legal and institutional unpreparedness, and financial dependence are also affecting operation and maintenance. Particularly for strengthening water users associations, structural repairs should be carried out simultaneously. Japan's long experience and technology in strengthening water users associations should be explored for use, considering the pilot projects already initiated by USAID.
- Restoration Needs and Sustainable Operation: Given the high needs for the restoration of irrigation and agricultural-related facilities in post-war reconstruction in Ukraine, these facility restoration projects must be carried out in conjunction with strengthening water users associations for sustainable facility operation and maintenance. When planning and selecting facility renovation projects, priority should be set appropriately based on not only the extent of damage but also the impact on the global (especially Global South) grain market, in addition to the industrial recovery of the entire country. To this end, an irrigation and agricultural product distribution facility renovation master plan survey should be conducted nationwide, and based on this, support in both hardware and software sectors should be considered as one of the support measures.

4.3 Other Donors' Trend

Section 2.8.2 "Trends of Donors/Institutions" details the support provided to Ukraine by major aid organizations such as the EU after the Russian invasion (see Table A2.8.5, Table A2.8.6). Upon overviewing this, it is evident that the current support for the agricultural sector is extremely limited in both amount and the number of projects. Furthermore, even within this limited support, when looking at the breakdown, the situation of support from donors from various countries and institutions to the agricultural sector, as shown in the donor meeting (see Figure A2.8.1), indicates that short-term support for "food and agricultural materials" is the most numerous at 19 projects, followed by "agricultural financial access support" (7 projects), which can be easily supported even from a relatively remote location and has high direct effects. Support for infrastructure facilities such as irrigation and agricultural

product distribution is extremely limited at this stage. Moreover, medium-to-long-term support, such as agricultural technology support (especially horticulture), is also not being carried out much at present.

While it is understandable that infrastructural support is not viable during the ongoing conflict, there is a recognized need to devise a roadmap for rapidly initiating such support once the conflict ceases, beginning from the current stage. Notably, preliminary efforts towards a master plan can be conducted remotely, though with some limitations on precision. Japan, with its extensive experience in technical cooperation through dispatching survey teams and experts for planning, analysis, and training, is well-positioned to aid in formulating a master plan for roadmap development.

4.4 SWOT Analysis of Japanese Agricultural Sector Support in Ukraine

Next, the SWOT analysis results, which compile the strengths and opportunities that JICA itself possesses when the Japanese government provides support to the agricultural sector in Ukraine, are shown in the following table.

Table A4.4.2 SWOT Analysis of Japanese Agricultural Sector Support

Strengths	**Weaknesses**
- Japan has a long history of ODA (Official Development Assistance) experience, not only in the investigation and implementation of individual projects but also in formulating national development plans that look at the long-term future prospects at a nationwide level. Moreover, Japan has carried out comprehensive agricultural development support based on these plans in numerous countries. - Our country has accumulated technology and knowledge in fruit tree cultivation and horticultural agriculture and has extensive experience in transferring this technology to many countries through support for developing nations. - There are various support options to suit different needs and situations, such as technical cooperation, grant aid, and loan aid. Especially under wartime conditions, it is possible to quickly support Ukraine's agriculture by remotely implementing technical cooperation projects centered around technology transfer. - In our country, both public and private sectors have abundant experience in research and practice in advanced agricultural technologies using IT and DX (Digital Transformation), as well as in energy-efficient agriculture that is environmentally considerate (a measure against energy problems faced due to distancing from the Russian economic sphere). There is	- Large-scale grain production, such as wheat and maize, which is one of Ukraine's core industries, is not a form of agriculture that Japan excels in. - Regarding projects implemented by JICA, the safety standards for implementation are slightly stricter than those in other countries. Therefore, there is a possibility that activity restrictions may be imposed even in areas where other countries and organizations are active, potentially limiting the areas of operation. - In JICA projects, there are limitations on providing facilities to specific private companies or individuals and on the direct provision of equipment. Therefore, there is a possibility that JICA's support measures may be limited when it comes to activities centered around private enterprises. - Geopolitically, the ties between Japan and Ukraine are at a disadvantage compared to EU countries in terms of economic connections, historical background, and commonalities in culture and systems.

a high possibility that this can be utilized for the leap of agriculture in Ukraine.

- In horticultural agriculture, such as greenhouse cultivation, small, agile agricultural machinery suitable for in-greenhouse operations is needed. This is a field where Japanese agricultural machinery manufacturers excel.
- In Japan, in addition to the physical recovery of farmland as a series of farmland recovery and reconstruction projects related to the Great East Japan Earthquake, there is also an accumulation of research in phytoremediation.
- Japan has been involved in ODA projects related to irrigation facilities, strengthening community organizations, and improving access to finance in various countries and regions for many years, accumulating a wealth of knowledge and experience.

Opportunities

- As decoupling from Russia progresses, enhancing trade with EU countries, Japan's expertise in high-value, high-quality fruit tree and horticultural agricultural technologies can contribute to this.
- To strengthen trade with the EU, there is a high likelihood that distribution networks like railways and roads leading from central to western Ukraine and into Poland will be rapidly developed in the future. Promoting horticultural agriculture for EU exports along these routes provides an excellent opportunity to cultivate a key industry alongside Ukraine's grain exports.
- Japan is considering support not only for the agricultural sector but also for infrastructure in general. Therefore, there is the potential for synergistic effects with other sectors, particularly in distribution sectors like railways and roads.
- The recent lifting of the moratorium on private land ownership, which had been long unapproved, presents a great opportunity for the development of agriculture.

Threats

- Due to the worsening of the conflict, there is a risk that the scope and content of JICA projects may be restricted.
- In the case of irrigation system support, the field areas owned by producers may be large, leading to a situation where the number of beneficiaries for a single irrigation system can be extremely limited. Given the nature of ODA, caution is needed as this could be perceived as disproportionately benefiting a select few.
- Ukraine is expected to face rapid aging and a labor shortage in recent years, which is anticipated to have a significant impact on agricultural production.
- During project implementation, there is a risk that essential supplies such as fuel and agricultural equipment may become difficult to obtain (or experience price surges).

Source: JICA Survey Team

The relationship between the recovery priorities and needs shown in Table A4.1.1, the current status and challenges in the agricultural sector presented in Chapter 4.2, and the strengths and opportunities of

Japanese support shown in Table A4.4.2, are compared and summarized in Table B4.4.1. A simplified version of this is shown in the table below.

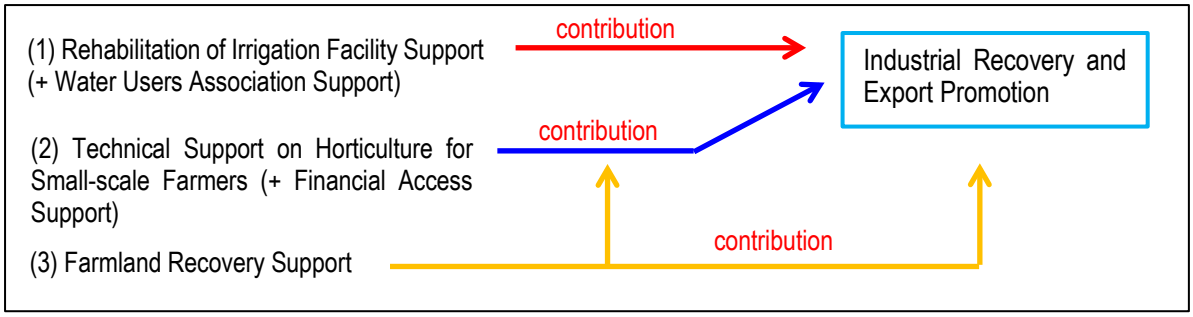
Table A4.4.3 Reconstruction Strategy and Needs, and the Strengths and Weaknesses of Japanese Support and Support Approach

		Japan's Strength						Japan's Opportunity		
Agriculture Priority Projects in Ukraine National Recovery Plan 2022	**Needs agreed in Overseas Invitation Program**	1. Implementation Experience of Master Plans	2. Accumulated Knowledge in Horticulture	3. Diverse Support Menu	4. IT, DX, and Energy-saving Technologies	5. Japanese Agricultural Machinery	6. Disaster Recovery & Remediation Research	(A) Trade Promotion with the EU	(B) Development of the East-West Corridor	(C) Cooperation with Other Infrastructure Sectors
Develop agri processing (starch, corn syrup, gluten, lecithin, protein) in alignment with EU Green Deal principles						O		O		
Build 1 million ha irrigation system in compliance with EU directives	ii) Efficient use of existing and recovered agricultural facilities and land	O		O	O		O			
Comprehensive planning of spatial development and land use in the communities	iii) Establishment of Master Plan for rehabilitation and reconstruction of the irrigation facilities in all of Ukraine	O		O						
Development of reclamation systems	iv) Improvement of efficiency and modernization of operation and maintenance of the irrigation facilities	O		O	**Approach-1 : Rehabiloitation of Irrigation Facilities**					
Develop high-value-add agri produce (vegetables, fruits, berries, seeds)	i) Support for marginal, small and medium-sized farmers and promotion of horticulture		O	O	O	O		O	O	
		Approach-2: Technical Support on Horticulture for Small-scale								
Bioenergy independence	ii) Efficient use of existing and recovered agricultural facilities and land				O					
Maintaining the agricultural sector in the context of the sea port blockade	vii) Efficient use of human resources in agriculture sector	O		O				O	O	O
Recultivation of damaged land	v) Use of renewable energy and introduction of circular agriculture			O Utilization of donated equipment			O			
					Approach-3 : Farmland Recovery					
Increase meat and milk production and processing	-									
Promoting the transition of the agri-food sector to "green" growth (by enabling precision farming)	-							O		
Fast restoration after the war of 10.5k agricultural enterprises	-									
Mapping Ukraine and implementation of the National Geospatial Data Infrastructure	-									
Development of seed production: construction of factories for the production of hybrid seeds	-									

Source: JICA Survey Team

Based on the analysis results of the above table, the following three approaches can be adopted to meet the current needs, priorities, and directions of Ukraine's recovery plans, while also leveraging Japan's strengths in assistance. To effectively implement and achieve these approaches, "Water Users Association Strengthening" and "Financial Access Strengthening" elements will be incorporated into Approaches 1 and 2, respectively (for reasons and details, please refer to Chapters 2.2 and 2.5).

In this section, the connection between "Industrial Recovery and Export Promotion", a key component of JICA's support strategy for Ukraine as detailed in Section 4.1.1, and the previously discussed three approaches, is systematically laid out. This interrelationship is visually represented and elaborated in the subsequent figure.



Source: JICA Survey Team

Figure A4.4.1 Supporting Approaches and JICA's Support Policy to Ukraine

As shown by the figure, it is clear that the three outlined approaches to support Ukraine's agricultural sector are in harmony with the four principal support policies JICA seeks to implement for Ukraine.

Building on these strategies, Chapter 5 outlines detailed proposals for specific support projects and interventions.

Ukraine
Ministry of Agrarian Policy and Food

DATA COLLECTION SURVEY FOR ASSISTANCE FOR RESTORATION AND RECOVERY OF UKRAINE IN AGRICULTURE SECTOR

FINAL REPORT
ANNEX TABLE

April 2024

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.
KOEI RESEARCH & CONSULTING INC.

Table B1. 4.1 Key interviewees of the Field Trips

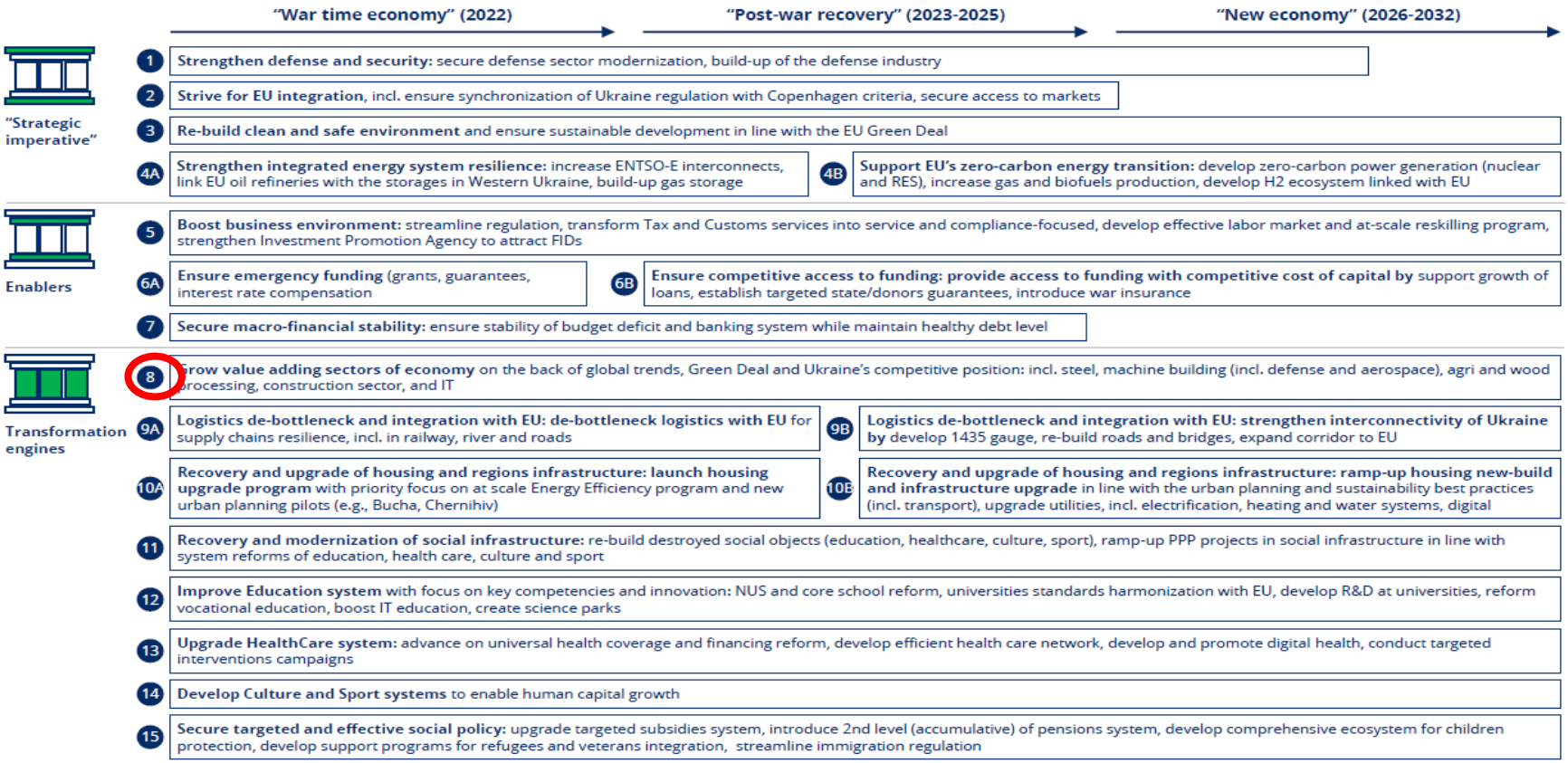
Key Interviewee(s) & Organization	Date of Interview	Objectives of Interviews
Ms.Tetiana Chuzha, Ministry of Economic Development and Technology Mr. Bartosz Kotusiewicz, Poland Association for Investment and Trading	2023/2/20	Collection of data and information on Post-war reconstruction of Ukraine in Poland
Mr. Artur Byszewski, EkoDom-Oze	2023/2/20	Collection of data and information on solar power generation for provision of equipment or materials (short-term)
Mr. Ivan, The Global 100% Renewable Energy Platform	2023/2/21	Collection of data and information on agriculture in Ukraine for Ukrainian residents
Mr. Kotaro Tanaka, Counsellor and Ms. Makiko Fujimoto, Secretary, Embassy of Japan in Ukraine	2023/2/21	Explanation of the data collection survey and Collection of data and information on agriculture in Ukraine
Mr. Radostaw Krzywda, Ebioterm	2023/2/21	Collection of data and information on solar power generation for provision of equipment or materials (short-term)
Mr. Ryutaro Yuki, Branch Manager, Third Wave Company/SDGs Ukraine Branch Office	2023/2/21	Collection of data and information on the activities of agricultural companies registered in the Chamber of Commerce and Industry in Ukraine
Mr. Wataru Takahashi, Deloitte Poland	2023/2/22	Collection of data and information on agriculture in Ukraine and activities of Deloitte Poland
Mr. Dariusz, Fortech	2023/2/22	Collection of data and information on solar power generation for provision of equipment or materials (short-term)
Mr. Yasuyuki Ishiga, Director, JETRO Warsaw Office	2023/2/22	Collection of data and information on JETRO's activities and trends of Japanese companies in Ukraine
Mr. Ryutaro Sakamoto, Ms. Olga, Warsaw Japanese Language School	2023/2/23	Collection of data and information on agriculture in Ukraine and discussion of transportation of equipment and materials to Ukraine
Dr. Andrzej Wrebiak, Polish-Ukraine Chamber of Commerce (PUCC)	2023/2/23	Explanation of the data collection survey and collection of data and information on activities of PUCC
Mr. Hironori Miyazaki, Spectr-Agro and Mr. Toru Ota, Branch Manager, Sumitomo Corporation, Kiev Branch	2023/2/24	Collection of data and information on agriculture in Ukraine
Mr.Yaroslav Romanchuk, Mr.Andrii Romanchuck, Ukraine Business Association in Poland	2023/2/24	Explanation of the supporting schemes of Japanese government and collection of data and information on activities of Ukraine Business Association in Poland

Key Interviewee(s) & Organization	Date of Interview	Objectives of Interviews
Vitaliy Golovnya, Polina Ivashchenko, Mnxank Cokonob, Mnxanzo Xopeb, Taras Kot, Olga Pazynch, Ministry of Agrarian Policy and Food of Ukraine	2023/2/24	Discussion on directions of the data collection survey and support of recovery of agriculture sector, invitation program, and contact person for the survey
Mr. Roger Boons, Commercial Director, Greenyard Logistics	2023/2/28	Collection of data and information on activities of Greenyard Logistics
Mr. Michal Slawinski etc.	2023/2/28	Collection of data and information on PC for provision of equipment or materials (short-term) from Media Expert, APOLLO and KOMPUTRONIK
Mr. Piotr Lubecki, Vako	2023/3/1	Collection of data and information on the fruit and vegetable market and distribution from a fruit and vegetable distributor in Rzeszów
Mr. Tomasz Bak, Mr. Leutenant Tomasz Szczepani, Boxchain	2023/3/2	Collection of data and information on the fruit and vegetable market and distribution from a fruit and vegetable distributor in Rzeszów
Mr. Bartłomiej Milczarek, Polish Blueberry Producers Association	2023/3/2	Collection of data and information on blueberry production in Poland
Mr. Hironori Miyazaki, Spectr-Agro	2023/3/2	Collection of data and information on agriculture in Ukraine
Site visit to border areas and railroad freight trains	2023/3/3	Visit to the repacking of corn brought from Ukraine (from railroad freight train to trucks)
Mr. Bartosz Gunia etc.	2023/3/4	Collection of data and information on PC for provision of equipment or materials (short-term) from KOMPUTRONIK and X-Kom
Ms. Larisa Huk, Agroperspective Information and Analytical Center	2023/6/13	Development obstacles and supporting measures for agricultural sector in Ukraine
Mr. Andrey Marushchak, Commercial Director, Van Dyke Technics	2023/6/13	Collection of data and information on agriculture in Ukraine from a post-harvest technology consultant and agriculture materials and equipment supplier in Kiev
Dr. Katarzyna Kowalczyk, Depart. of Horticulture and Medicinal Plants, Mr. Tomasz Pogorzelec, External Guest Lecturer, Warsaw University of Agriculture	2023/6/14	Collection of data and information on research activities in facility horticulture
Mr. Michal Malicki, fruit farmer and Mr. Ryutaro Yuki, Branch Manager, Third Wave Company	2023/6/14	Site visit to modern horticultural agriculture near urban area
Ms. Iryna Kukhtina, President, Ukraine Berries Association	2023/6/15	Collection of data and information on agricultural sector in Ukraine and activities of Ukraine Berries Association

Key Interviewee(s) & Organization	Date of Interview	Objectives of Interviews
Mr. Mykhailo Kubara、Representative/Founder, Eurosad	2023/6/16	Collection of data and information on business plan of fruit production company to expand their business
Ms.Tetiana Sladkovska, Wroclaw University of Environmental and Life Sciences	2023/6/20	Collection of data and information on Phytoremediation
Mykhailyna Kaparulina - Head of the Board, Oleksiy Shunder - executive director, Artem Vivdich - Project Manager, Mykolay Ratushnenko - member of the Association of Water Users (Life of water)	2023/6/22	Collection of data and information and confirmation of supporting needs on water users' association in Ukraine
Ms. Oksana Ruzhenkova, Former President of the Potato Producers Association	2023/6/24	Collection of data and information on potato cultivation and market in Ukraine
Mr. Nikolai Nalbandyan and three others, Persha Water Users' Association	2023/6/24	Collection of data and information and confirmation of supporting needs on water users' association in Ukraine

Source: JICA Survey Team

Table B2.1.1 15 National Programs in Ukraine's National Recovery Plan



Source：Ukraine's National Recovery Plan 2022

Table B2.8.1 List of Equipment Provided in Grant Aid Phase (Phase 1)

Ukrainian Institute for Plant Variety Examination (UIPVE)

No	Equipment	Q'ty	Purpose
3	Diesel Generator 10 kVA ディーゼル発電機　10 kVA	15	Equipment will be deployed to the required branch offices among the 20 locations.
7	Diesel Generator 30 kVA ディーゼル発電機 30 kVA	1	It will be installed at the headquarters and utilized as a backup power source for refrigerators and other equipment.
14	Tractor 150 hp トラクター150 馬力	10	The equipment will be used for field tests such as cultivation, seeding, and harvesting at the test sites. The existing equipment, being over 20 years old and deteriorating, incurs maintenance and fuel costs. Introducing new equipment will lead to cost reduction and efficiency in testing. Distribution to each of the 20 national branch offices is planned (additional quantity requested).
15	Combine harvester (for breeding) コンバインハーベスター（品種試験用）	5	
16	Sowing machine (seeder, for breeding) 播種機　（品種試験用）	17	
17	Capillary column キャピラリーカラム	30	Consumables such as columns and filters for the existing Shimadzu Corporation gas chromatograph are needed. UIPVE uses this equipment to conduct about 400 types of tests annually, requiring replacement of consumables 2 to 4 times a year. A sufficient quantity must be secured for year-round testing. The equipment will be placed at the Kiev headquarters, which conducts advanced testing.
18	Shimadzu Gas Filter - (Ox/Moi/hyd) ガスフィルター（酸素/水分除去/炭化水素）	10	
19	Shimadzu Gas Filter (Hyd/Moi) ガスフィルター（水分除去/炭化水素）	20	
20	Automatic Seed Counter 自動種子カウンター	17	Equipment for measuring seed germination ability. Currently, seeds are counted manually, so using a seed counter will improve efficiency. It will be used at the UIPVE headquarters and branch offices conducting measurements. Additionally, incubators for germination tests will be introduced to two branch offices currently without this equipment, allowing for accurate temperature control and simultaneous testing of more samples, thus enhancing measurement capabilities.
22	Incubator max 65°C 520L 恒温器　520L	2	
21.1	High speed centrifuge 高速遠心分離機	1	Equipment required for PCR testing for analysis using DNA markers and storage proteins. The currently owned equipment is aging, and many parts are no longer being manufactured, necessitating the need for new equipment. The introduction of these requested equipment will enable the implementation of the DUS tests (Distinctness, Uniformity, Stability) recommended by the International Union
21.2	Centrifuge Mini 遠心分離機（追加)	1	
21.3	Microplate centrifuge マイクロプレート遠心分離機（追加）	3	
23.1	Incubating cooling thermal shakers 振盪インキュベーター	2	

No	Equipment	Q'ty	Purpose
23.2	TSC block module サーマルブロック（インキュベーターの付属品として追加）	2	for the Protection of New Varieties of Plants (UPOV), thereby reducing the number of varieties in field tests and the duration of inspections. This will improve the testing capabilities of UIPVE and is expected to enhance the quality of test results demanded by UPOV member countries. Initially, of the 5 high-speed centrifuges (21.1), 1 is to be changed to a centrifuge (21.2) and 3 to microplate centrifuges (21.3)."
24	Real-Time Thermal Cycler リアルタイムPCR 装置	2	
25	Gel Documentation System with High Sensitivity CCD Camera 高感度ゲル撮影装置	2	
26	DSLR Camera 一眼レフカメラ	1	Cameras and tripods used for managing data of test varieties. High-quality cameras will be used to create a more accurate database. The equipment will be placed at the Kiev headquarters, which conducts advanced testing.
27	Travel Tripod 三脚	1	
28	Tablet PC タブレット PC	20	Tablet PCs for UIPVE headquarters and branch office experts to use in field testing information and report creation. Currently, information is handwritten in notebooks, so digitization will enable more efficient information management. To be distributed to 20 branch offices (with an additional request for 3 units, totaling 20 units).
29	Truck 6t (for transportation of experimental samples) トラック（試験サンプル運搬用）	1	For transporting test equipment and seeds. Currently, it relies on delivery services, which are costly and time-consuming. Additionally, some test samples are prohibited from outsourced delivery, necessitating transportation vehicles. To be placed at the Kiev branch office, which conducts advanced testing.
48	Biomedical Refrigerator with Freezer フリーザー付き薬用保冷庫	2	Used for storing reagents and DNA samples. Storing PCR reagents at low temperatures allows them to function effectively and yield accurate results. To be placed at the Kiev branch office, which conducts advanced testing.
50	Reefer container 20 feet リーファーコンテナ	2	To be used as a cooling warehouse for storing seeds without impairing their germination ability. Seed samples submitted at the time of application are required to be stored, and the number of samples has been increasing annually. An additional request is made to improve storage capacity using this equipment. To be placed at the Kiev headquarters, which conducts advanced testing

Leonid Pohorily Laboratory

No	Equipment	Q'ty	Purpose
2	Diesel Generator 10 kVA ディーゼル発電機　10 kVA	5	Deploy as a power source and backup power source during field surveys

No	Equipment	Q'ty	Purpose
5	Diesel Generator 20 kVA ディーゼル発電機　20kVA	4	Equip as a backup power source at headquarters.
31	Engine test bench エンジンテストベンチー式	1	An engine dynamometer. A testing device that generates load on the engine and reproduces the load condition during operation.
32	Measuring equipment for engine エンジン特性性能測定システムー式	1	Testing equipment to verify the engine's condition and fuel economy under the load condition reproduced by the engine dynamometer.
33	Exhaust gas sampling system 排ガス検査システム	1	Equipment to extract gases emitted from the engine under the load condition reproduced by the engine dynamometer.
34	Gas analyzers 排ガス分析システム	2	A gas analysis device to measure the content of carbon monoxide (CO), hydrocarbons (CH), nitrogen oxides (NOx), and particulate matter (PM).
35	Computer software to work with the above laboratory equipment エンジン排ガス検査装置管理ソフトー式	2	PCs and software for data management of the above equipment.
13	Seeds 種子	-	Used for research contributing to the improvement of crop quality and harvestability at the test fields owned by the research institute. Planned crops include winter wheat, winter barley, winter rye, and winter rapeseed.

Institute of Soil Protection of Ukraine

No	Equipment	Q'ty	Purpose
6	Diesel Generator 20 kVA ディーゼル発電機　20 kVA	7	Equip as a backup power source at 7 branch offices
9	Diesel Generator 50 kVA ディーゼル発電機　50 kVA	1	Equip as a backup power source at headquarters
36	GNSS/RTK receiver 測量装置用レシーバー	7	GNSS (Global Navigation Satellite System) receivers and total stations, along with tablets for data management. Using wireless receivers that utilize multiple satellite positioning systems to determine coordinates, enabling high-precision surveying and data management for the efficient analysis of soil.
37	Electronic total station 測量用トータルステーション	7	
38	Field tablet 測量装置用タブレット	7	
39	Atomic absorption spectrometer (mercury, arsenic, selenium, antimony) 高分解能連続光源原子吸光分析装置用（水銀、砒素、セレン、アンチモン分析用）	7	Measures the content of mercury, arsenic, selenium, and antimony in soil, fertilizers, and agricultural raw materials.

No	Equipment	Q'ty	Purpose
40	Atomic absorption spectrometer with autosampler (for soil) , for determination of heavy metals, micro-macro elements in soil 高分解能連続光源原子吸光分析装置（重金属・マイクロマクロ元素分析用）	7	Measures the elemental composition, especially heavy metals, in soil, fertilizers, and feed.
41	Mass spectrometer with inductively coupled plasma 誘導結合プラズマ質量分析装置	7	Mass spectrometer. Analyzes soil fertility and contamination by hazardous elements (metals, metal compounds, sulfur, boron, phosphorus, and others) in environmental targets.
42	Gas chromatograph ガスクロマトグラフ	7	Equipment used for the quantitative analysis of petroleum products and oils in soil, for monitoring soil pollution.
43	Determination of total sulfur, carbon in soil 炭素・硫黄分析装置	7	Equipment used for quantifying total carbon, organic carbon, inorganic carbon, total sulfur, and chlorine in soil, for monitoring soil fertility and pollution levels.
45	Spectral lamps with hollow cathode for atomic absorption spectrometers 分光ランプ	182	Used for quantifying heavy metals and macro and trace elements in soil and fertilizers. Used with No.39,40.
46	Automatic soil sampler 架装式採泥装置	7	An automatic soil sampler and vehicle. The sampler is mounted on the vehicle to sample at depths of 10 to 30 cm.
47	Pickup truck Diesel 4WD ピックアップトラック	7	

Source：Data from JICA Survey Team of Ukraine Emergency Recovery Plan Phase 1

Table B2.8.2 List of Equipment Provided in Grant Aid Phase (Phase 2)

ト

(1) Nemishaieve Professional College of the National University of Life and Environmental Sciences of Ukraine

No.	Priority	Equipment	Q'ty	Purpose
1	1	Mobile bale shredders (for the tractor) 干し草用ベーラー	1	Use for agriculture training
2	1	Mobile feed mixer (4.5-8 m2) 飼料用ミキサー	1	- ditto -
3	1	Wheeled tractor – traction class 3 トラクター	1	- ditto -
4	1	Disc harrow for deep rippers (to the tractor under traction class 3) 残渣用ロータリーソイラー	1	- ditto -
5	1	Pre-sowing complex (for the tractor) ロータリーソイラー	1	- ditto -
6	1	Grain separator (2-5 t/h) 精選機（セパレーター）	1	- ditto -
7	1	Mini loader with a set of equipment 小型ローダー	1	- ditto -
8	1	Rake (type sun) 攪拌用レーキ	2	- ditto -
9	1	Rotary mower ロータリーモア	2	- ditto -
10	2	Maize drill – 6 or 8 rows 種まき機	1	- ditto -
11	2	Plough to the tractor under traction class 3 耕起用プラウ（鍬）	1	- ditto -
12	2	Rotary mulcher (traction class 4) マルチャー	1	- ditto -
13	2	Baler ベーラー	1	- ditto -
14	2	Boom truck クレーントラック	1	- ditto -
15	3	Grain harvester with a set of reapers (corn, grain, for mowing in rolls, window pick-up) コンバイン	1	- ditto -
16	3	Bus (for 20-30 seats) バス　（20～30 人乗り）	1	Transportation of students
17	4	Maize for silage, grain – 180 seed units 飼料用トウモロコシの種子	180 SU	Use for agriculture training
18	4	Winter wheat 冬小麦の種子	50 ton	Use for agriculture training
19	4	Sunflower – 50 seed units ひまわりの種子	50 SU	Use for agriculture training
20	4	Buckwheat ソバの種子	4 ton	Use for agriculture training
21	4	Alfalfa アルファルファの種子	2 ton	Use for agriculture training

No.	Priority	Equipment	Q'ty	Purpose
1	1	Mobile bale shredders (for the tractor) 干し草用ベーラー	1	Use for agriculture training
22	4	Plant protection products – herbicide of continuous action – 700 l (desiccant max) 除草剤	700 L	Use for agriculture training
23	4	Mineral fertilizers – 150 t (compound NPK fertilizer, UAN, ammonium nitrate) 肥料	150 ton	Use for agriculture training

(2) State Agency of Melioration and Fisheries of Ukraine

No.	Priority	Equipment	Q'ty	Purpose
1	1	Wheeled excavator ホイール式バックホー	2	Restoration, maintenance and management, and new construction of irrigation facilities, agricultural water, and reservoirs, among others, for use in construction projects.
2	1	Backhoe loader 0.5 m3 バックホーローダ 0.5 m3	12	- ditto -
3	1	Backhoe loader 1.0 m3 バックホーローダ 1.0 m3	9	- ditto -
4	2	Excavator 0.04 m3 バックホー 0.04 m3	1	- ditto -
5	2	Excavator 0.25 m3 バックホー 0.25 m3	2	- ditto -
6	2	Excavator 0.5 m3 バックホー 0.5 m3	1	- ditto -
7	2	Excavator 1.0 m3 バックホー 1.0 m3	1	Restoration, maintenance and management, and new construction of irrigation facilities, agricultural water, and reservoirs, among others, for use in construction projects. 機材番号 8 と異なるモデルが要請されているが、調達段階で要求仕様を確認し整理することが推奨される。
8	1	Excavator 1.0 m3 バックホー 1.0 m3	4	Restoration, maintenance and management, and new construction of irrigation facilities, agricultural water, and reservoirs, among others, for use in construction projects.
9	2	Bulldozer 150HP ブルドーザ 150 馬力	1	- ditto -
10	1	Mobile crane クレーン車	3	- ditto -
11	1	Crane Truck 12t クレーントラック 12 トン	2	- ditto -
12	2	Crane Truck 25t クレーントラック 25 トン	1	- ditto -
13	2	Telescopic Crawler Crane テレスコピッククレーン	1	- ditto -
14	2	Loader crane ローダークレーン	1	- ditto -

No.	Priority	Equipment	Q'ty	Purpose
15	1	Tractor 75-80 hp トラクター 75-80 馬力	13	Use for land preparation and grass cutting
16	1	Tractor 100-110 hp トラクター 100-110 馬力	9	- ditto -
17	2	Tractor 335 hp トラクター 335 馬力	1	- ditto -
18	2	Low-bed Trawl ローベッドトレーラー	5	Use for transportation of equipment
19	2	Truck トラック	4	Transportation of materials
20	2	Rotary mower for tractor トラクター用ロータリーモア	5	Use for land preparation and grass cutting
21	2	Hydraulic manipulator mower-shredder for tractor トラクター用油圧式マニプレーター草刈り機	1	- ditto -
22	1	Reach mower リーチモア	12	- ditto -
23	2	Amphibious dredger 水陸両用ドレッジャー	2	For dredging at irrigation pond
24	2	Dredging boat 浚渫船	2	For dredging at irrigation pond
25	2	Mobile concrete complex 移動式コンクリートプラント	2	For repairing works of concrete at irrigation facilities
26	2	Dump truck ダンプトラック	2	For transportation of soils
27	2	Tractor trailer クレーン付油圧トラクタートレーラー	1	Restoration, maintenance and management, and new construction of irrigation facilities, agricultural water, and reservoirs, among others, for use in construction projects.
28	1	Pickup truck ピックアップトラック	10	Transportation of people and materials
29	1	Van バン車両	10	Transportation of people
30	2	Forklift フォークリフト	2	Restoration, maintenance and management, and new construction of irrigation facilities, agricultural water, and reservoirs, among others, for use in construction projects.
31	2	Telehandler テレハンドラー	2	- ditto -
32	2	Auto-manipulator トラッククレーン車	2	- ditto -
33	2	Aerial Platform 高所作業車	1	- ditto -

Source：Data from JICA Survey Team of Ukraine Emergency Recovery Plan Phase 1 (as of Sep '23)

Table B4.1.1 Reconstruction Strategy, Needs, and Japan's Support: Strengths, Weaknesses, and Support Approach

Agriculture Priority Projects in Ukraine National Recovery Plan 2022	Needs agreed in Overseas Invitation Program	Japan's Strength						Japan's Opportunity			Analysis by the Survey Team
		1. Implementation Experience of Master Plans	2. Accumulated Knowledge in Horticulture	3. Diverse Support Menu	4. IT, DX, and Energy-saving Technologies	5. Japanese Agricultural Machinery	6. Disaster Recovery & Remediation Research	(A) Trade Promotion with the EU	(B) Development of the East-West Corridor	(C) Cooperation with Other Infrastructure Sectors	
Develop agri processing (starch, corn syrup, gluten, lecithin, protein) in alignment with EU Green Deal principles						○		○			- In Ukraine, most agricultural and livestock products are exported as raw materials, with value addition through processing still in its developmental stages. Bearing this in mind, Ukraine is aiming to foster and develop its processing industry, but the level of quality and quantity is not yet satisfactory.
Build 1 million ha irrigation system in compliance with EU directives	ii) Efficient use of existing and recovered agricultural facilities and land	○		○	○		○				- In Ukraine, 85% of the total irrigation system (2.16 million hectares) is currently non-functional, with only 15%, or 300,000 hectares, operational. This dysfunction is not solely due to war damage and impact; a significant portion is also due to aging infrastructure and lack of maintenance. - Damage to agricultural facilities is primarily concentrated in the areas around Kyiv and in the southern and eastern parts of the country. There is a high need for repairing irrigation and storage facilities in these regions. - To efficiently restore and improve facilities using limited financial resources, a broad development master plan is required. This plan should incorporate modernization of facilities using IT and digital transformation (DX) technologies. - Strengthening of water user associations is essential for the sustainable operation and use of the facilities post-repair.
Comprehensive planning of spatial development and land use in the communities	iii) Establishment of Master Plan for rehabilitation and reconstruction of the irrigation facilities in all of Ukraine	○		○							
Development of reclamation systems	iv) Improvement of efficiency and modernization of operation and maintenance of the irrigation facilities	○		○							
Develop high-value-add agri produce (vegetables, fruits, berries, seeds)	i) Support for marginal, small and medium-sized farmers and promotion of horticulture		○	○	○	○		○	○		- While overshadowed by grain production, Ukraine ranks among the top three countries in Eastern Europe for horticultural crop production, and in 2021, horticultural crops accounted for 70% of its agricultural exports to Europe. The majority of this horticulture is carried out by small and micro farmers. - In recent years, Ukraine has seen growth in the production and export of premium fruits, such as blueberries. With increasing trade volume with the EU, there is significant potential for growth in horticulture, including fruit and vegetable cultivation. - Horticulture is an area of expertise for Japan, offering high potential for collaboration. - In this context, it is necessary to consider the application of technologies such as biogas utilization and energy-efficient farming facilities. - Currently, access to funding in the agricultural sector in Ukraine is limited to large-scale enterprises and farmers. Enhancing financial access for small and micro farmers is essential for the future development of horticulture.
Bioenergy independence	ii) Efficient use of existing and recovered agricultural facilities and land				○						- Ukraine consumes about 30 billion cubic meters of natural gas annually. With the impending decoupling from Russia, energy shortage has become one of the most critical issues for the country. In this situation, biogas generation is gaining attention as an alternative energy source to natural gas. - Japan has accumulated technology, practical applications, and operational experience in biogas power generation. Especially in recent years, besides the conventional wet biogas systems (suitable for processing organic materials with high moisture content, like livestock excrement and food residues), there has been significant development in dry biogas generation technology. This new technology is applicable to general waste with low moisture content, such as dried food and paper waste, leading to the construction of large-scale power plants and numerous practical applications. This indicates a high potential for Japan to contribute to Ukraine in this area. - However, this matter extends beyond the agricultural sector to encompass all of Ukraine's energy fields. Therefore, it is preferable to consider the use of biogas in agriculture on a case-by-case basis for individual facility upgrades, from a Build Back Better perspective.
Maintaining the agricultural sector in the context of the sea port blockade	vii) Efficient use of human resources in agriculture sector	○		○				○	○	○	- Ukraine is expected to further its decoupling from Russia while deepening its economic ties with the EU countries, with one of the main conduits being the corridor from Western Ukraine to Poland. - In terms of agricultural product distribution, the flow through this route is expected to become more active in the future. - The World Bank report 'Ukraine Rapid Damage and Needs Assessment' (July 2022) highlights the following as the second priority in reconstruction: - Strengthening rail connections to the EU to promote economic integration with the European market and to build resilience against potential future disruptions in Black Sea access. - Despite an annual production of nearly 10 million tons of vegetables, Ukraine's international trade in fresh vegetables and fruits is characterized by imports exceeding exports. This is believed to be due to a lack of appropriate storage facilities, proper handling techniques, and refrigerated transportation for fresh produce, and improvement in these areas is necessary.
Recultivation of damaged land	v) Use of renewable energy and introduction of circular agriculture			○ Utilization of donated equipment			○				- Currently, the area reported to be contaminated by landmines and unexploded ordnance is estimated to be between 160,000 and 174,000 square kilometers (representing 25-30% of the country's land), and it is widely mentioned that the removal process will take at least about 10 years. - In March 2023, the Ukrainian Institute of Soil Science and Agrochemistry reported, based on satellite images and sample surveys, that soil contamination due to toxic substances such as mercury and arsenic contained in bullets and fuel left in conflict areas is becoming severe. The affected area is estimated to be about 10.5 million hectares, approximately one-quarter of Ukraine's total agricultural land, highlighting it as a national-level issue that needs to be addressed. - Although JICA is providing support for mine removal in another project, the issue of soil contamination is causing significant damage specifically to the agricultural sector, making proactive measures in this sector essential. - For soil contamination treatment, in addition to the effective but costly physical methods, the application of more affordable phytoremediation techniques has also been advancing in research and practical use in recent years, necessitating an approach that incorporates both methods.
Increase meat and milk production and processing	-										
Promoting the transition of the agri-food sector to "green" growth (by enabling precision farming)	-							○			
Fast restoration after the war of 10.5k agricultural enterprises	-										
Mapping Ukraine and implementation of the National Geospatial Data Infrastructure	-										
Development of seed production: construction of factories for the production of hybrid seeds	-										

Approach-1 : Rehabiloitation of Irrigation Facilities

Approach-2: Technical Support on Horticulture for Small-

Approach-3 : Farmland Recovery

Ukraine
Ministry of Agrarian Policy and Food

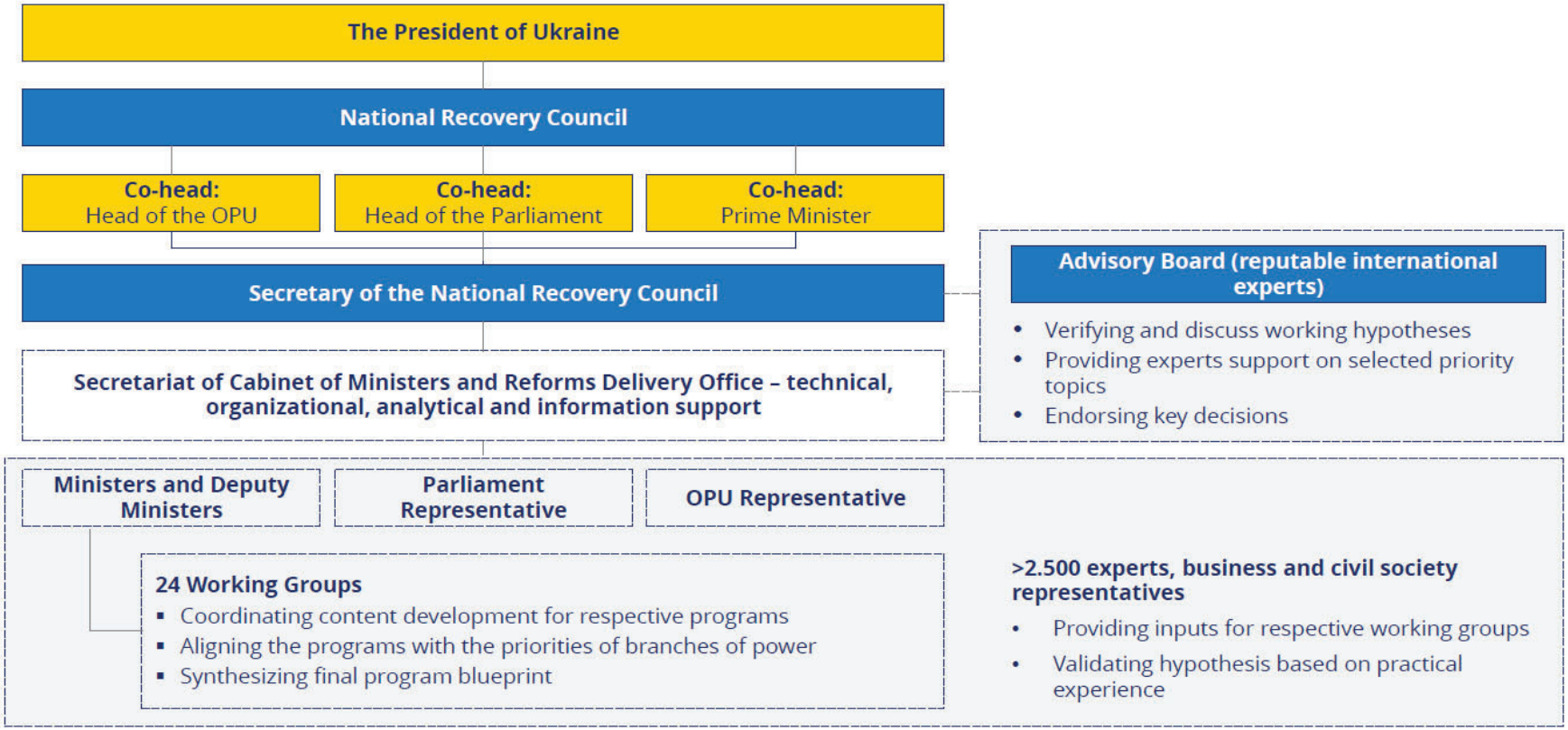
DATA COLLECTION SURVEY FOR ASSISTANCE FOR RESTORATION AND RECOVERY OF UKRAINE IN AGRICULTURE SECTOR

FINAL REPORT
ANNEX FIGURE

April 2024

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIPPON KOEI CO., LTD.
KOEI RESEARCH & CONSULTING INC.



出典：Ukraine's National Recovery Plan 2022

Figure B2.1.1 Organization Chart for Ukraine's National Recovery Plan

Ukraine
Ministry of Agrarian Policy and Food

DATA COLLECTION SURVEY FOR ASSISTANCE FOR RESTORATION AND RECOVERY OF UKRAINE IN AGRICULTURE SECTOR

FINAL REPORT
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Annex 2.1.1

Towards a strategy for Agriculture and Rural Development in Ukraine from 2023 to 2030 harmonized with the EU

Annex 2.1.1 Towards a strategy for Agriculture and Rural Development in Ukraine from 2023 to 2030 harmonized with the EU.

Principle of the Strategy Development.

- As an EU candidate country Ukraine wants to harmonize Ukrainian policies with the EU New Common Agricultural policy that has been launched in January 2023.
- Outcome: Strategy and action plan for agriculture and rural development including war recovery to be adopted by cabinet of Ministers.
- Based on various current strategy documents and legal acts in Ukraine.
- Following the format of the EU National strategy plan with 10 strategic objectives.
- Facilitating dialogue with the EU and other donors on pre-accession assistance and development support.
- Full MAPF ownership supported by cabinet of ministers.
- Covering MAPF mandate – further coordination with other line ministries necessary.
- Support by dedicated EU team of consultants.
- Stakeholder consultations with private sector, civil society and development partner.

Ukraine – Current challenges in Agriculture and Rural Development.

- Direct war losses are estimated at about 8 billion USD, indirect war losses are estimated at more than 30 billion USD (KSE figures).
- EU solidarity Lanes and Black Sea Grain Initiative (stopped) facilitate exports, but high logistics costs and constant export risks threaten farmers and agribusiness.
- Input-output price ratios for producers impact negatively on liquidity of farms, farm output, investments and earnings.
- Two million ha of farmland mined.
- Due to financial bottlenecks public support programs had to be reduced or cancelled.
- Poverty leads to food security concerns.

Government priorities.

1. **War time**: ensuring farm operations for producers and food security for consumers; developing alternative export routes via western borders; demining; supporting the food industry to get sufficient raw materials for food production; ensuring food logistics and distribution.
2. **Post-war**: demining of farmland ;creating employment for war veterans; re-opening of all Black Sea Ports supporting operators to invest in damaged port logistics; suppling global markets with agricultural commodities and food products; investment promotion for domestic and international investors in the

food industry ;irrigation rehabilitation ;diversification of agricultural production with focus on value addition: investment in renewable energy with focus on biogas; harmonization of legislation with the EU acquis, implementation of climate action , rural development and small producer programs ; harmonization of Ukrainian policies with the EU New CAP.

War Recovery Plan

- Rehabilitation of irrigation infrastructure and investment in irrigation and drainage systems in southern Ukraine to mitigate war damages and climate change.
- Investments in biogas based on maize and agriculture waste to replace imported natural gas.
- Promotion of high value addition products in the sector, Inc. Fruits and vegetables.
- Promotion of livestock production and processing to diversify farm sales.
- Investment promotion to diversify crop production and food processing to balance raw commodity and processed food exports.
- Diversifying domestic and export logistics, incl. Sea, river, truck and rail transport.
- Demining of farms, farmland and village household plots.
- Updating and completing the cartographic basis, making it available online and decentralizing land use planning.
- Developing green growth strategy and alignment with EU.
- Implementing plant and animal health, food safety and SPS measures aligned with the EU.
- Developing domestic seed industry.
- Restoration of lost assets due to war damages.
- Supporting internally displaced people with employment in horticulture and green housing.
  EU Common Agriculture Policy (2023-2027)

Strategic objectives 1: To support viable farm income and resilience of the agricultural sector.

- Legal recognition and registration of all producers.
- Definition of minimum sizes of agricultural producers independent of legal form.
- Definition of payment caps and ceilings for state support.
- Development of EU pre-accession program.
- Predictability of tax laws.
- Competition policy in relevant industries.
- Harmonization of labor market and migration regulations.

Strategic objective 2: To enhance market orientation and increase competitiveness.

Table 1 Index of Agricultural Total Factor Productivity (2015=100)

	2010	2013	2014	2015	2016	2017	2018	2019	2020
Ukraine	83	100	103	100	105	115	113	114	108
Poland	91	100	104	100	106	112	113	110	124
Georgia	89	103	94	100	109	106	120	118	125
Serbia	104	103	104	100	112	104	111	115	118
India	87	99	101	100	104	110	115	116	117
Brazil	89	94	96	100	96	104	105	106	107

Lower productivity growth in Ukraine due to

i. The high share of agricultural commodities, cereals, and oilseeds, in total production and the low share of high value-added processed food products.
ii. The high share of producers with lower-than average productivity.

Strategic goals to increase productivity:

1. Diversification of production, including more processed food and renewable energy.
2. More attention to smaller producers to improve productivity of low performing producers.
3. De-risking investments and better access to finance.
4. Digitalization of production and state services.
5. Trade promotion and trade diversification.

Strategic objective 3: To improve the farmers position in the value chain

- Supporting producer organizations and value chain partnerships.
- Promoting investments in diversification, aggregation and food processing.
- Promoting Foreign Direct Investments in Food Industry.
- Promoting private-public partnerships, including irrigation and bio-energy.
- Reducing regulatory constrains in primary agriculture and agribusiness.

Strategic objective 4: To contribute to climate change mitigation and adaptation

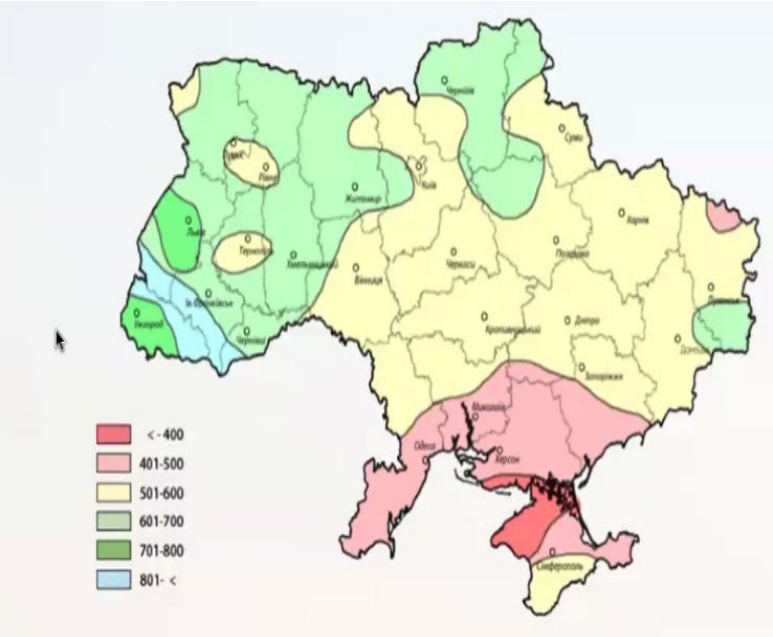


Figure 1 Precipitation in Ukraine (mm/year)

- Promote climate-smart agriculture and water-saving irrigation
- Promote organic farming
- Promote investments in renewable energy, including biogas

Strategic objective 5: To finalize land reform and to foster sustainable development and efficient management of soil, air and water, including by reducing chemical dependency.

- Seed legislation, including GMO in line with EU at the day of accession.
- Fertilizer and plant protection products registration and use harmonized with EU.
- Manure management regulations harmonized with EU.
- Land reform finalized, including National Geoportal, land valuation, electronic auction and land market monitoring.
- Land of the Academy of science auctioned off.
- Management of water resources harmonized with EU.
- Promotion of irrigation rehabilitation, including private-public partnerships.

Strategic objective 6: To contribute to halting and enhance ecosystem services and preserve habitats and landscapes.

The objective doesn't include Ukraine biodiversity strategies yet. It would consultations with the Ministry of Ecology ang Natural Resources MENR.

Strategic objective 7: To attract and sustain young and new farmers and facilitate sustainable business development in rural areas.

- Support to young farmers.
- Support to war veterans.

Strategic objective 8: To promote employment, growth, gender equality in rural areas, including circular bioeconomy

This objective doesn't include Forestry yet. It would need further consultations with the ministry of Ecology and Natural Resources.

- Development of rural development programs following the EUs LEADER approach supporting local action groups.
- Promoting women entrepreneurship in rural areas.
- Promoting circular bioeconomy in rural areas.

Strategic objective 9: To ensure food security and to improve the response of agriculture to society demands on food and health, including high quality, safe and nutritious food produced in a sustainable way, the reduction of food waste, as well as improving animal welfare and combatting antimicrobial resistance.

- Ensure food security in rural and urban areas.
- Support preschool and school nutrition programs.
- Adopt EU animal welfare standards and limit antimicrobial use.
- Adopt EU integrated food safety policy and SPS control standards.
- Promote sustainable food systems following Farm to Fork strategy.
- Align food packing and labelling requirements with EU.
- Reducing food waste in value chains.

Strategic objective 10: Modernizing the sector by fostering and sharing knowledge, innovation and digitalization in agriculture and rural areas by encouraging their uptake by farmers, through improved access to research, innovation, knowledge exchange and training.

- Integration of research, education and extension services.
- Reform of the National Academy of Science.
- Supporting effective business development and farm advisory services.
- Supporting digital advisory.
- Supporting digital financial solutions in agriculture.

Implementation and institutional effectiveness.

- High level support of prime ministers' office and MAPF senior leadership.
- Stakeholder consultation with private sector, civil society and development partners.
- Legal adoption of strategy by the cabinet of ministers.
- Strengthening of implementation capacity within MAPF.
- Establishing necessary systems (paying Agency, Integrated Administration and control systems, Farm and Animal Register, Legal Framework for common market organization).
- Preparation of multi-annual pre-accession assistance program with specific investment support measures for agriculture, food processing and bioenergy to be submitted to the EU.
- Continuation of AA/DCFTA legal approximation in agriculture and SPS towards EU standards.
- Re- orientation of public expenditures: direct aid to those who need it most.
- Specific measures for small producers.
- Specific measures for rural communities.
- Definition of climate action baselines and targets.

Annex 2.2.1

Detailed tasks of the State Agency of Melioration Fisheries

Annex 2.2.1 Detailed tasks of the State Agency of Melioration Fisheries

1) develops and participates in the implementation of state targeted programs on land reclamation;

2) develops proposals for prioritizing hydrotechnical land reclamation;

3) monitor compliance with channel operation modes;

4) monitor the technical condition of reclamation systems and hydraulic structures of enterprises, institutions and organizations under its management;

5) conducts industry expertise of design and estimate documentation for the construction (reconstruction) of certain engineering infrastructure facilities of reclamation systems;

6) ensures the operation of state water management facilities for complex purposes, inter-farm irrigation and drainage systems, and ensures scheduled preventive maintenance of reclamation systems and facilities;

7) develops and submits to the Ministry of Agrarian Policy proposals for the development, revision and approval of regulatory documentation on the design, construction and operation of water management facilities and reclamation systems;

8) ensure the design, construction and reconstruction of canals, reclamation systems and individual infrastructure facilities;

9) ensure the implementation of applied research and development works in the field of land reclamation;

10) carry out inventory and certification of national and inter-farm land reclamation systems;

11) prepare and submit proposals to the Minister of Agrarian Policy and Food for consideration of the state target programs on land reclamation for short and medium-term periods and ensure their implementation;

12) informs the public about the implementation of the state policy in the field of hydrotechnical land reclamation;

13) submit proposals on the scope of the state order for training, retraining and advanced training of specialists in the field of land reclamation;

14) organizes scientific, scientific and technical, investment, information, publishing activities, promotes the creation and implementation of modern information technologies and computer networks in the field of land reclamation;

15) develops long-term forecasts and proposals on the main directions of development of hydrotechnical land reclamation and use of reclaimed lands;

16) provides organizational support for training, retraining and advanced training of specialists in the field of land reclamation in higher education institutions that belong to the control of the State Agency;

17) improve energy efficiency in the enterprises, institutions, and associations under the control of the Agency.

18) manages the state-owned objects belonging to the sphere of management of the State Agency;

19) consider complaints from the public on issues related to the activities of state institutions, and enterprises, institutions, and associations under its control.

20) exercise any other powers provided for by law.

Annex 2.2.2

Establishment and Organization of WUA

Annex 2.2.2 Establishment and Organization of WUA

1 Purpose of Establishment of WUA (Article 2 of Water Users' Association Law)

WUA is established to operate and manage an irrigation system effectively on the parcels of agricultural land included in its operational area. Revenues from the activities of WUA shall be used solely to finance the association's statutory activities.

2 Philosophy of activities of WUA (Article 3 of the Water Users' Association Law)

WUA is established and operated based on the following principles.

1) Water users may join WUA on a voluntary basis.
2) Membership in WUA is open to owners who independently use land parcels included in its service area, and to users of land parcels transferred for use in the areas serviced by WUA.
3) WUA provides for the autonomy of its service area.
4) WUA ensures transparency and access to information on its activities.
5) WUA ensures the rights and legitimate interests of the owners and users of the land parcels within its service area.
6) WUA complies with environmental and safety requirements in the use of land and water resources within its service area.

3 Status of WUA (Article 4 of the Water Users' Association Law)

WUA is non-profit and does not seek to make profits for distribution to its members.

4 Process for Establishment and Registration of WUA (Article 5 and 6 of Water Users' Association Law)

4.1 Preparation for establishment

Information from land management documents, the National Land Registry, the National Register of Real Estate Rights, as well as information provided by central executive agencies, enterprises, etc. that administer irrigation are used to determine the areas managed by the WUAs and the composition of their owners (users). Similarly, information on existing water facilities in the area managed by the WUA will be collected from the central executive agency responsible for irrigation administration.

4.2 Preparation for the founding general meeting

The establishment of WUA shall be decided by a founding general meeting. The general meeting for establishment is convened by initiators, which includes owners (users) of the land parcels within the area managed by WUA. The initiators notify the owners and users of the land parcels of the holding of the founding general meeting. The notice to the members shall be sent at least 20 days prior to the date

of the meeting. The notice of the founding general meeting shall also specify the initiators of the meeting, venue and time of the meeting, and the agenda to be discussed at the meeting.

4.3 Holding of the founding general meeting

The chairman of the founding general meeting shall be elected by a majority vote of the owners (users) of the parcels present at the founding general meeting. The owner(s) of the parcel (user(s)) shall participate in the founding general meeting of incorporation either in person or through his/her representative(s).

In the voting at the founding general meeting, each landowner (user), regardless of the number of land parcels he/she owns (uses), has one base vote and an additional vote calculated in proportion to the area of the owner's (user's) land parcel in relation to the total area of the service area of WUA. The total number of additional votes held by all land parcel owners (users) is equal to the base vote of the owners (users) of the land parcels included in the service area of WUA. The decision to establish a water users' association shall be considered adopted if at least 50 percent of the main votes of the land owners (users) participating in the formation meeting and at least 50 percent of the additional votes of the land owners (users) participating in the formation meeting are cast at the same time.

Only landowners (users) who voted in favor of the establishment of WUA at the founding general meeting shall be members of WUA. Those landowners (users) who did not participate in the establishment meeting or who opposed the establishment of WUA may join WUA in the future as general members.

Resolutions at the founding general meeting are adopted by a show of hands vote. Resolutions adopted at the founding general meeting are recorded in the minutes, which are as follows.

1) The date and Venue of the founding general meeting
2) The total area of the area managed by WUA, the name of the irrigation system that will develop the irrigation of the relevant land parcel, its location, and the source of water for irrigation
3) Participants in the general meeting and the area of the land parcel for each participant.
4) The decision to establish WUA
5) The name and abbreviation of WUA (if any)
6) The amount and procedure for setting admission fees, if any
7) Approval of the constitution of WUA or the activities of WUA in accordance with the model constitution
8) Establishment of the executive committee of WUA and election of its members
9) Determination of the representatives of WUA in the registration process.

WUA shall be considered established from the date of its state registration. WUA shall prepare land management documents, which shall be used to determine the irrigation facilities to be managed by WUA. Based on the results of this process, it submits an application for inclusion of the information in the State Land Cadastre.

5 Constitution of WUA (Article 7 of the Water Users' Association Act)

The constitution of WUA shall include the followings.

1) Name of WUA and its abbreviation (if any)
2) Purpose of the activity of WUA
3) Name, location, and water resource for irrigation systems managed by WUA
4) Executive committees of WUA, their powers and decision-making procedures
5) Procedures for convening and holding general meetings
6) Frequency of the general meetings
7) Procedures for voting and decision-making at the general meetings, list of agenda requiring a qualified majority
8) Sources of funds, and procedures for the use of the assets and funds of WUA
9) Procedures to determine the amount of contributions and liability of WUA's members for breach of their obligations to pay contributions
10) The rights and obligations of the members of WUA
11) Actions to be taken in the event of non-compliance with the constitution and resolutions of the general meeting
12) Procedures to amend the constitution of WUA
13) Procedures for the raising and use of the funds of WUA
14) Procedures for the preparation, review and approval of the budget of WUA
15) Reasons and procedures for liquidation or reorganization (merger or split) of WUA, and the resolution of property issues related to such liquidation or reorganization.

6 Joining WUA (Article 8 of the Water Users' Association Law)

The number of members of WUA is not limited. Any owner (user) of agricultural land within the service area of WUA shall have the right to become a member of WUA. WUA shall be obliged to accept such agricultural land owners (users) as members. Owners (users) of agricultural land parcels outside the service area of WUA may become members of WUA after its service area is extended. To join WUA, the owner (user) of a land parcel must submit an application in any form to the president of the association (the president of WUA).

7 Rights and obligations of WUA's members (Water Users' Association Law, Article 9)

Member of WUA shall have the rights to:

1) participate in the management of WUA, vote at the general meetings, elect and be elected to committee members of WUA.
2) receive services from WUA

3) withdraw from WUA and receive eligible refundable contributions (if paid by the member) within the procedures and timeframe established by resolution of the general meeting.

4) apply to the committee and the members of the committee for requests concerning membership in WUA and the activities of WUA and its committee members, and receive written responses to such requests

5) Receive information on the activities of WUA, including the annual financial statements, accounts and other financial information of WUA.

6) receive compensation for the value of the investments made in the technical infrastructure facilities of the irrigation system owned by WUA, in accordance with the procedures and conditions set forth in the contract entered into with WUA.

Members of WUA shall have the obligations to:

1) Adhere to WUA's constitution.

2) implement the decisions of the committee of WUA made within the scope of its authority

3) Pay contributions to WUA in the manner and amount determined by decision of the General Assembly and pay the necessary expenses for the work of WUA.

4) allow employees of WUA or third parties involved by WUA to enter the land parcel in order to perform maintenance and/or repair of the water facilities comprising the irrigation system installed on the land parcel.

5) Prevent any damage to the water facilities installed on the member's land parcel in the course of activities by WUA.

8 Organization of WUA (Articles 11, 12, 13 and 14 of the Water Users' Association Law)

The structure of WUA is as follows.

1) Supreme governing body - the general meeting of the association

2) Executive body – the executive committee headed by the president

3) Governing body - the audit committee

4) Other governing bodies as defined in the articles of association

8.1 General Meeting of WUA

All members of WUA have the right to participate in the General meeting.

The exclusive authority of the general meeting is to:

1) approve the constitution of WUA and any amendments thereto.

2) Establish the executive committee of WUA.

3) Hear reports of the executive committee of WUA.

4) discuss complaints against the decisions, actions or inactions of WUA's executive committee and its members, and make decisions based on the results of the discussions

5) approve the budget of WUA

6) establish the reserve and special funds of WUA.

7) decide the payment of admission fees by new members of WUA, determine the method (formula) for calculating the admission fees of new members of WUA, and determine the procedures and conditions for the payment of admission fees

8) determine target contributions by members of WUA, and determine the conditions and procedures for the return of refundable target contributions

9) determine the fees for the services rendered by WUA, or the method (formula) for calculating the fees, and establish the procedures and conditions for payment for the services.

10) determine the compensation of the president and members of executive committee and the chairman and members of the audit committee (auditors) of WUA

11) decide to change (expand) the service area of WUA, if its service area is expanded by the addition of new members.

12) decide the ownership, use, and disposal of property, if provided for in the WUA's constitution.

13) decide on membership in an union of WUAs.

14) approve regulations for the provision of services by WUA.

15) decide the reorganization or liquidation of WUA.

General meetings of WUA shall be convened by the President (Chairman) of WUA as necessary, but at least once a year. An extraordinary general meeting must be called at the request of at least one-third of WUA's members or at the request of the audit committee (auditors) or the supervisory board (if any). Resolutions of the general meeting shall be adopted by vote, and minutes of the general meeting shall be prepared based on the results of the meeting.

8.2 Executive committee

The executive body of WUA is the executive committee or the president. The executive committee (the president) of WUA is accountable to the general meeting and responsible for the effectiveness of the WUA's activities.

8.3 Audit Committee

Control over the financial and economic activities of WUA is exercised by the Audit Committee (auditors). The operating procedures and composition of the Audit Committee are approved by the general meeting. The audit committee (auditors) is accountable to the general meeting. The chairman of the audit committee (Auditor) may participate in the executive committee as an advisor.

The audit committee (auditors) prepares a report based on the results of the audit of WUA's activities. Extraordinary audits of the results of the financial and economic activities of the Partnership may be carried out by the audit committee (auditors) on its own initiative or by decision of the general meeting or at the request of at least one-third of the total number of members.

Annex 2.2.3

Irrigation System Maintenance by WUA

Annex 2.2.3 Irrigation System Maintenance by WUA

1 Financial resources and activity budget of WUA (Articles 16, 17, 18, and 19 of the Water Users' Association Law)

1.1 Financial resources/assets

Financial resources/assets of WUA are as follows.

1) Admission fee
2) Contributions with a defined use
3) Income from services rendered to WUA's members
4) Inter-farm and on-farm irrigation facilities transferred to WUA
5) Donations of money or property, charitable contributions, grants, humanitarian aid, and free technical assistance to WUA or individuals
6) Other sources not prohibited by law

Funds and property received by WUA shall be used solely for legally recognized activities of WUA.

1.2 Admission fees

By decision of the general meeting of WUA, it may provide for the payment of an admission fee upon acquiring membership in WUA.

1.3 Contributions

Payment of non-refundable contributions is mandatory if decided by the general meeting. Contributions subject to refund by individual members may only be determined by prior agreement with members of WUA.

1.4 Budget

The budget of WUA establishes the amount of expenses for the operation and management of WUA and for the maintenance of the irrigation system managed by WUA. The general meeting of WUA approves the budget. The general meeting may delegate to the executive committee (the President) the right to reallocate the amount of expenses itemized in the budget.

2 Services by WUA(Article 20 of the Water Users' Association Law)

WUA shall perform the services of abstracting water from the water source, distributing water to members of WUA and discharging such water in accordance with the service provision rules of WUA approved by the general meeting. The provision of services to non-members shall be carried out in accordance with a separate contract, the terms of which shall not be contrary to the service provision rules of WUA.

WUA is obligated to provide and confirm, upon request of any members of WUA who has a land parcel in its service area, the rules and regulations concerning the services provided by WUA. WUA is obliged to keep records of the amount of water allocated by WUA to each member of WUA.

The amount of water allocated by WUA to each member of WUA shall not exceed the withdrawal limit stated in the special water use permit issued to such member or the amount of water that may be withdrawn and/or used without a special water use permit in accordance with law.

If the water demands of all members of WUA cannot be fully met due to a shortage of water from water sources or an emergency situation, WUA shall meet the water demands of its members on a priority basis. In such case, the water demands of the members of WUA shall be met in proportion to their land parcel area located in its service area.

3 Cost of services by WUA (Article 20 of the Water Users' Association Law)

Service charge of WUA includes the following elements.

1) The cost of maintaining the irrigation system managed by WUA, including

Costs for maintenance and repair of irrigation facilities

Costs to replace or construct (install) irrigation facilities

Costs for repayment of external funds

2) Costs for water abstraction, distribution to members of WUA, and drainage. The cost includes the cost of the payments of WUA for water and electricity services and other costs necessary for water abstraction, distribution, and drainage, the amount of which depends on the volume of water delivered (drained) to each member of WUA.

3) Costs necessary to manage WUA. These costs include the compensation of the members of executive committee and employees of the operating WUA.

The cost of managing WUA and maintaining the irrigation facilities by WUA shall be borne by members of WUA in proportion to the area of each member's land parcel within its service area. By decision of the general meeting, the cost to operate and manage WUA and/or maintaining irrigation facilities managed by WUA may be paid by the members before WUA begins to provide services to members of WUA in accordance with an approved schedule. WUA shall have the right to terminate services relating to the abstraction of water from water sources, distribution of water to members of WUA and the drainage thereof, if payment for the services of WUA is delayed for a period longer than that specified in the service provision rules of WUA.

4 Transfer of ownership of irrigation facilities to WUA (Article 21 of the Water Users' Association Law)

WUA shall have the right to acquire right of ownership for the following irrigation facilities within the state-owned and communal lands at no cost.

1) Pumping stations, intakes, and other water facilities

2) Irrigation and drainage canals (if service area of WUA includes all land parcels irrigated by such canals)

3) Water storage ponds and reservoirs

4) Pipelines

5) Other water facilities such as inter-farm and on-farm irrigation systems

In order to submit an application to acquire ownership of irrigation facilities within the area managed by WUA, WUA must prepare a list of such irrigation facilities. The application with the list shall be submitted to state agency or local government body authorized to decide on the transfer of ownership of the facilities. Said agency must decide within 20 days from the date of receipt of said application of WUA whether or not to transfer the irrigation facilities to WUA.

5 Investment in WUA (Article 23 of the Water Users' Association Law)

Members of WUA may independently pay for the construction (installation) and repair of irrigation facilities and equipment within WUA's service area in accordance with an agreement with WUA. Any agreement between WUA and its members to make capital contributions for the repair and improvement of irrigation facilities shall be subject to the approval of the general meeting of WUA.

6 Regulations for State Assistance for Rehabilitation of Irrigation Facilities and Equipment

Resolution No. 1070 of the Council of Ministers of Ukraine dated October 11, 2021 (as amended) "On Approval of the Procedure for the Use of Funds Provided in the State Budget for State Support to Agricultural Producers and Water Users Associations Using Agricultural Development Lands" (hereinafter "CMU Resolution No. 1070") approves the procedure defining the mechanism for use of funds provided in the state budget by the Ministry of Agricultural Policy and Food under the "Financial Support to Agricultural Producers" program.

CMU Resolution No. 1070 establishes a mechanism for the Government to provide assistance to rehabilitate pumping stations that have been transferred to agricultural producers and WUA that use agricultural development land and that are not in operation or whose performance is below the level set by the Government. The resolution also stipulates procedures for the submission of documents, review by the commission, decisions regarding the payment of budgetary subsidies, and the mechanism for the allocation of funds.

Budget funds, in the form of budgetary grants, are available to agricultural producers for 1) reconstruction of existing irrigation systems and/or construction of new irrigation system systems with sprinkler or drip irrigation, and 2) rehabilitation of pump stations whose ownership has been transferred to WUA for state assistance.

Resolution No. 974 of the Cabinet of Ministers of Ukraine dated August 30, 2022 "On Determining the Level of Performance Indicators of Pumping Stations whose ownership is transferred to Water User Associations" defines the performance indicators of pumping stations that have come into the ownership of WUA. The resolution stipulates that "if a pump for which ownership has been transferred to WUA

does not have the appropriate performance level of the stipulated, WUA may receive budgetary assistance for the rehabilitation and improvement of such pumps."

Annex 2.2.4

List of Irrigation System in Ukraine

Annex 2.2.4 List of Irrigation System in Ukraine

No.	Name of Oblast/Name of Irrigation System
	Vinnytsia region
1	Voronivka irrigation system
2	Nikiforivtsi irrigation system
3	Dashiv irrigation system
4	Ivchan irrigation system
5	Gorbaniv irrigation system
6	Agronomichne-Bohonyky irrigation system
7	Sumy irrigation system
8	Petrashivka irrigation system
9	Zavadivka irrigation system
10	Irrigation system Kyvachivka
11	Irrigation system Bondurivka
12	Trostianchyk irrigation system
13	Fedorivska irrigation system
14	Kinashiv irrigation system
15	Torkov irrigation system
16	Petrashiv irrigation system
17	Yampil irrigation system
18	Porohiv irrigation system
19	Yaruzhka irrigation system
20	Babchynetsk irrigation system
21	Ozarinet irrigation system
22	Chernivtsi irrigation system
23	Yaryshiv irrigation system
24	Silver irrigation system
25	Kisnitsa irrigation system
	Dnipropetrovsk region
1	Bagli irrigation system
2	Bohuslav irrigation system
3	Vasylivska irrigation system
4	Vyshchetarasiv irrigation system
5	Irrigation system " Nivotrudivskyi "
6	Dnipro irrigation system
7	Irrigation system " Progress "

No.	Name of Oblast/Name of Irrigation System
8	Irrigation system " Sura "
9	Irrigation system at the Naukova agricultural firm
10	Irrigation system in the area of the Dnipro-Kryvyi Rih canal
11	Irrigation system in the educational and research farm " Samarskyi "
12	Irrigation system in the experimental farm " Dnipro "
13	The irrigation system of the Kakhov reservoir
14	Irrigation system of wastewater in the city of Kryvyi Rih
15	Kielce irrigation system
16	Kamian irrigation system
17	Kapul irrigation system
18	Kaliniv irrigation system
19	Magdalin irrigation system
20	Krasin irrigation system
21	Sukhachiv irrigation system
22	Mykolaiv irrigation system
23	Solonyan-Tomakiv irrigation system
24	Petrovsky irrigation system
25	Nikopol irrigated massif
26	Pavlograd irrigation system
27	Oleksandriv irrigation system
28	Mykhailo irrigation system
29	Tsarychan irrigation system
30	Trinity irrigation system
31	Irrigation system of the Sholokhiv Reservoir
	Donetsk region
1	Myronivska irrigation system
2	Serebryan irrigation system
3	Myrolyubiv irrigation system
4	Oskil irrigation system No 1
5	Oskil irrigation system no 2
6	Lymanska irrigation system
7	Pravdy irrigation system
8	Slavic irrigation system
9	Volnovaska irrigation system
10	Anatolian irrigation system
11	Veselov irrigation system

No.	Name of Oblast/Name of Irrigation System
12	Kirov irrigation system
13	Mariupol irrigation system
14	Mangush irrigation system
15	Starodubivka irrigation system
16	Pavlopol irrigation system
	Zaporizhzhia region
1	Annunciation irrigation system
2	Vasylivska irrigation system
3	Vilnius irrigation system
4	Upper Tarasiv irrigation system
5	October irrigation system
6	Zaporizhzhia irrigation system
7	Ivanovo irrigation system
8	Kamian irrigation system
9	Kainkulak irrigation system
10	Kakhov irrigation system
11	Cossack irrigation system
12	Lyman irrigation system
13	North Rohachik irrigation system
14	May Day irrigation system
15	Azov irrigation system
16	Rozumivska irrigation system
17	Shevchenko irrigation system
	Kyiv region
1	Belotserkiv irrigation system
2	Bloshchyna irrigation system
3	Bohuslav irrigation system
4	Lutarsk irrigation system
5	Chubynetsk irrigation system
6	Pustovariv irrigation system
	Kirovohrad region
1	Vilshan irrigation system
2	Sinitsivka irrigation system
3	Suburban irrigation system
4	Kirovohrad irrigation system
5	Company irrigation system

No.	Name of Oblast/Name of Irrigation System
6	Sofia irrigation system
7	Bobrynetsk irrigation system
8	Novgorodkiv irrigation system
9	Fedorivska irrigation system
10	New Ukrainian irrigation system
11	Novomyrhorod irrigation system
12	Malovyskiv irrigation system
13	Zvenigorod irrigation system
14	Holovkiv irrigation system
15	Alexandria irrigation system
16	Voynivska irrigation system
17	Velikoskeliv irrigation system
18	Dnieper irrigation system
	Luhansk region
1	Bilokurakin irrigation system
2	Volodar irrigation system
3	Dyomin irrigation system
4	Kamian irrigation system
5	Zorya-Bulavinivska irrigation system
6	Denezhnik irrigation system
7	Kolyad irrigation system
8	Crimean irrigation system
9	Malo-Alexandriv irrigation system
10	New Donbas-Ukraine irrigation system
11	Zhovten irrigation system
12	Peredilsk irrigation system
13	Progress-Avangard irrigation system
14	Timonivka irrigation system
15	Rudiv irrigation system
16	Swativ irrigation system
17	Kolomiychi irrigation system
18	Privilnia irrigation system
19	Trinity irrigation system
20	Danyliv irrigation system
21	Bilovodsk irrigation system
22	Stanychno-Luhansk irrigation system

No.	Name of Oblast/Name of Irrigation System
	Mykolaiv region
1	Yuzhno-Buzka irrigation system
2	Kateryniv irrigation system
3	Kamian irrigation system
4	Kaliniv irrigation system
5	Novo Odesa irrigation system
6	Novosafronivka irrigation system
7	Kandybin irrigation system
8	Oleksandriv irrigation system
9	Belousiv irrigation system
10	Voznesensk irrigation system
11	Vodiano-Loryna irrigation system
12	Volnov irrigation system
13	Yelanetska irrigation system
14	Shcherbaniv irrigation system
15	Yastrubynov irrigation system
16	Ingulets irrigation system
17	Yavkin irrigation system
18	Spaska irrigation system
19	Ingul irrigation system
20	Michurin irrigation system
21	Comintern irrigation system
22	Kostychiv irrigation system
	Odesa region
1	Nizhny Dniester irrigation system
2	Mayako-Bilyaiv irrigation system
3	Troitsko-Gradanytska irrigation system
4	Irrigation system of Troitsky Island
5	Belgorod-Dniester irrigation system
6	Semeniv irrigation system
7	Udbyan irrigation system
8	Karnaliiv irrigation system
9	Krutoyariv irrigation system
10	Danube-Dniester irrigation system
11	Yalpug irrigation system
12	Krynychan irrigation system

No.	Name of Oblast/Name of Irrigation System
13	Vynohradiv irrigation system
14	Banivsk irrigation system
15	Interdistrict irrigation system
16	Kotlovinsk irrigation system
17	Novosilsk irrigation system
18	Rainy irrigation system
19	Kagul irrigation system
20	Danube irrigation system
21	Chudnov irrigation system
22	Konstantinovka irrigation system
23	Khadzhey irrigation system
24	Oryol irrigation system
25	Nagornya irrigation system
26	Valley irrigation system
27	Suvorov irrigation system
28	Ant irrigation system
29	Irrigation system Kislytska No. 1
30	Kislytsk rice irrigation system
31	Irrigation system of Kislytskyi island
32	Staronekrasiv irrigation system
33	Kyslytsk irrigation system
34	Ozernyan irrigation system
35	Ishmael irrigation system
36	Tashbunar irrigation system
37	Loshchyniv irrigation system
38	Dmitrov irrigation system
39	Kagach irrigation system
40	Novo-Kagach irrigation system
41	Danube-Dniester irrigation system
42	Kamian irrigation system
43	Tatarbunar irrigation system (Bolhrad district)
44	Vasylivska irrigation system
45	Inter-farm irrigation system
46	Irrigation system of the island of Stepovy
47	Chervonoyarsk irrigation system
48	Kiliya irrigation system

No.	Name of Oblast/Name of Irrigation System
49	Kiliya-Mayak irrigation system
50	Michuryn irrigation system
51	Liskiv irrigation system
52	Tatarbunar irrigation system (Izmail District)
53	Shevchenko irrigation system
54	Priozernyan irrigation system
55	Irrigation system of the State Research Institute of Rice
	Poltava
1	Grady irrigation system
2	Babychiv irrigation system
3	Karpiv irrigation system
4	Maksimiv irrigation system
5	Kozelshchyna irrigation system
6	Mashiv irrigation system
7	Kishenkiv irrigation system
8	Orlykiv irrigation system
9	Sokol irrigation system
10	Grigoro-Brigadiriv irrigation system
11	Kuibysh irrigation system
	Kharkiv region
1	Balaklia irrigation system
2	Irrigation system " Stepok "
3	" Slobidske " irrigation system
4	Irrigation system " Sivash "
5	Irrigation system " Pobyeda "
6	Irrigation system " Upper Bishkin "
7	Irrigation system " Chistovodivka "
8	Irrigation system " Nadezhdivka "
9	Irrigation system " Orilka "
10	" Movchanivska " irrigation system
11	Velikoburlutska irrigation system _
12	Irrigation system " Petrivka "
13	Irrigation system " Vyshnivska "
14	Irrigation system " Kupianskyi "
15	Irrigation system " Mykolaivka "

No.	Name of Oblast/Name of Irrigation System
16	Irrigation system of the peasant farm " Promin " of the peasant farm " Mayak " of the open joint-stock company " Ulianivske "
17	Ivano-Shiychan irrigation system
18	Irrigation system at the private agricultural enterprise " Oazis " , at the private agricultural enterprise " Yavir "
19	Rogozian irrigation system
20	Bratenytsk irrigation system
21	Dergachev irrigation system
22	Unmanned irrigation system
23	Irrigation system on the lands of the Babaiv village council
24	Irrigation system in the agricultural production cooperative " Kharkov Vegetable Factory "
25	Herbal irrigation system
26	Murom irrigation system
27	Tsirkuniv irrigation system
28	Martiv irrigation system
29	Pecheneg irrigation system
30	Lebyazka irrigation system
31	Irrigation system in the private joint-stock company of the Agrocombination " Slobozhansky "
32	Repin irrigation system
33	Irrigation system in the limited liability company Agrofirm " Nadia "
34	Irrigation system in the agricultural production cooperative " Ivanivskyi Lan "
35	Lyman irrigation system
36	Genius irrigation system
37	Shebelin irrigation system
38	Irrigation system in the private agricultural enterprise " Krasnograd Vegetable Factory "
39	May Day irrigation system
	Kherson region
1	Kakhov irrigation system
2	Syrogoz irrigation system
3	North Crimean irrigation system
4	Batumi irrigation system
5	Rubaniv irrigation system
6	North Rohachytsk irrigation system
7	Beryslav irrigation system

No.	Name of Oblast/Name of Irrigation System
8	Tomarin irrigation system
9	Limanets irrigation system
10	Ukrainian irrigation system
11	Sofia irrigation system
12	Zolotobalkivsk irrigation system
	Cherkasy region
1	Adamiv irrigation system
2	Ratsivka irrigation system
3	Tinkiv irrigation system
4	Topiliv irrigation system
5	Trushiv irrigation system
6	Chorniav irrigation system
7	Mykhailo irrigation system
8	Geronimo irrigation system
9	Rusko-Polyan irrigation system
10	Moshniv irrigation system
11	Yasnozir irrigation system
12	Korsun-Shevchenkiv irrigation system
13	Shenderiv irrigation system
14	Khudyakiv irrigation system
15	Cherkasy irrigation system
16	Shpolyansk irrigation system
17	Bohuslav irrigation system
18	Burim irrigation system
19	Veremiev irrigation system
20	Domantiv irrigation system
21	Dmitrov irrigation system
22	Irkliiv irrigation system
23	Klischen irrigation system
24	Lipyavsk irrigation system
25	Moskalenko irrigation system
26	Mezhiritka irrigation system
27	Palmyra irrigation system
28	May Day irrigation system
29	Sand irrigation system
30	Podilsk irrigation system

No.	Name of Oblast/Name of Irrigation System
31	Lyashchiv irrigation system
32	Sokolov irrigation system
33	Zvenigorod irrigation system
34	Stebniv irrigation system
35	Nemoroz irrigation system
36	Katerynopil irrigation system
37	Elizabeth irrigation system
38	Lysyan irrigation system
39	Buk irrigation system
40	Knyazhe-Krynytsk irrigation system
41	Talniv irrigation system
42	Kryvo-Kolinska-I irrigation system
43	Kryvo-Kolinska-II irrigation system
44	Kobrynovo-Grebel irrigation system
45	Zelenkiv irrigation system
46	Uman irrigation system
47	Ladyzhen irrigation system
48	Dubiv irrigation system
49	Lotashivka irrigation system
50	Yagubet irrigation system
51	Yurkiv irrigation system

Annex 2.2.5

Salient Feature of
Major Irrigation System

Annex 2.2.5 Salient Feature of Major Irrigation System

Table B2.2.5 Description of Major Irrigation Systems (1/8)

Name of Irrigation Systems	Oblast	Area (equipped with irrigation infrastructure, and operational) Estimates	Water resources (Name of River)	Main features of irrigation infrastructure	Type of Irrigation	Crops under irrigation practice Estimates	Number of beneficiaries, Estimates	Outline of Water Users' Association
Yaryshivska	Vinnytsia	1400 ha/ 930 ha (66%)	Dniester river	The main pumping station Pumping stations Main channel Concreted Water pipes - polyethylene	Sprinkler Irrigation	Nuts	1	OVC Yaryshiv irrigation system
Kilchensk	Dnipropetrovsk	36,500 ha / 35,300 ha (97%)	Dnipro Reservoir	2 concrete trunk channels, concrete and earth distribution channels, polyethylene pipelines Pressure pipeline 11 pumping stations 2 pressure pools	Sprinkler Irrigation	Crops Oily	43	Dnipro Voda HVACR
Magdalinovska	Dnipropetrovsk	25,700 ha/ 5,060 ha (20%)	Dnipro-Donbass channel	From the main pumping stations Open channels are lined with reinforced concrete slabs, closed steel, reinforced concrete and polyethylene pipelines. Horizontal and vertical drains.	Sprinkler Irrigation	Cereal crops Oil crops Fodder crops	9	
Tsarychanska	Dnipropetrovsk	12,830 ha/ 3,320 ha (26%)	Dnipro-Donbas channel	The main pumping station Pumping stations The main channel is lined with reinforced concrete. Inter-farm and intra-farm pipelines are concrete, steel or polyethylene.	Sprinkler Irrigation Drip irrigation	From arable and oil crops Vegetables	9	

Source: Ministry of Agriarian Policy and Food

Table B2.2.5 Description of Major Irrigation Systems (2/8)

Name of Irrigation Systems	Oblast	Area (equipped with irrigation infrastructure, and operational) Estimates	Water resources (Name of River)	Main features of irrigation infrastructure	Type of Irrigation	Crops under irrigation practice Estimates	Number of beneficiaries, Estimates	Outline of Water Users' Association
Slavic language _	Donetsk	10,074 ha /2,400 ha (24%)	Siversk Deanery River	main pumping stations and pumping stations . The trunk channel is lined with prefabricated and monolithic reinforced concrete. The domestic network is made of metal and asbestos-cement pipes.	Sprinkler Irrigation Drip irrigation	Grain and oil crops	11	
Priazovska	Donetsk Zaporizhzhia	280,000 ha/ 96,800 ha (35%)	Kakhov reservoir	The main pumping station Pumping stations The main channel and distributors are built with anti-filtration lining, the irrigation network is in closed pipelines,	Sprinkler Irrigation Drip irrigation	Cereal crops Oil crops Vegetables Potato gardens	89 (before the war) Located in the occupied territory	
Vilnius	Zaporizhzhia	20,021 ha/ 7,350 ha (37%)	Dnipro Reservoir	The main pumping station Pumping stations The main channel is lined with reinforced concrete. Inter-house pipelines are concrete, steel and polyethylene.	Sprinkler Irrigation Drip irrigation	Cereal crops Oil crops Vegetables	29 It is located close to the war zone	

Source: Ministry of Agriarian Policy and Food

Table B2.2.5 Description of Major Irrigation Systems (3/8)

Name of Irrigation Systems	Oblast	Area (equipped with irrigation infrastructure, and operational) Estimates	Water resources (Name of River)	Main features of irrigation infrastructure	Type of Irrigation	Crops under irrigation practice Estimates	Number of beneficiaries, Estimates	Outline of Water Users' Association
Severochoraghac hitska	Zaporizhzhia	164,000 ha /109,300 ha (67%)	Kakhov reservoir	The main pumping station Pumping stations The trunk channel is lined with prefabricated and monolithic reinforced concrete. The domestic network is made of metal and asbestos-cement pipes.	Sprinkler Irrigation	Cereal crops Oil crops Vegetables Potato gardens	64 (before the war) Located in the occupied territory	
October	Zaporizhzhia	13,500 ha/ 12,671 ha (94%)	Dnipro Reservoir	The main pumping station , pumping stations (2, 3 , 4 , 5 lifts). 2 main canals and steel and reinforced concrete inter-farm pipelines Drainage was built within the system .	Sprinkler Irrigation	Crops Oily Vegetables	11	
Syrogozka	Zaporizhzhia Khersonsk	116,400 ha/ 41,600 ha (36%)	Kakhov reservoir	The main pumping station pump-up stations Main and distribution channels are waterproofed	Sprinkler Irrigation Drip irrigation	Cereal crops Fodder crops Vegetables gardens	44 (before the war) Located in the occupied territory	

Source: Ministry of Agriarian Policy and Food

Table B2.2.5 Description of Major Irrigation Systems (4/8)

Name of Irrigation Systems	Oblast	Area (equipped with irrigation infrastructure, and operational) Estimates	Water resources (Name of River)	Main features of irrigation infrastructure	Type of Irrigation	Crops under irrigation practice Estimates	Number of beneficiaries, Estimates	Outline of Water Users' Association
Kakhovskaya	Zaporizhzhya Kherson	780,000 ha/ 262,000 ha (34%)	Kakhov reservoir	The main pumping station , pump-up stations Main and distribution channels are waterproofed. Concrete, steel and polyethylene pipelines. It is equipped with regulatory structures	Sprinkler Irrigation Drip irrigation	Grain, oil, technical, fodder crops Vegetable Grape Fruits Berries	113 (before the war) Located in the occupied territory	
Peredilska	Luhansk	1,800 ha /864 ha (48%)	Siversk Deanery River	Main pumping stations 3 pumping stations. The trunk channel is lined with prefabricated and monolithic reinforced concrete. The domestic network is made in metal and concrete pipes.	Sprinkler Irrigation Drip irrigation	Grain and oil crops Vegetables	6 (before the war) Located in the occupied territory	
Inguletska	Mykolayivska	60,800 ha/ 23,900 ha (39%)	Ingulets River	The main pumping station Pumping stations The main channel and open distribution channels are waterproofed with concrete slabs. Closed water pipes are made of steel or polyethylene.	Sprinkler Irrigation	Cereal crops Fodder crops Vegetables	54	

Source: Ministry of Agriarian Policy and Food

Table B2.2.5 Description of Major Irrigation Systems (5/8)

Name of Irrigation Systems	Oblast	Area (equipped with irrigation infrastructure, and operational) Estimates	Water resources (Name of River)	Main features of irrigation infrastructure	Type of Irrigation	Crops under irrigation practice Estimates	Number of beneficiaries, Estimates	Outline of Water Users' Association
Spaska	Mykolayivska	10,200 ha/ 4,700 ha (46%)	Lyubyn reservoir	The main pumping station Pumping stations The main channel and open distribution channels are waterproofed with concrete slabs. Closed water pipes are made of steel or polyethylene.	Sprinkler Irrigation	Cereal crops Fodder crops Vegetables	23	
Yavkinska	Mykolayivska	50,300 ha / 2,800 ha (6%)	Ingulets River	The main pumping station 42 pumping stations Main channels are waterproofed with a concrete-film coating Steel, concrete, polyethylene pipelines	Sprinkler Irrigation	Cereal crops Fodder crops Vegetables	28	
Yuzhno-Buzka	Mykolayivska	12,200 ha /4,168 ha (34%)	Pivdenniy Bug River	The main pumping station 8 pumping stations The main channel is lined with anti-filtration reinforced concrete slabs laid on polyethylene film; inter-farm distributors are built in reinforced concrete pipes, intra-farm network - from steel and asbestos-cement pipes;	Sprinkler Irrigation	Grain, oil, technical, fodder crops	16	
Kiliya rice	Odesa	4,832 ha	Danube River	Main and distribution channels with reinforced concrete lining ; 4 pumping stations 1 water intake, 2 double action, 1 reset.	Gravity irrigation	Fig	9	

Source: Ministry of Agriarian Policy and Food

Table B2.2.5 Description of Major Irrigation Systems (6/8)

Name of Irrigation Systems	Oblast	Area (equipped with irrigation infrastructure, and operational) Estimates	Water resources (Name of River)	Main features of irrigation infrastructure	Type of Irrigation	Crops under irrigation practice Estimates	Number of beneficiaries, Estimates	Outline of Water Users' Association
Danube-Dniester	Odesa	48,325 ha/ 0 ha (0%)	Lake Sasyk	5 main pumping stations, two-way pumping stations Main and inter-farm channels are open, in concrete-film lining. The domestic network is closed and consists of steel, reinforced concrete and asbestos-cement pipes.	Sprinkler Irrigation	Cereal crops Fodder crops Vegetables Fruits	0 Canned.	
Suvorivska	Odesa	10,300 ha/ 1,680 ha (16%)	Lake Katlabukh	The main pumping station, two-way pumping stations. Main and distribution channels lined with reinforced concrete slabs, polyethylene pipelines.	Sprinkler Irrigation Drip irrigation	Winter crops Greek river Vegetables Potato	8	HVAC Water of life
Belgorod-Dnistrovska	Odesa	14,584 ha/ 11,937 ha (82%)	Dniester River	11 pumping stations, Subduct, open and closed channels-pipelines	Sprinkler Irrigation Drip irrigation	Vegetables Potatoes _ _ In a foreign city Agricultural crops	29	

Source: Ministry of Agriarian Policy and Food

Table B2.2.5 Description of Major Irrigation Systems (7/8)

Name of Irrigation Systems	Oblast	Area (equipped with irrigation infrastructure, and operational) Estimates	Water resources (Name of River)	Main features of irrigation infrastructure	Type of Irrigation	Crops under irrigation practice Estimates	Number of beneficiaries, Estimates	Outline of Water Users' Association
Nizhny-Dniester	Odesa	37,000 ha/ 12,000 ha (32%)	Dniester River	Main pumping station, pumping stations of the 2nd lift. The main channel and distribution channels are lined with prefabricated and monolithic reinforced concrete on a polyethylene film, the domestic network is laid in reinforced concrete pipes and trays.	Sprinkler Irrigation Drip irrigation	Vegetables Potatoes _ _ In a foreign city Agricultural crops	56	
Tatarbunarska	Odesa	31,700 ha/ 12,714 ha (40%)	Danube River	Main pumping stations (of the first, second and third lifts) Main charging stations . _ _ The trunk channel is lined with prefabricated and monolithic reinforced concrete. The domestic network is made of metal and asbestos-cement pipes.	Sprinkler Irrigation Drip irrigation	Cereal crops Vegetables Grape	38	
Lymanetska	Khersonsk	1,700 ha/ 1,500 ha (88%)	Dnipro River	The main pumping station , pump-up stations Main and distribution channels are waterproofed Concrete and polyethylene pipelines	Sprinkler Irrigation	Cereal crops Vegetables Fruits	18	

Source: Ministry of Agriarian Policy and Food

Table B2.2.5 Description of Major Irrigation Systems (8/8)

Name of Irrigation Systems	Oblast	Area (equipped with irrigation infrastructure, and operational) Estimates	Water resources (Name of River)	Main features of irrigation infrastructure	Type of Irrigation	Crops under irrigation practice Estimates	Number of beneficiaries, Estimates	Outline of Water Users' Association
Krasnoznamyansk	Khersonsk	96,700 ha/ 72,000 ha (74%)	North Crimean Canal	The main pumping station Pumping stations The network is made in closed concrete and steel pipelines Drainage was built within the system .	Sprinkler Irrigation Drip irrigation	Cereal crops Bashtanny Vegetables gardens	63 (before the war) Located in the occupied territory	
Kalanchak	Khersonsk	18,080 ha/ 14,675 ha (81%)	Kakhov reservoir	Main pumping stations Pumping stations. The trunk channel is lined with prefabricated and monolithic reinforced concrete. The domestic network is made of metal and polyethylene pipes.	Sprinkler Irrigation Drip irrigation	Crops Vegetables Berries Bashtanny Fig	28 (before the war) Located in the occupied territory	
Chaplinska	Khersonsk	50,330 ha/ 38,564 ha (76%)	Kakhov reservoir	Main pumping stations Pumping stations. The trunk channel is lined with prefabricated and monolithic reinforced concrete. The domestic network is made in metal and concrete pipes.	Sprinkler Irrigation Drip irrigation	Crops Vegetables Berries Bashtanny Fig	47 (before the war) Located in the occupied territory	

Source: Ministry of Agriarian Policy and Food

Annex 2.2.6

Analysis of Damage to Irrigated Area

2.2.9 Analysis of Damage to Irrigated Area

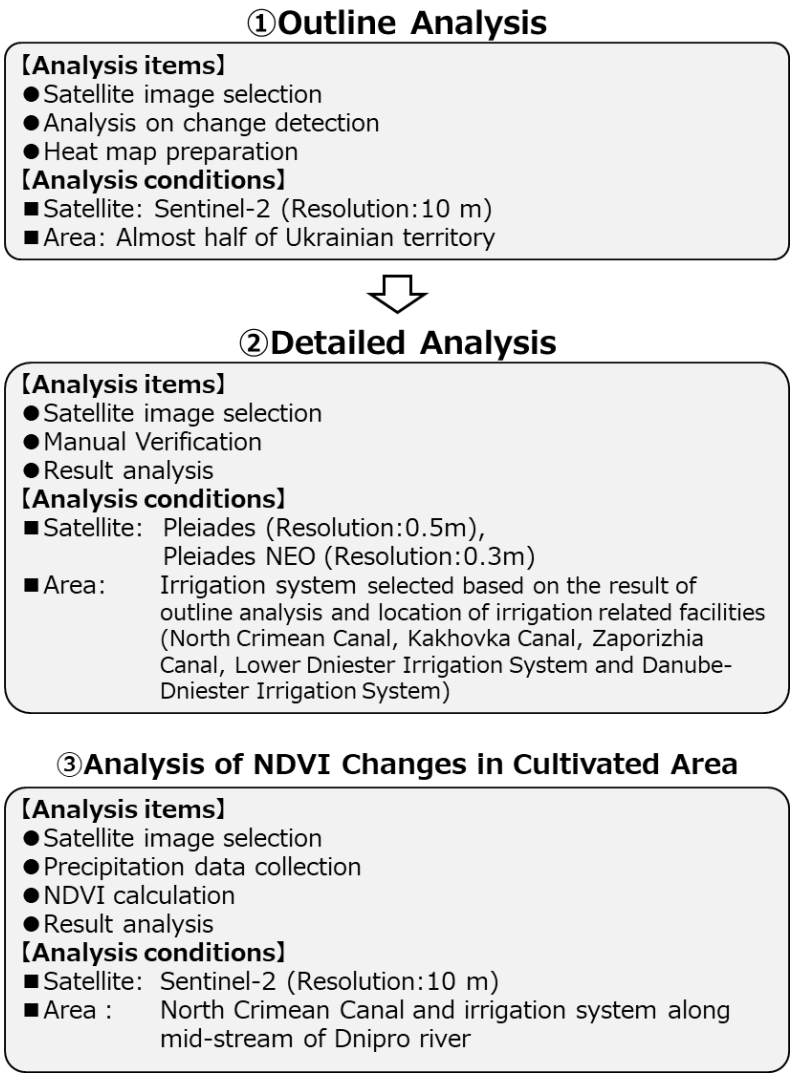
JICA Survey Team carried out satellite image analysis to analyse the damage to irrigated land,

(1) Method

In order to assess the damage to irrigation facilities, “outline analysis” was carried out for 300,000 km^2, almost half of Ukraine’s land area. Based on the result of “outline analysis” and other collected information related to the damage to irrigation facilities, “detailed analysis” was conducted for the area where the damage to irrigation facilities was judged to be serious or need to be verified.

In addition to the above, analysis of NDVI changes in cultivated area with/without irrigation was conducted in a part of North Crimean Canal, in which JICA Survey Team evaluated whether NDVI changes in cultivated area could be useful to assume the damage to irrigation facilities.

The workflow of satellite image analysis is shown in Figure 1.



Source: JICA Survey Team

Figure 1 The Workflow of Satellite Image Analysis

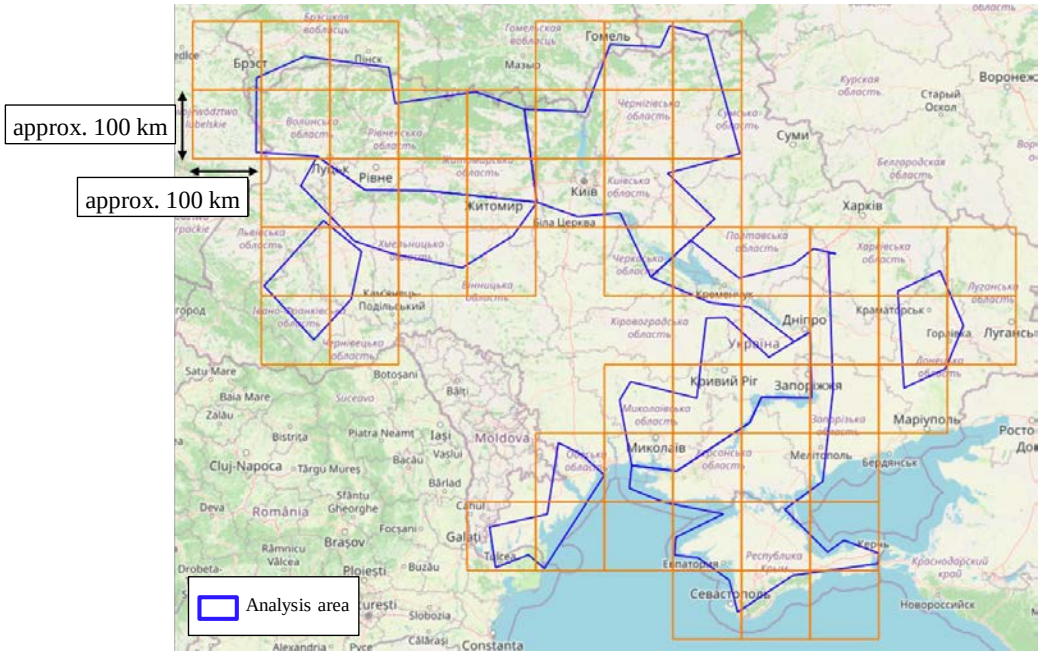
(2) Outline analysis

In order to assess the damage to irrigation facilities, outline analysis was carried out by three processes: satellite image selection, analysis on change detection, and heat map creation. The analysis area (approximately 300,000 km^2) of the outline analysis was selected with reference to the irrigation area map published by the Food and Agriculture Organization of the United Nations (FAO). Figure 2 and Figure 3 show the analysis area for the outline analysis and the irrigation area map (FAO), respectively.

It should be noted that "change" is defined as colour change in land cover, and that outline analysis is a method to detect the damage by Russian invasion by colour change. There is a possibility that other natural/ social phenomena can be detected as “change” such as demolition of buildings, deforestation, flooding. However, JICA Survey Team finally selected this method since this method can quickly analysis the vast area of Ukraine territory.

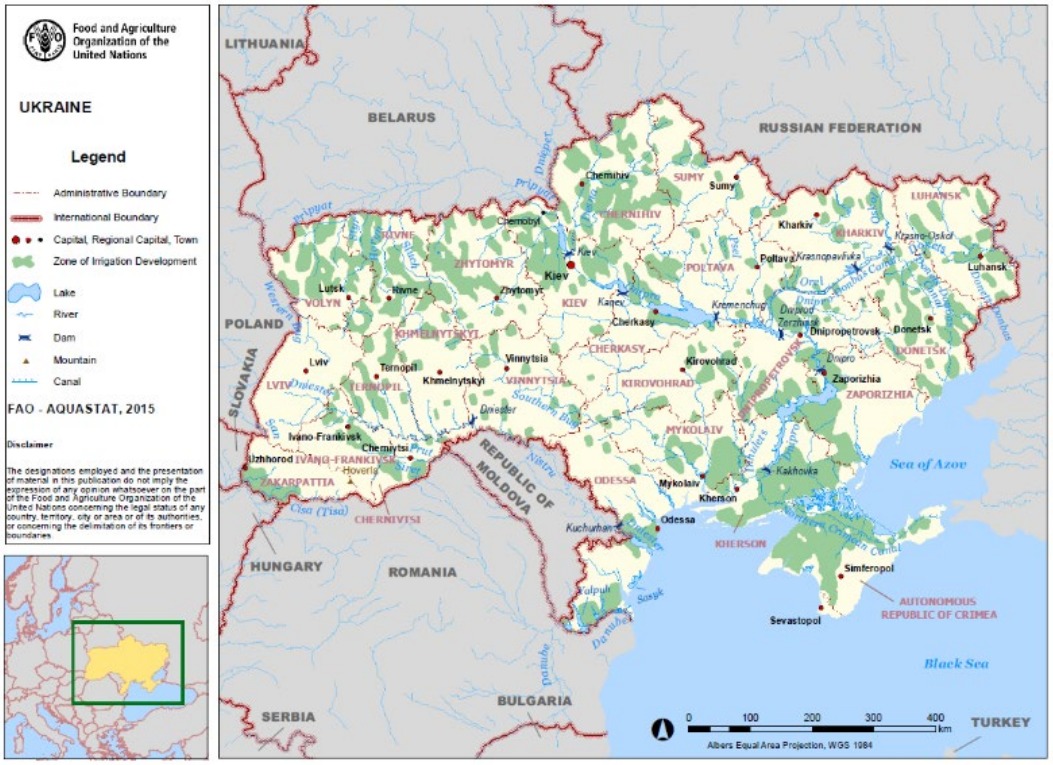
The analysis area was selected based on the following points:

- To select areas where many irrigation facilities and canals are located in the invasion area (Kherson Province, Zaporizhzhia Province, Luhansk Province, Crimean Peninsula, etc.),
- To select areas where many existing irrigation facilities are located along the Dnipro River, in Odessa Province, etc., and
- To select areas in the northwestern part of Ukraine where the invasion damage is less and many irrigated facilities are expected to be found.



Source: JICA Survey Team

Figure 2 Analysis Area for Outline Analysis



Source: Food and Agriculture Organization of the United Nations (FAO)

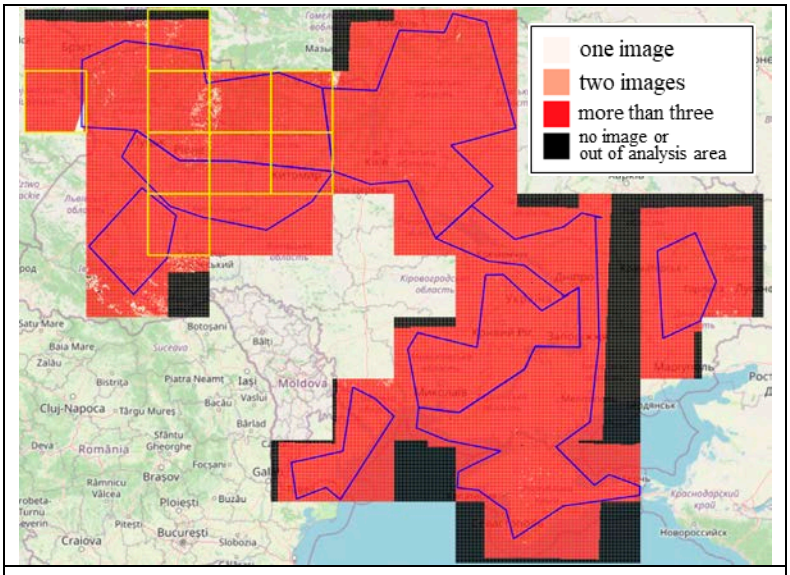
Figure 3 Irrigation Area Map prepared by FAO

a) Satellite Image Selection

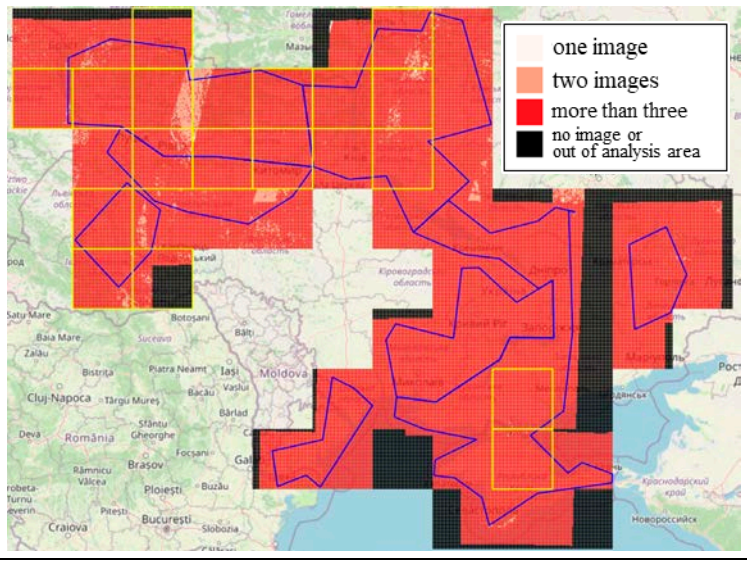
The Sentinel-2, which is a free satellite image (resolution: 10 m) operated by the European Space Agency (ESA), was selected for satellite images of the outline analysis.

The satellite images were selected from June to August 2021 as “Pre-invasion”, and from June to August 2021 as “After-invasion”. JICA Survey Team tried to obtain three images in each period with no cloud cover for the accuracy of the analysis (for the detail, refer the next page). And

Figure 4 shows the number of the satellite images obtained in the analysis area. In the almost all analysis area, three images were found to be good condition for outline analysis. In some areas where three images could not be obtained, outline analysis was conducted with available images.



Pre-invasion period (June to August 2021)



After-invasion period (June to August 2022)

Source: JICA Survey Team

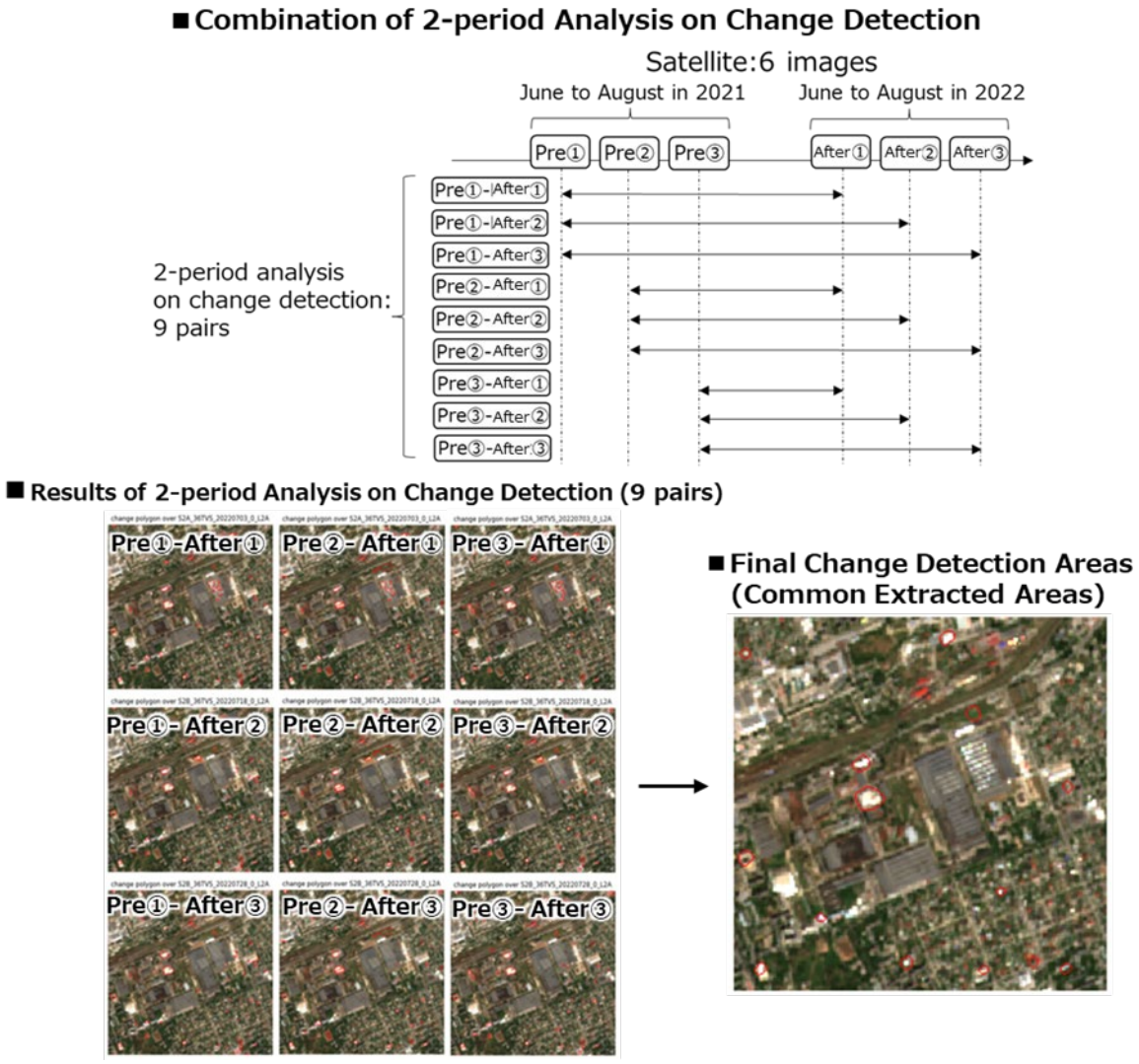
Figure 4 Number of Satellite Images for Outline Analysis Area

b) Analysis on Change Detection

Analysis on change detection was conducted using satellite images obtained in pre-invasion and after-invasion periods. The detailed concept of analysis on change detection is shown in Figure 5.

In general, satellite images could be slightly different due to i) differences in the angle at which they are taken and ii) differences in the altitude of the sun at each hour. Therefore, analysis on change detection just comparing 2 images may result in errors due to differences in the appearance of satellite images.

In order to reduce these possibilities, 2-period analysis on 9 pairs in total, consisting of 3 images from pre-invasion and 3 images from after-invasion periods, were conducted for change detection. After the completion of 2-period analysis, the final change detected areas (common extracted area) were extracted where the same changes were found in all 9 pairs.



Source: JICA Survey Team

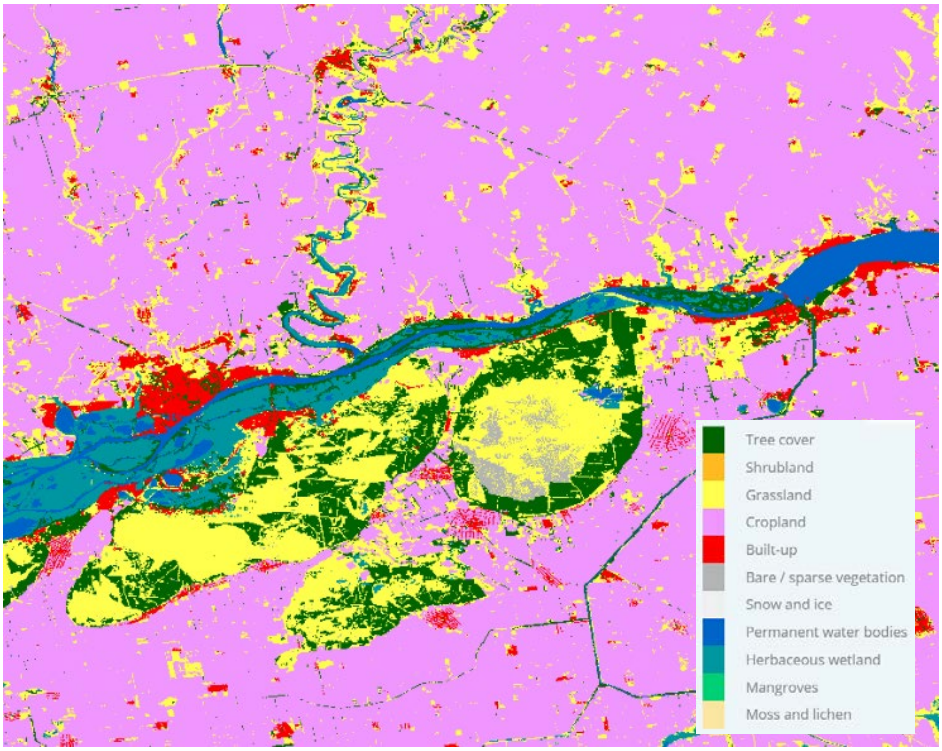
Figure 5 Detailed Concept of Analysis on Change Detection

In Russian invasion, attack on urban areas were severe and the urban areas were supposed to have more damage than agricultural area. So, in the next step of heat map creation, which is explained in subsequent page, the heat map might focus on urban damage, and the results in agricultural area could be inconspicuous.

To focus on the changes in agricultural area, the land cover classification map (WorldCover 2021) published by ESA was utilised to classify the results of change detection into agricultural area and urban area. WorldCover 2021 map is 10 m resolution data with land cover classified into 11 classes for the entire earth in 2021 based on satellite data (Sentinel-1 and Sentinel-2). A sample image of WorldCover 2021 is shown in Figure 6.

Agricultural areas and urban areas were defined as the following classes in WorldCover 2021, and the results of change detection areas were extracted in agricultural areas and urban areas respectively.

- Agricultural area: areas other than "Tree cover," "Built up," and "Bare /sparse vegetation", where expected to be agricultural land.
- Urban area: areas corresponding to "Built up" and "Bare /sparse vegetation.



Source: European Space Agency (ESA)

Figure 6 Example image of World Cover 2021

c) Heat map creation

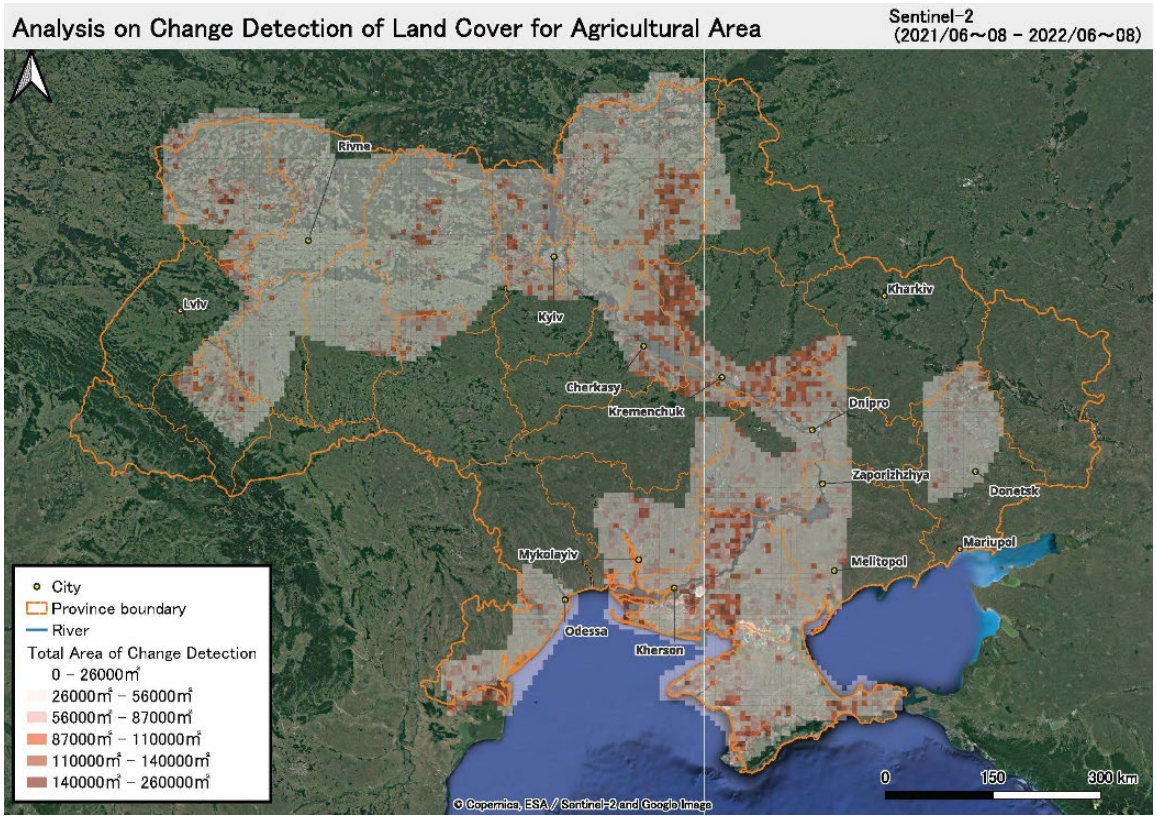
Heat maps were prepared converting the common extracted area into colour strength in order to easily grasp the spatial distribution of the results over Ukraine overall area.

After creating square grids on the map, the total common extracted areas were calculated as a value in each grid. Each grid was depicted by colour based on its value (high value: red, low value: white). Using an index called tile coordinates technically, the size of the grid is set as approximately 6.8 km square for Ukraine overall area map (corresponding to tile coordinate zoom level 12), and approximately 1.7 km square for detailed map (corresponding to tile coordinate zoom level 14). The heat map of Ukraine overall area for agricultural area are shown in Figure 7.

The heat map results show that most of the common extracted area were often observed in the mid-stream of Dnipro River (around Cherkasy and Kremenchug), on the opposite site of Dnipro River near Zaporizhzhia province, and in the south of Kherson (around North Crimean Canal and Kakhovka Canal). It should be noted, however, that the common extracted areas were also observed in areas where there was no invasion (western Ukraine).

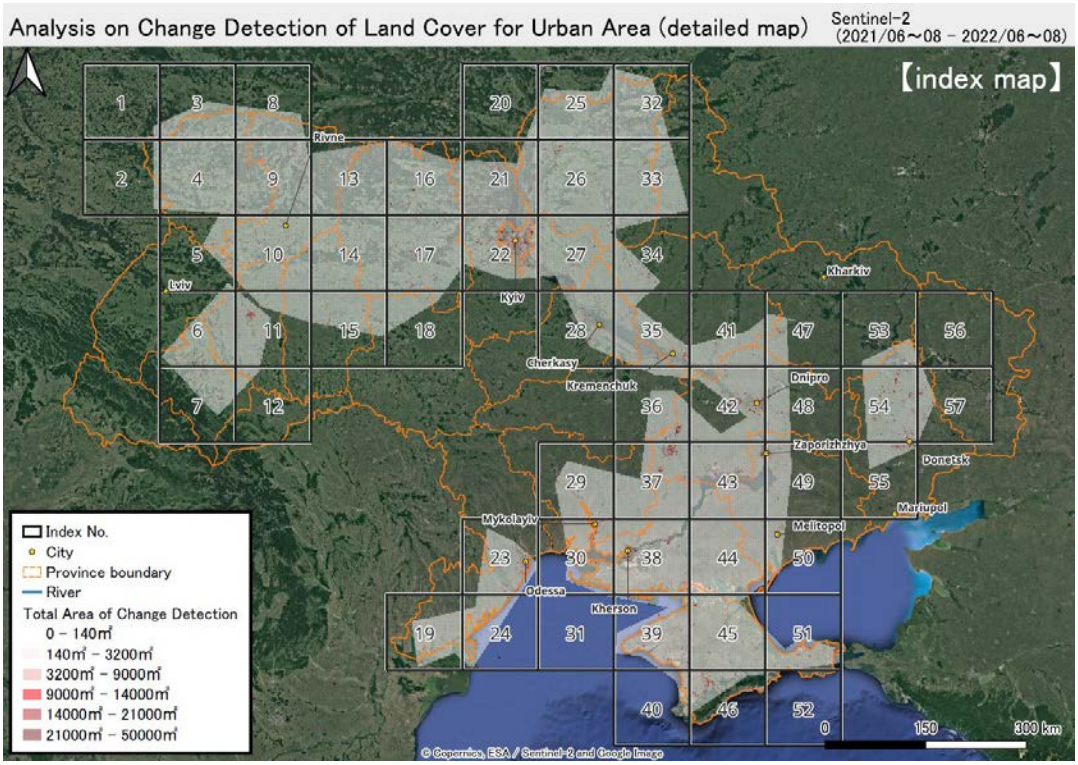
It was technically difficult to determine whether the areas were actually damaged by the invasion based on outline analysis only. In the areas where the common extracted areas were often observed, JICA Survey Team checked whether the common extracted area were actually attacked by the Russian invasion through detailed analysis (for the detail, refer the subsequent page).

The Ukraine overall area map and the detailed map were prepared in both of agricultural area and urban area as shown in Annex 2.2.7A, 2.2.7B. As shown in Figure 8 and Figure 9, the detailed maps were prepared 57 sheets in grid-wise, which is approximate 100 km square (corresponding to zoom level 8 of tile coordinate).



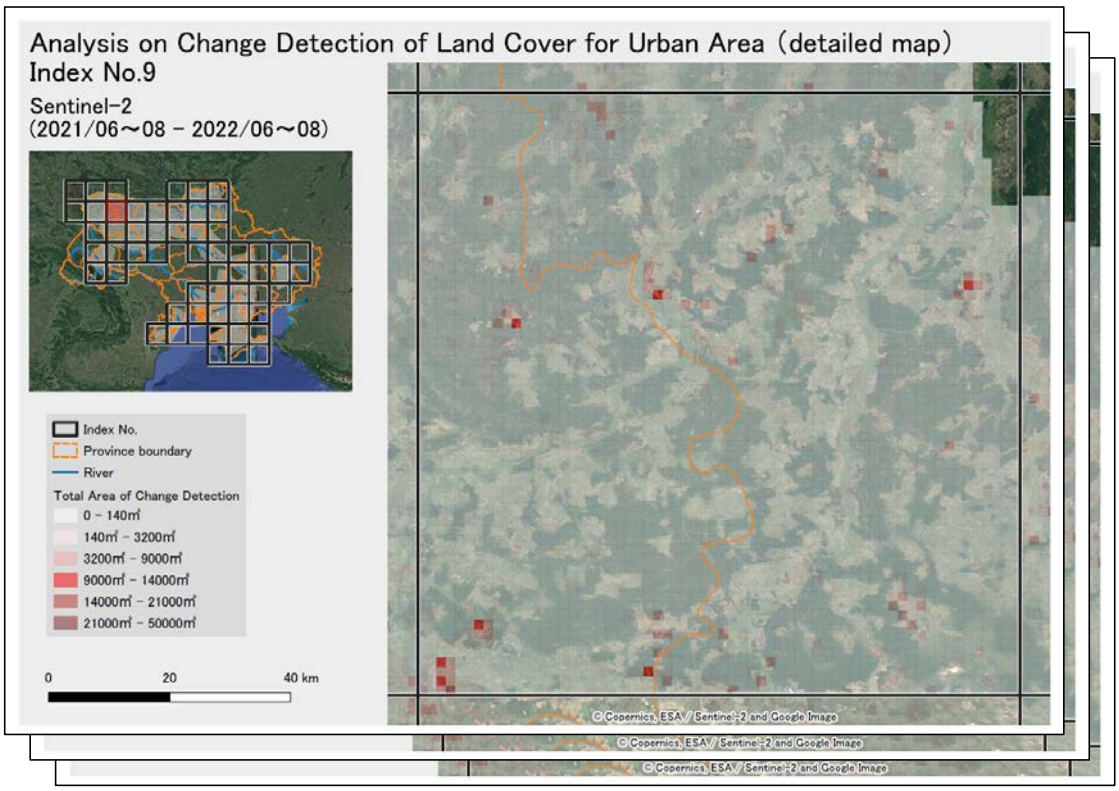
Source: JICA Survey Team

Figure 7 Heat Map of Ukraine Overall Area (Agricultural Area)



Source: JICA Survey Team

Figure 8 Sample Images of Heat Map (Index for Detailed Map)



Source: JICA Survey Team

Figure 9 Sample Images of Heat Map (Detailed Map)

(3) Detailed Analysis

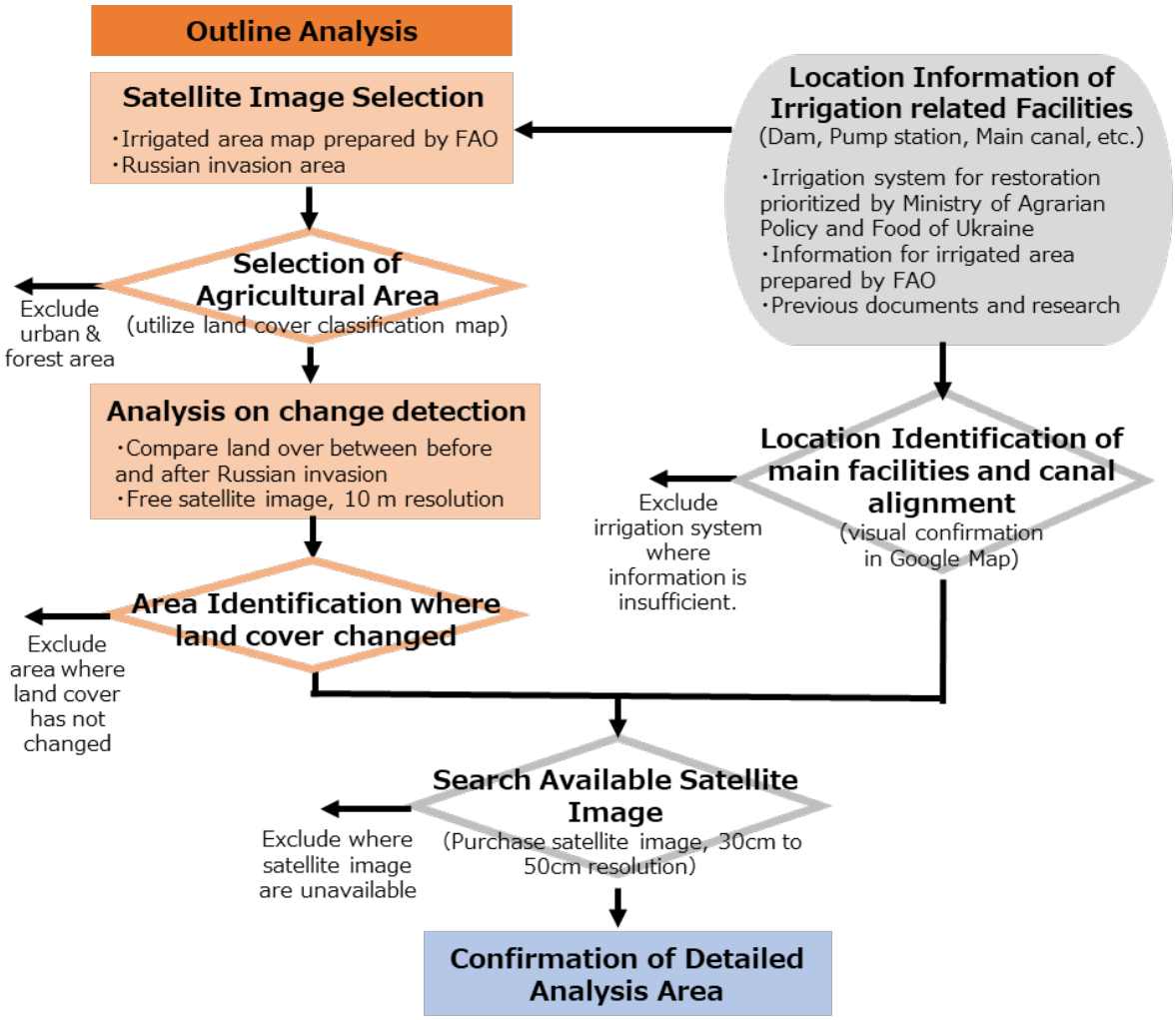
In order to assess the damage to irrigation facilities more precisely, the detailed analysis was carried out by three processes: satellite image selection, manual verification, and result analysis. The manual verification was selected for the detailed analysis to check the damage to irrigation facilities quickly and precisely.

a) Satellite Image Selection

The analysis areas for the detailed analysis were selected based on the information such as location of irrigation related facilities, and the result of outline analysis. The workflow of satellite image selection is shown in Figure 10.

Satellite images used for the detailed analysis were taken by Pleaides (resolution: 0.5 m) and Pleiades NEO (resolution: 0.3 m), commercial satellites operated by Airbus, France. It is said that structures with a width of 1.5 m to 2.5 m or more can be visually observed with the above mentioned resolution. The satellite image was taken in both of pre-invasion and after-invasion. In case of unavailable of pre-invasion satellite image, the satellite image of Goole map was used for manual verification.

Initially, it was planned to use a subscription service ("SecureWatch" operated by Japan Space Imaging), which allows immediate online downloading of satellite image. However, due to restrictions on the use of satellite image in Ukraine after the start of this Study, JICA Study Team changed the supplier (The necessary procedures required for the purchase of satellite image were taken time more than the initial schedule).



Source: JICA Survey Team

Figure 10 The Workflow of Satellite Image Selection for Detailed Analysis

As shown in the figure in the subsequent page, candidates of irrigation system were selected based on the result of outline analysis, the collected information, and the prioritised irrigation system list, which Ukraine prepared for early rehabilitation and restore (namely, "Projects on Irrigation systems restoration" dated on 28th May 2022, prepared by Ministry of Agrarian Policy and Food).

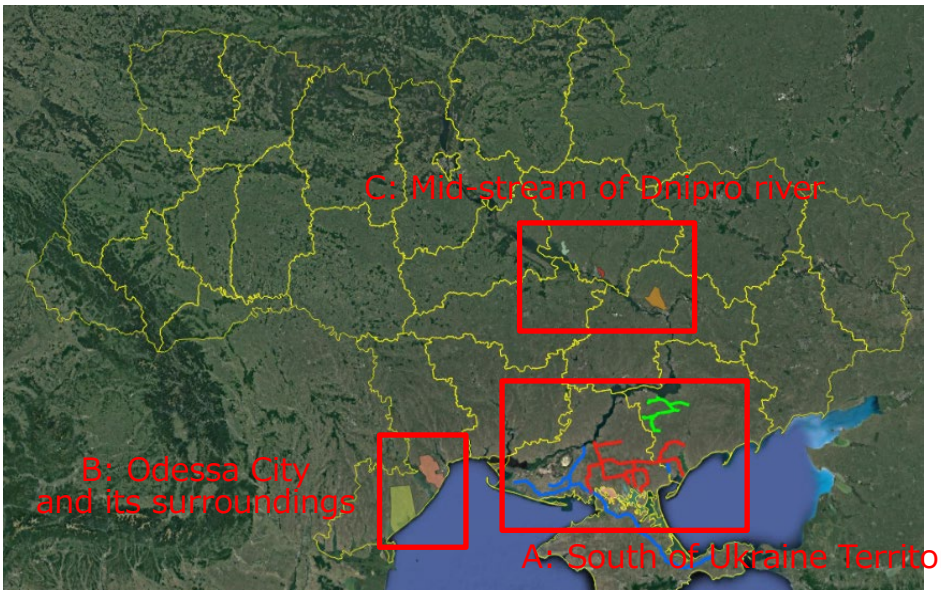
However, it should be noted that the area available for detailed analysis was limited since there were fewer irrigation systems for which information could be collected well, and satellite images were not sufficient in agricultural area after the invasion.

The irrigation systems, which were selected finally for the detailed analysis, are five in total: North Crimean Canal, Kakhovka Canal, Zaporizhia Canal, Lower Dniester Irrigation System, Danube-Dniester Irrigation System. The remaining four systems (Hardyzka Irrigation System, Maxymivska Irrigation System, Karpivska Irrigation System, Kilchenska Irrigation System) were analysed in "Analysis of NDVI Changes in Cultivated Area" (refer to section (4)).

Table 1 Selection of Irrigation System for Detailed Analysis

Item	Location	Availavility of Satellite Image	Detailed Analysis
1. Irrigation scheme selected based on the result of outline analysis, and collected information			
North Crimean Canal	A	○	○
Kakhovka Canal	A	○	○
Zaporizhia Canal	A	○	○
2. Irrigation system, which Ukraine selected for rehabilitation and restoration*1			
Lower Dniester Irrigation System	B	○	○
Danube-Dniester Irrigation System	B	○	○
Hardyzka Irrigation System	C	―	―
Maxymivska Irrigation System	C	―	―
Karpivska Irrigation System	C	―	―
Kilchenska Irrigation System	C	―	―

Ukraine Overall Area Map



Remark : *1 “Projects on Irrigation systems restoration” dated on 28th May 2022, prepared by Ministry of Agrarian Policy and Food Projects

Source: JICA Survey Team

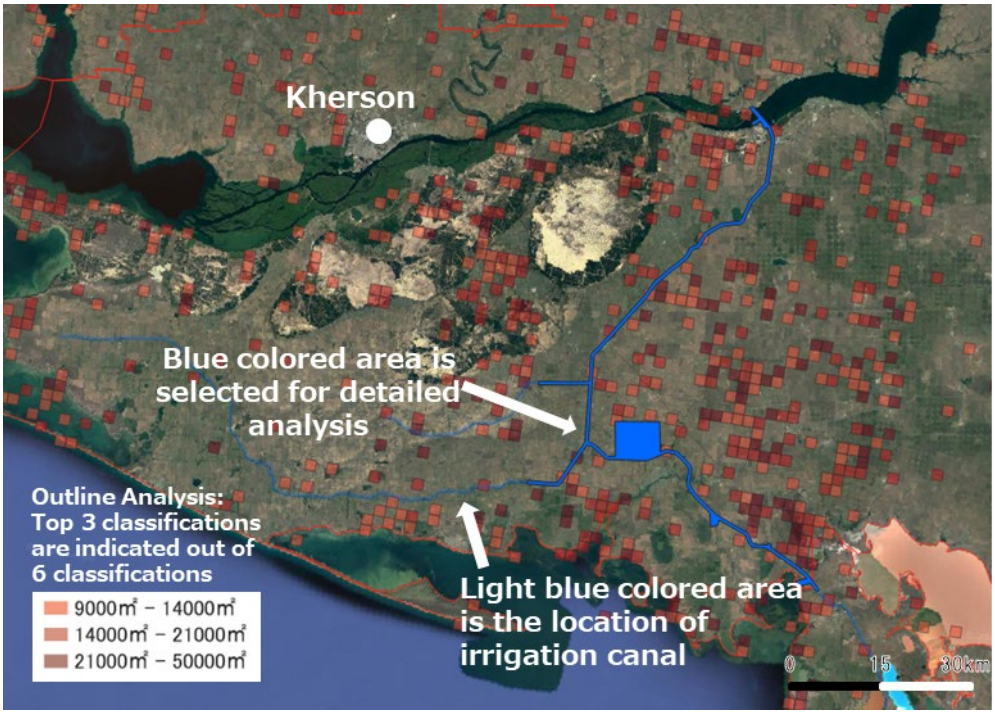
The areas of purchased satellite image in each irrigation system are shown in Table 2. The area maps of the purchased satellite image are shown in Figures 11 up to Figure 15. The satellite image locations in each irrigation scheme and the map numbers of each satellite image are shown in Annex 2.2.8.

Table 2 Summary of Areas of Purchased Satellite Image for Detailed Analysis

S/N	Irrigation System	Purchase Area (km^2)	
		Pre-invasion	After-invasion
1	North Crimean Canal	0	107
2	Kakhovka Canal	0	233
3	Zaporizhia Canal	0	47
4	Lower Dniester Irrigation System	60	78
5	Danube-Dniester Irrigation System (August 2022)	130	210
6	Danube-Dniester Irrigation System (December 2022)	180	233
Total		370	521

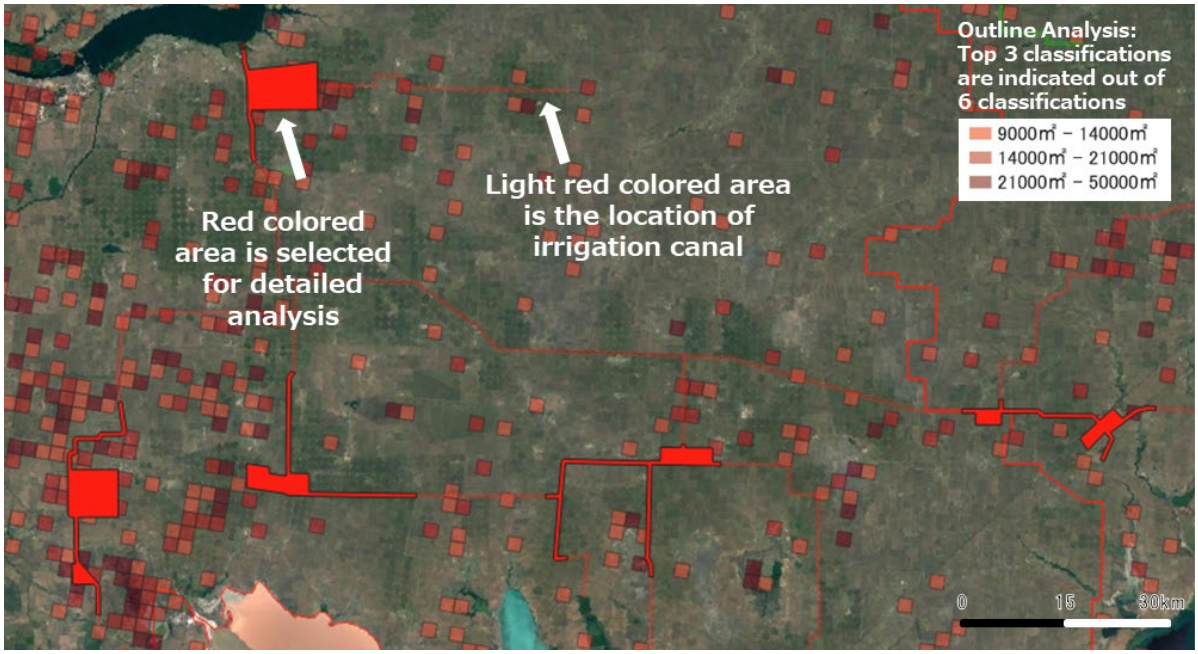
Remarks: In case of unavailable of pre-invasion satellite image, the satellite image of Goole map was used for manual verification.

Source: JICA Survey Team



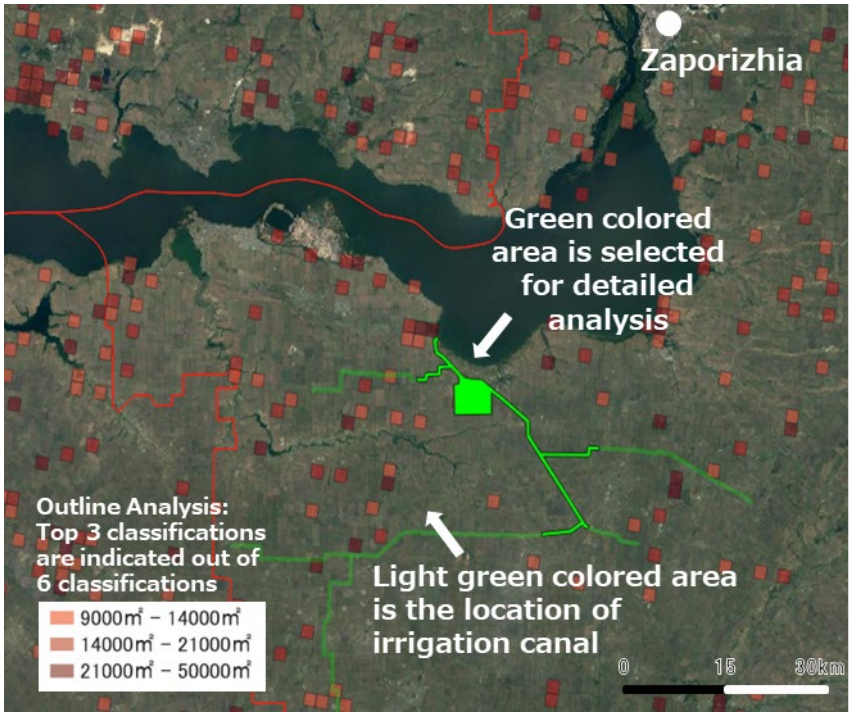
Source: JICA Survey Team, the background is Google map.

Figure 11 Area Map of the Purchased Satellite Image (North Crimean Canal)



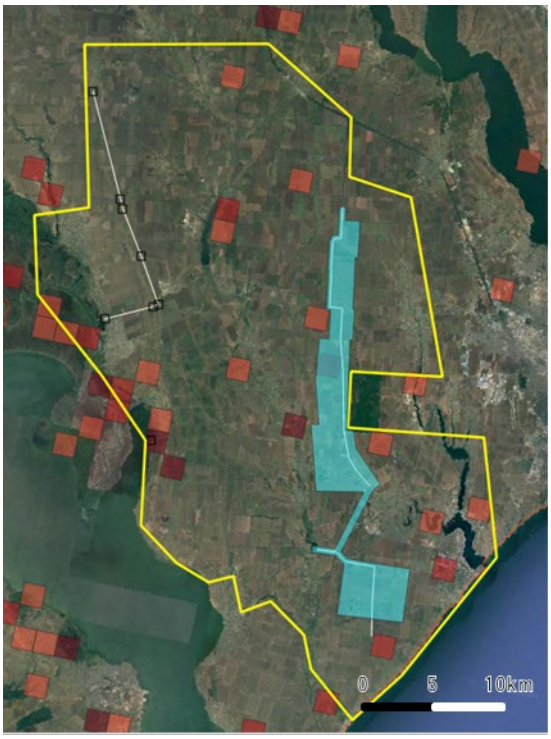
Source: JICA Survey Team, the background is Google map.

Figure 12 Area Map of the Purchased Satellite Image (Kakhovka Canal)



Source: JICA Survey Team, the background is Google map.

Figure 13 Area Map of the Purchased Satellite Image (Zaporizhia Canal)



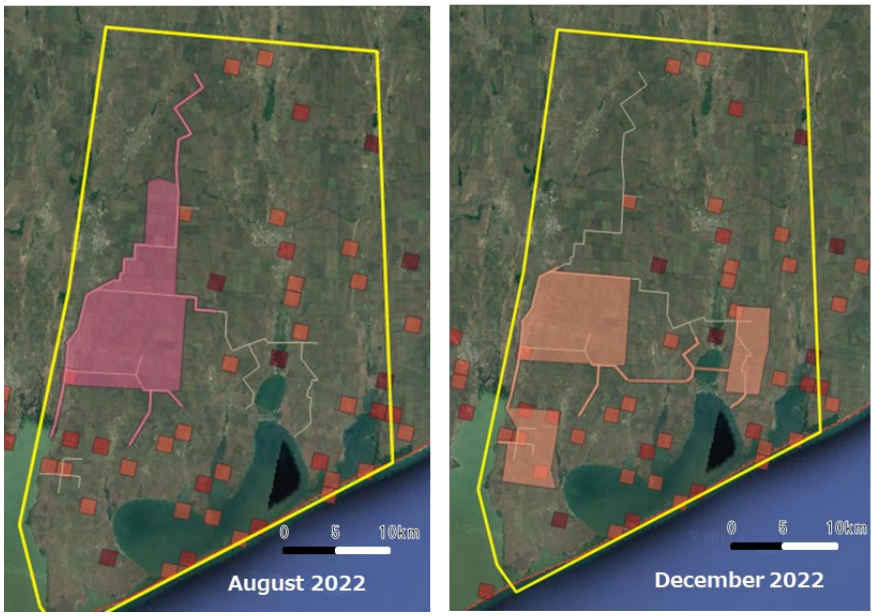
○Blue colored area is selected for detailed analysis
○White colored area is the location of irrigation canal

Outline Analysis: Top 3 classifications are indicated out of 6 classifications

9000㎡ – 14000㎡
14000㎡ – 21000㎡
21000㎡ – 50000㎡

Source: JICA Survey Team, the background is Google map.

Figure 14 Area Map of the Purchased Satellite Image (Lower Dniester Irrigation System)



○Red and Orange colored area is selected for detailed analysis
○White colored area is the location of irrigation canal

Outline Analysis: Top 3 classifications are indicated out of 6 classifications

9000㎡ – 14000㎡
14000㎡ – 21000㎡
21000㎡ – 50000㎡

Source: JICA Survey Team, the background is Google map.

Figure 15 Area Map of the Purchased Satellite Image (Danube-Dniester Irrigation System)

b) Manual Verification

The following facilities were manually observed to confirm the damage is visible or not in the purchased satellite image:

- Main irrigation facilities such as headworks, pumping station, etc.,
- Main canal (inclusive of bridge and access road),
- Other visible structure such as booster pump used for center pivot irrigation, and
- Farmland (inclusive of artillery shell marks and tank moving truck): It should be noted that the analysis area was selected as a representative area from the irrigation systems due to the time limitation for the analysis.

c) Result

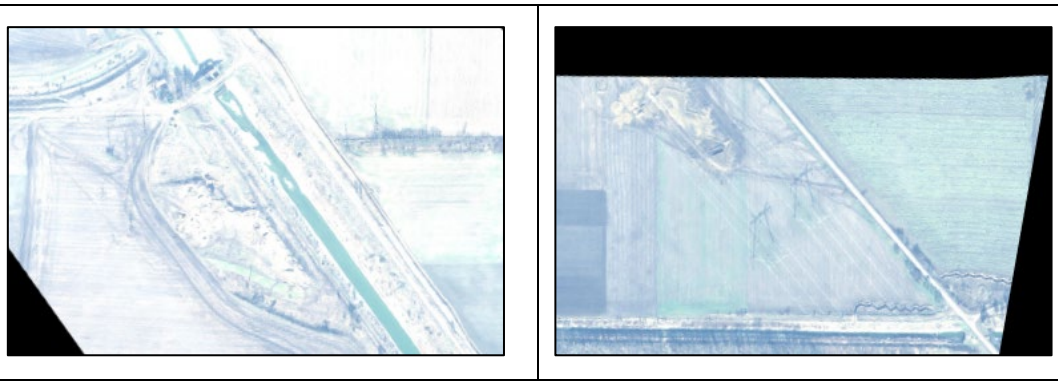
The summary of the result of manual verification are shown in the table below. The detailed results of manual verification are shown in Annex 2.2.9.

Table 3 Summary of Result of Manual Verification

Irrigation System	Result of Manual Verification
North Crimean Canal	There was visually no obvious damage to irrigation facilities by the invasion, but there were some unusual signs in the farmland (expected vehicle tracks and trenches).
Kakhovka Canal	
Zaporizhia Canal	
Lower Dniester Irrigation System	There was visually no obvious damage to irrigation facilities by the invasion.
Danube-Dniester Irrigation System (August 2022)	There was visually no obvious damage to irrigation facilities by the invasion.
Danube-Dniester Irrigation System (December 2022)	There was visually no obvious damage to irrigation facilities by the invasion.

Source: JICA Survey Team

In all irrigation systems, there was rarely found visible physical damage to main facilities or main canals (one bridge over downstream of main canal of the North Crimean Canal was observed to have been destroyed). The evidence of shelling or other attacks were not found in the analysed area. However, in the areas where the Russian invasion took place (surroundings of North Crimea Canal, Kakhovka Canal, and Zaporizhia Canal), some traces were found in farmland, expected to be Russian invasion, as shown in the figure below. These traces were mostly observed in farmlands near large urban areas.



Source: Pleaides and Pleiades NEO operated by Airbus

Figure 16 Satellite Image along Main Canal of Zaporizhia Canal (9th March 2023)

d) Recommendations

Under the detailed analysis, some traces expected to be Russian invasion were found in farmland near large urban areas. There is a high possibility that the damages are concentrated in irrigation facilities and farmland (e.g., unexploded shell, landmine) near large urban areas. It could be one idea to focus on urban area in the further satellite image analysis.

Even if there are not visible changes in the appearance of irrigation facilities, the machinery and internal facilities could be damaged or not well- maintained, so it is recommended to have a field survey on the actual damage of the irrigation facilities.

(4) Analysis of NDVI Changes in Cultivated Area

The analysis of NDVI changes in cultivated area with/without irrigation was conducted in a part of North Crimean Canal, in which JICA Survey Team evaluated whether NDVI changes in cultivated area could be useful to assume the damage of irrigation facilities.

As shown in the table below, JICA Survey Team expected that NDVI would show different trends in irrigated and non-irrigated areas. In this analysis, NDVI were compared between irrigated and non-irrigated areas. NDVI represents the amount and vitality of vegetation, and is said to have a strong correlation with the amount of precipitation.

Table 4 Expected Trend of NDVI in Irrigated and Non-irrigated Areas

Area	Normal Year	Dry Year	Wet year
Irrigated Area	High	Equivalent to average year	Equivalent to average year or more
Non-irrigated Area			
(High yield)	High	Lower than average year	Equivalent to average year or more
(Low yield)	Low	Significantly lower than average year	Significantly higher than average year

Source: JICA Survey Team

This analysis was carried out by four processes: satellite image selection, precipitation data collection, NDVI calculation, result analysis. NDVI was calculated from free satellite images of Sentinel-2, which was available after the year of 2016, and also used for outline analysis (resolution: 10 m). Besides, the cultivated situation was also checked utilising NDVI of 2022 satellite image after the invasion.

a) Satellite Image Selection

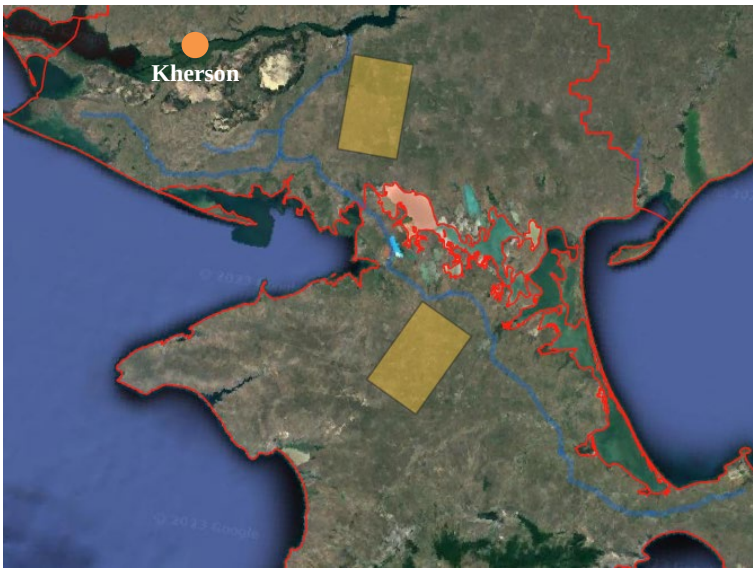
In order to compare NDVI between irrigated and non-irrigated areas, the analysed areas were selected from the northern and southern parts of the North Crimean Canal, where irrigation status is clearly identified. The north and south parts of the canal are clearly divided into irrigated and non-irrigated areas after the annexation of Crimean Peninsula by Russia in 2014.

Table 5 Irrigation Status after Annexation of Crimean Peninsula by Russia in 2014

Location	Status
Northern parts of North Crimean Canal	Irrigation water is available from North Crimean Canal
Southern parts of North Crimean Canal (Crimean Peninsula)	Water distribution to North Crimean Canal suspended by Ukrainian government

Source: JICA Survey Team

The areas highlighted in yellow were selected for this analysis in the northern and southern parts of North Crimean Canal, respectively, as shown in the figure below (area of 1,000 km^2), avoiding urban and forested areas, etc.

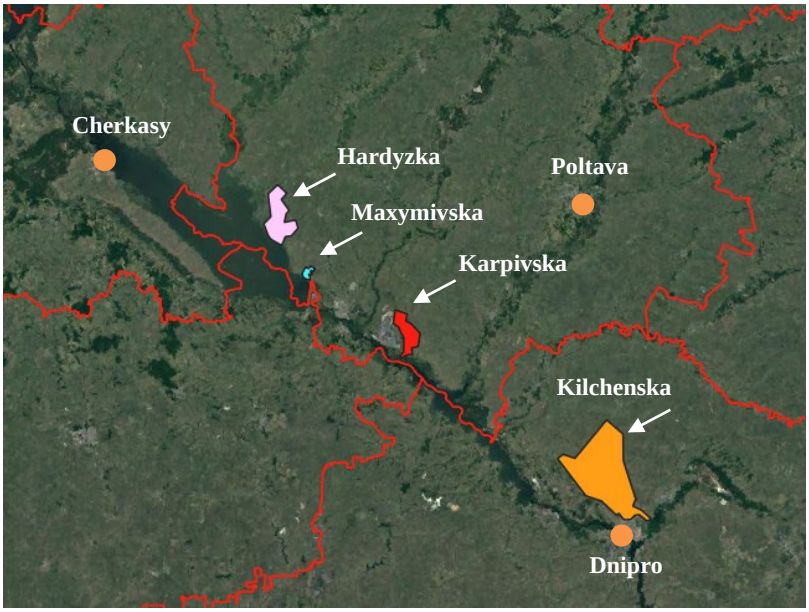


Remarks: Redline is provincial boundary, blue line is canal alignment of North Crimean Canal, the background is Google Map.

Source: JICA Survey Team

Figure 17 Analysis Area of NDVI Changes in Cultivated Area (North Crimean Canal)

In addition to North Crimean Canal, this analysis was conducted in four systems which were excluded in the detailed analysis (Hardyzka Irrigation System, Maxymivska Irrigation System, Karpivska Irrigation System, Kilchenska Irrigation System).



Remarks: Redline is provincial boundary, blue line is canal alignment of North Crimean Canal, the background is Google Map.

Source: JICA Survey Team

Figure 18 Analysis Area of NDVI Changes in Cultivated Area (Mid-stream of Dnipro River)

b) Precipitation Data Collection

From the database of Japan Meteorological Agency, weather stations close to the analysis area were selected and used as representative values of precipitation as shown in the table below.

Table 6 Weather Stations close to Analysis Area

Analysis Area	Weather Station	Location
Northern parts of North Crimean Canal	Kherson	
Southern parts of North Crimean Canal (Crimean Peninsula)	Simferopol	
Mid-stream of Dnipro River (Hardyzka Irrigation System, Maxymivska Irrigation System, Karpivska Irrigation System, Kilchenska Irrigation System)	Lubny	

Remarks: the background of location map is Google Map.

Source: JICA Survey Team

In Kherson and Simferopol, the following years were designated as dry and wet years respectively since both precipitation trends were the same, as shown in Figure 19 and Figure 20. In addition, the year of 2018 were compared also since precipitation trends were dry in Herson and wet in Simferopol.

A the year of 2017: dry year (heavy rain in April)

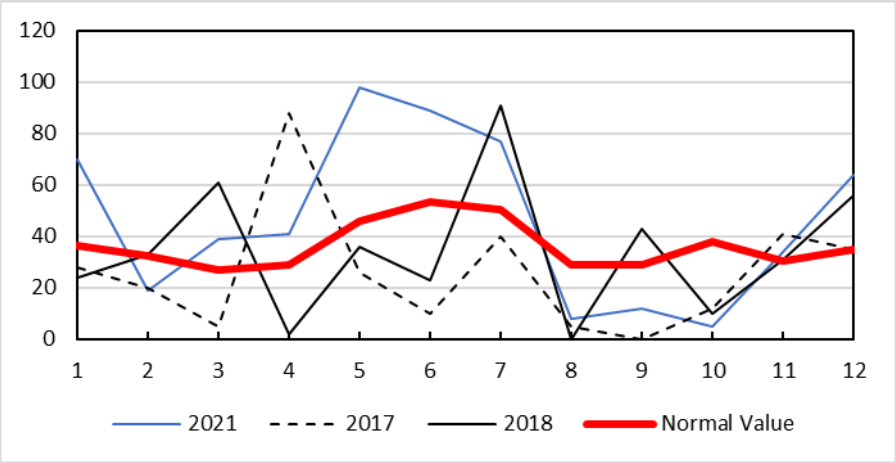
B the year of 2021: wet year

C the year of 2018: dry year in Kherson, wet year in Simferopol

In Lubny, the following years were designated as dry and wet years respectively

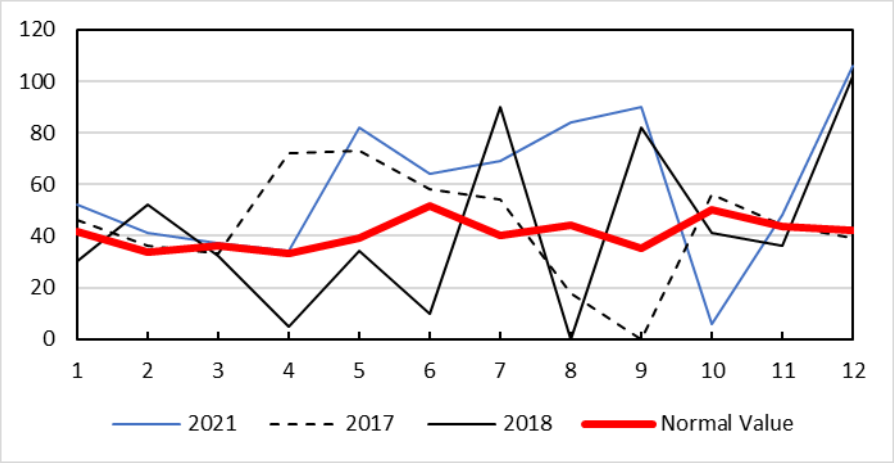
D the year of 2019: dry year

E the year of 2018: wet year



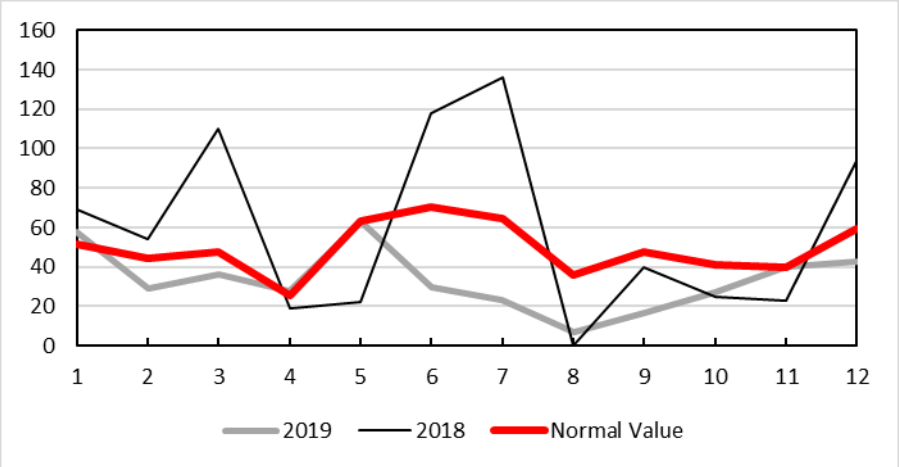
Source: JICA Survey Team

Figure 19 Monthly Precipitation in Kherson (Northern Part of North Crimean Canal)



Source: JICA Survey Team

Figure 20 Monthly Precipitation in Simferopol (Southern Part of North Crimean Canal)



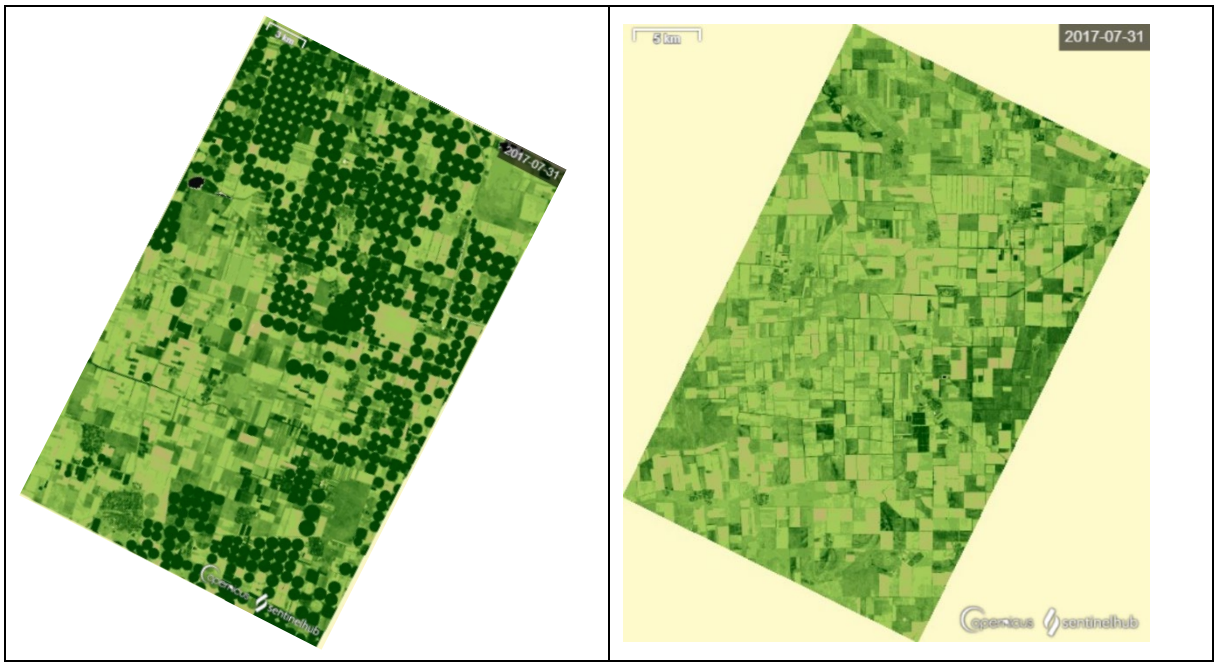
Source: JICA Survey Team

Figure 21 Monthly Precipitation in Lubny (Mid-stream of Dnipro River)

c) NDVI Calculation

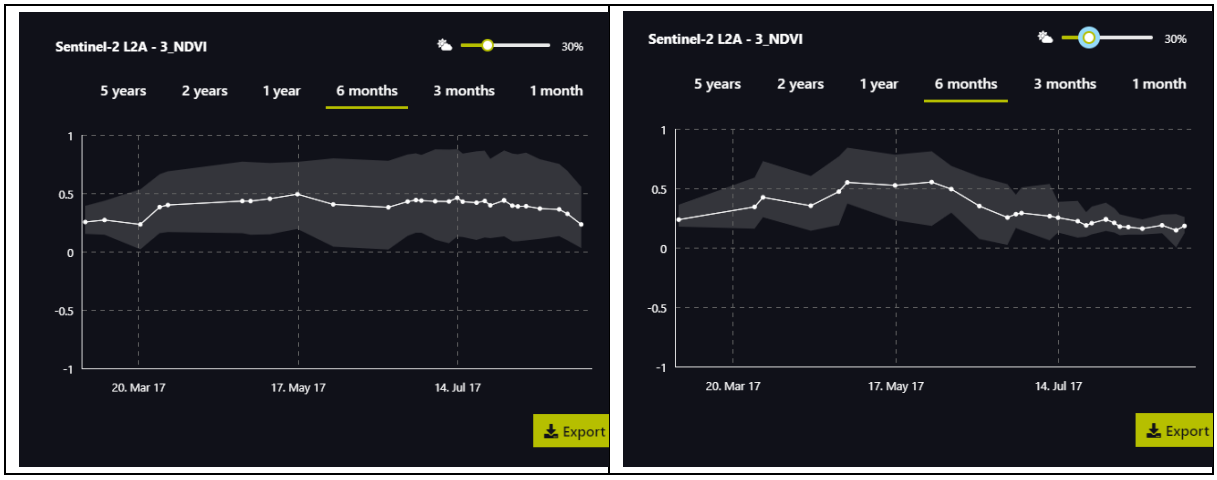
Satellite images were obtained from April to August, when temperature begins to grow actively and get fully grown before harvest season (2016-2022). The cloud cover in the images was controlled to be less than 30%. As an example, Figure 22 shows the results of the NDVI calculation.

The area average value of NDVI were calculated from the above calculated NDVI of the analysed area (hereinafter area average NDVI) as a representative value of the analysis area. The temporal change of area average NDVI as shown in Figure 23.



Source: EO Browser (https://www.sentinel-hub.com/explore/eobrowser/)

Figure 22 Dissemination of NDVI (Left: Northern Parts of North Crimean Canal, Right: Southern parts of North Crimean Canal)



Source: EO Browser (https://www.sentinel-hub.com/explore/eobrowser/)

Figure 23 Temporal Change of Area Average NDVI in 2017 (Left: Northern Parts of North Crimean Canal, Right: Southern parts of North Crimean Canal)

d) Result and Discussion

In the northern part of the North Crimean Canal, as shown in Figure 24, the strongest NDVI appeared differently between the circular plots with center pivot irrigation, and the rectangular plots (the dark green colour shows NDVI higher).

In the northern part of the North Crimean Canal, NDVI was strongest in the circular plots with center pivots from June to August each year. On the other hand, rectangular plots had the highest NDVI from April to May each year, with the values decreasing after May.

As shown in Figure 25, in the southern part of North Crimean Canal, no circular plots with center pivots were found, and NDVI was generally highest around April and May each year, followed by a decrease in values. On the other hand, the area circled in red (right of Figure 25) maintained a high NDVI despite 2017 being a dry year.

Initially, JICA Survey Team assumed that NDVI trends would be generally the same in both of northern and southern parts of North Crimean Canal, but it is likely that the cropping pattern and harvesting time might differ (or the different crops could be planted in both areas).

- North Crimean Canal

  (circular plots): possibility to be harvested in August or later (spring wheat?)

  (rectangular plots): possibility to be harvested in June and July (winter wheat?)

- Southern part of the North Crimean Canal

  (round plots): possibility to be harvested in June (winter wheat?)

Besides, in the southern part of North Crimean Canal, there were areas where NDVI remained high even in dry year. It is suggested that irrigated cultivation was conducted by using water sources other than North Crimean Canal.

Source: EO Browser (https://www.sentinel-hub.com/explore/eobrowser/)

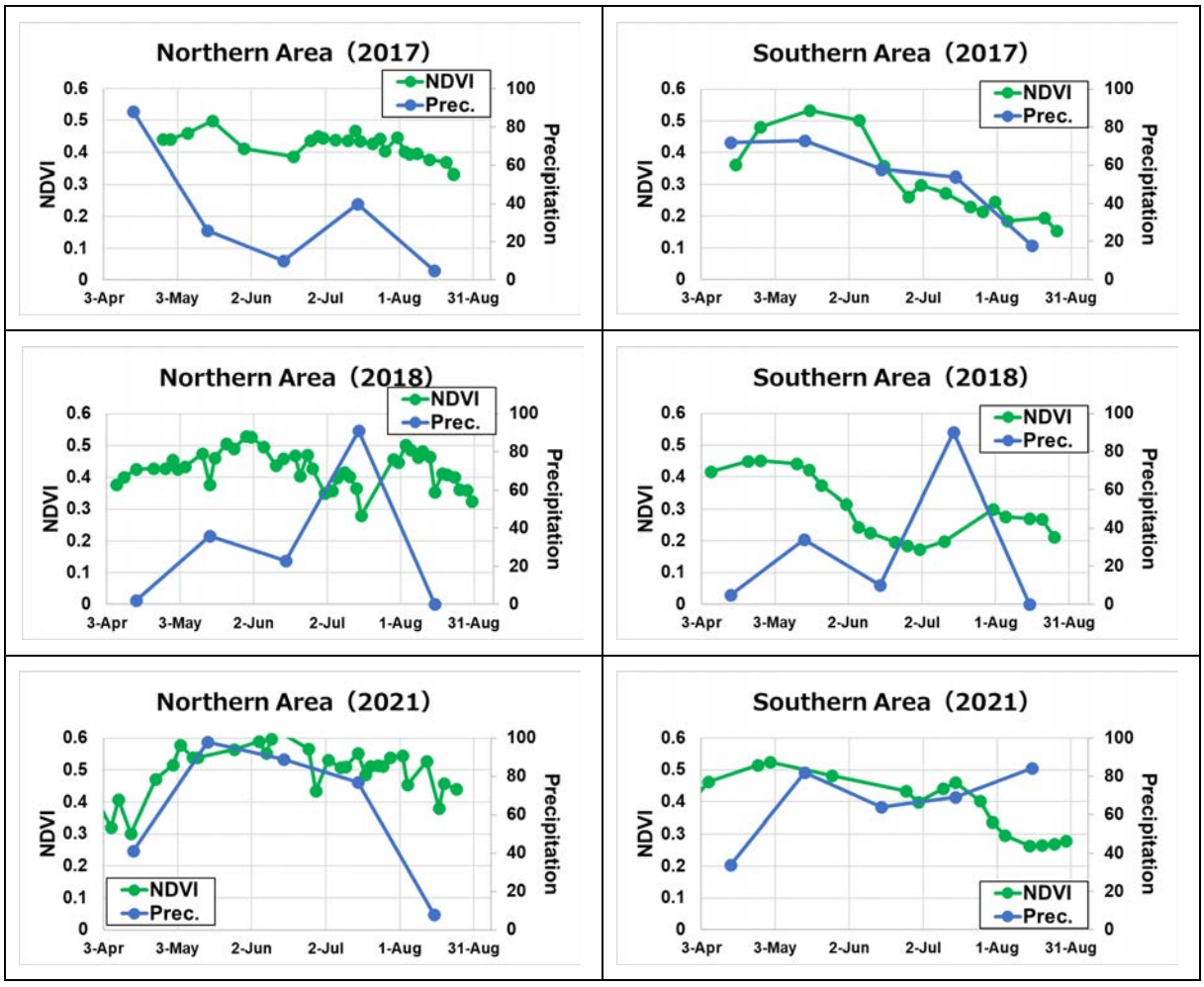
Figure 24 Dissemination of NDVI in Northern Parts of North Crimean Canal in Dry Year 2021 (Left:27th April 2017, Right 31st July 2017)

Source: EO Browser (https://www.sentinel-hub.com/explore/eobrowser/)

Figure 25 Dissemination of NDVI in Southern parts of North Crimean Canal in Dry Year 2021 (Left:27th April 2017, Right 31st July 2017)

The temporal changes of area average NDVI and the amount of precipitation for each month in the northern and southern parts of the North Crimean Canal are shown in the figure below. In the northern part of the North Crimean Canal, the area average NDVI were high from April to August, regardless of dry or wet years. On the other hand, in the southern part of the North Crimean Canal, the area average NDVI tended to decrease from May and June.

The above results are supposed to be due to the difference in cropping pattern between the northern and southern parts of the North Crimean Canal, which resulted in inconsistent crop growth conditions. Therefore, it is not possible to determine the presence or absence of irrigation simply by comparing the area average NDVI. As a conclusion in this analysis, it was difficult to identify differences in area average NDVI between irrigated and unirrigated areas.

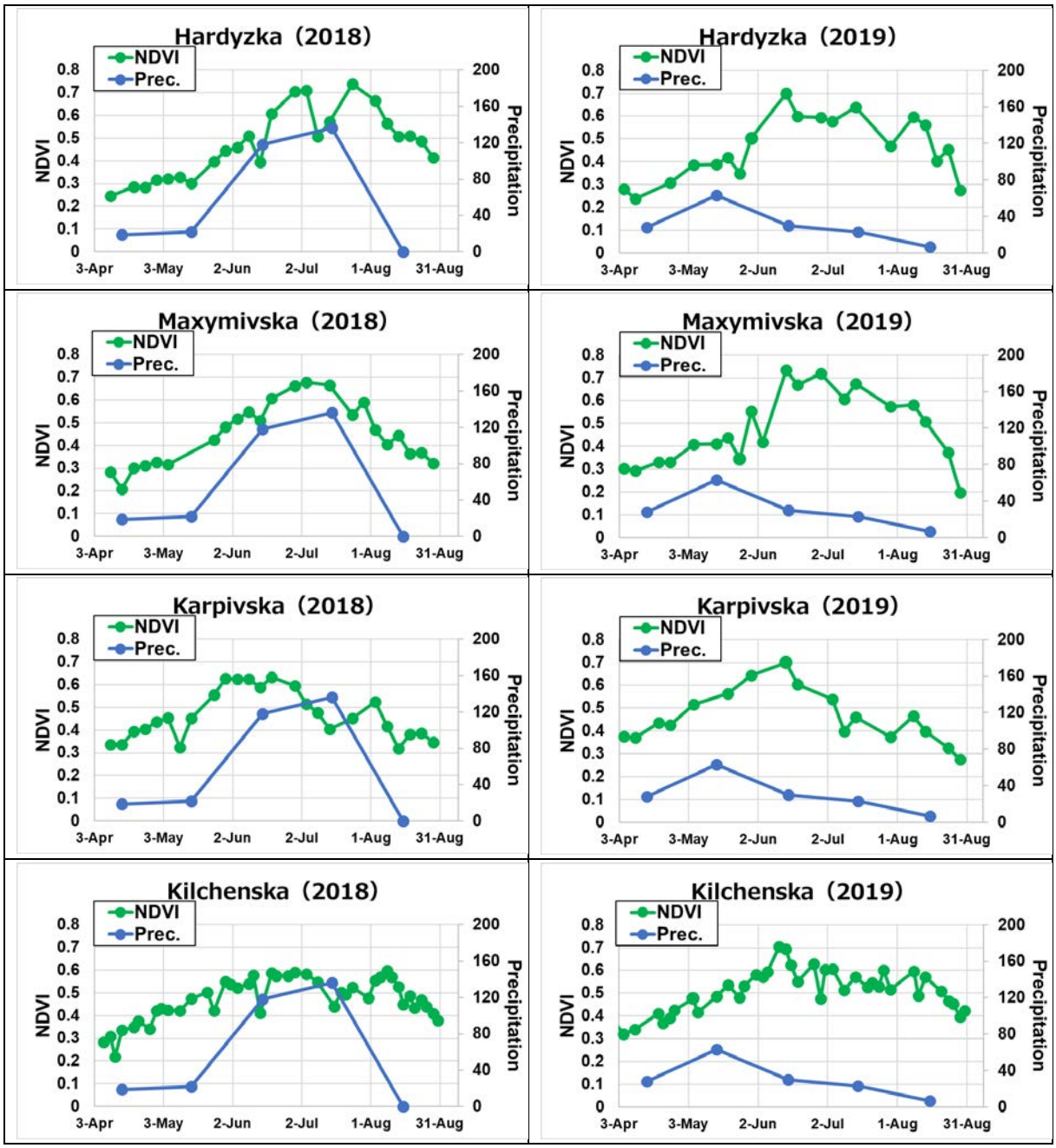


Source: JICA Survey Team

Figure 26 Temporal Change of Area Average NDVI in North Crimean Canal

JICA Survey Team also checked the temporal changes of area averages NDVI and the amount of precipitation for each month in the Mid-stream of Dnipro River as shown in the figure below.

In all irrigated areas, the trend of area average NDVI was the same in dry and wet years, and there was no clear effect of rainfall on the area average NDVI. In all irrigated systems, the area average NDVI reached 0.6 or higher from June to July, indicating that the irrigated areas had sufficient amount of water for growth. Therefore, it is highly likely that irrigation facilities are functioning in all irrigated systems.

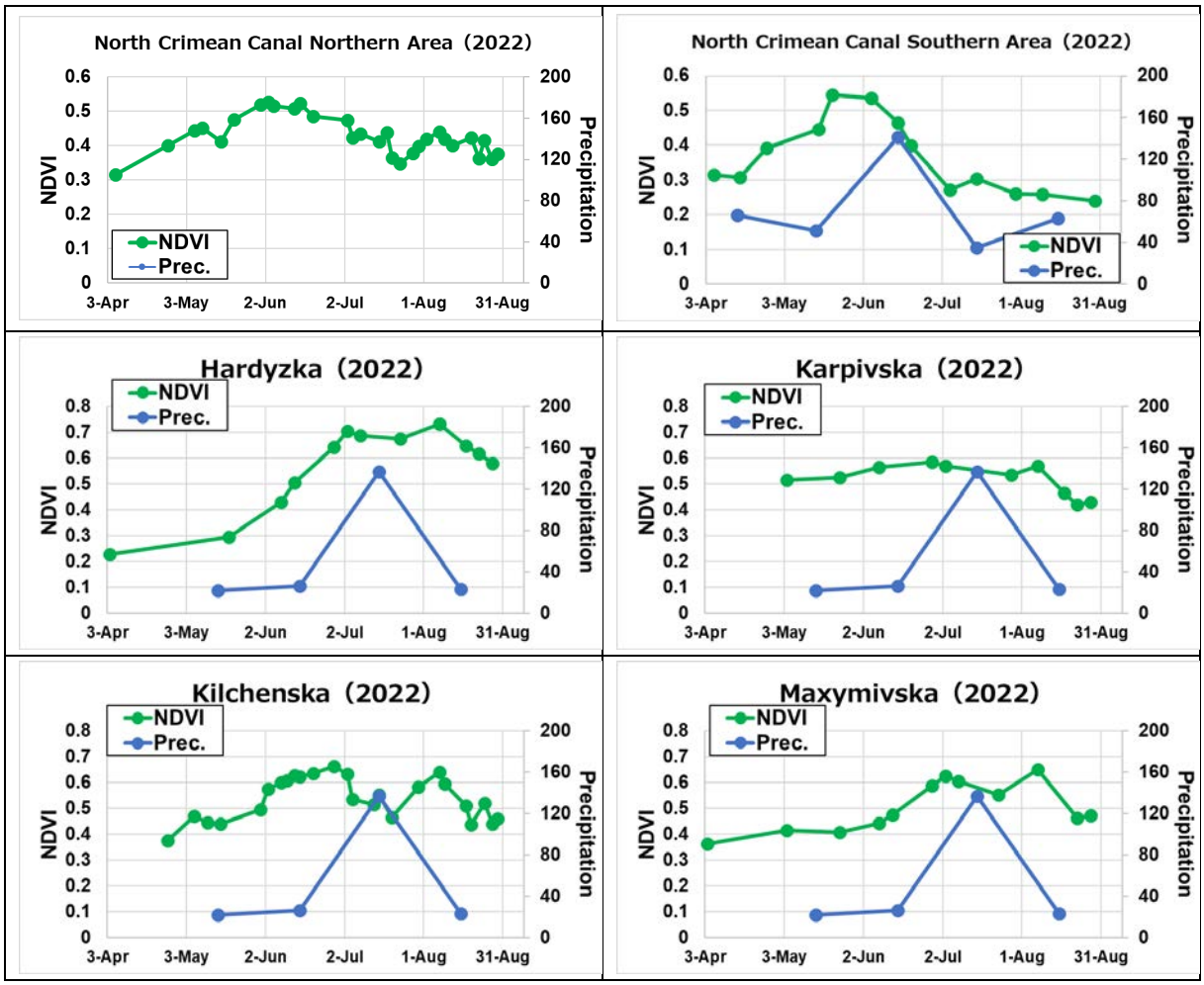


Source: JICA Survey Team

Figure 27 Temporal Change of Area Average NDVI in Irrigated System of Mid-stream of Dnipro River in 2018 and 2019

To evaluate the cultivation status after the invasion, JICA Study Team checked the area average NDVI values for 2022 in each analysed area as shown in the figure below.

There are no irrigated areas with extremely low NDVI, and in all irrigated areas, the impact of the Russian invasion on planting and growth is expected to be minimal.



Remarks: There was missing data in the weather station of Herson (Northern Area of North Crimean Canal).

Source: JICA Survey Team

Figure 28 Temporal Change of Area Average NDVI in the Selected Irrigated Area in 2022

e) Recommendations

It is found that the presence or absence of irrigation cannot be determined simply by comparing area average NDVI; rainfall, crops grown, and planting time may be three factors in the NDVI change pattern. Therefore, when field surveys become available in the future, it will be necessary to check each item for each field, compare and verify the results with the NDVI, and improve the accuracy of the NDVI.