ISLAMIC REPUBLIC OF IRAN
MINISTRY OF JIHAD-E AGRICULTURE (MOJA)
JIHAD-E AGRICULTURE ORGANIZATION (JAO)

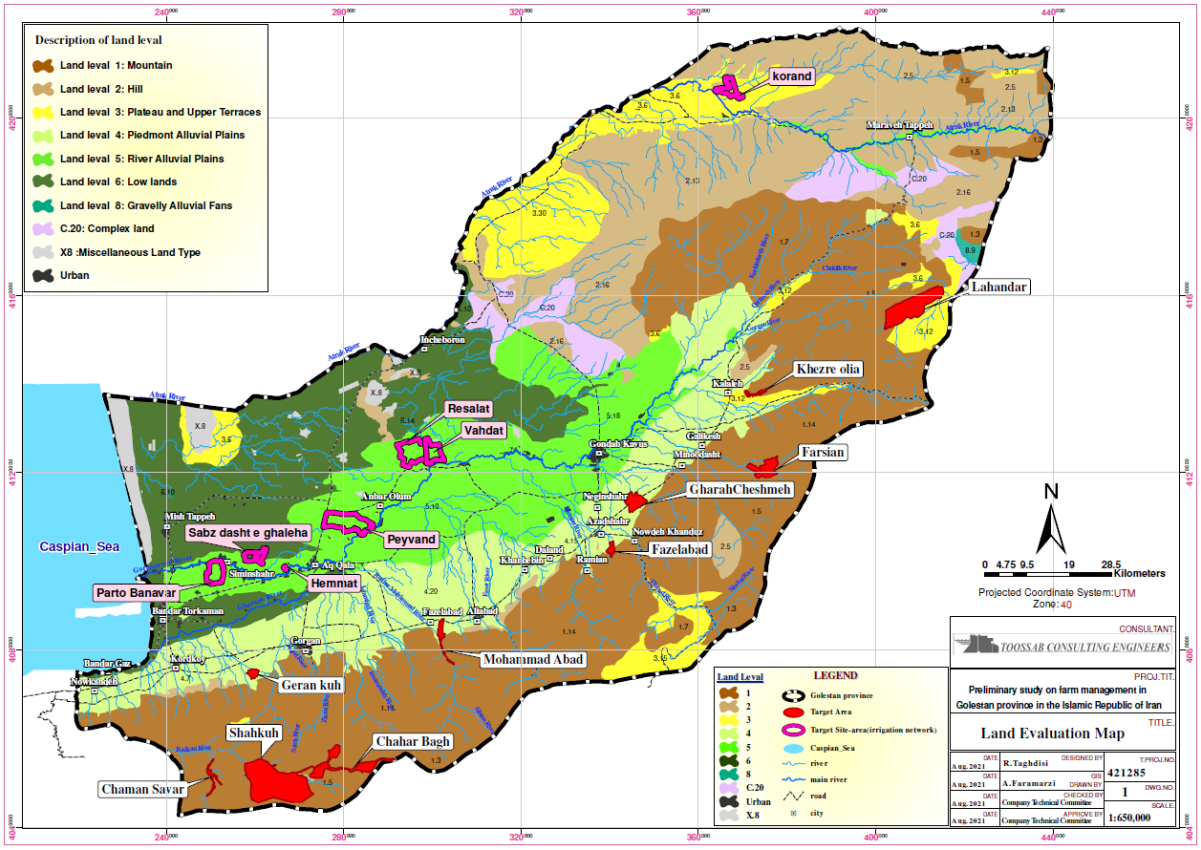
PRELIMINARY STUDY
ON
FARM MANAGEMENT
IN GOLESTAN PROVINCE
IN THE ISLAMIC REPUBLIC OF IRAN (QCBS)

FINAL REPORT

JUNE 2022

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
SANYU CONSULTANTS INC.(SCI)

Location map of study areas



Area	Township	Village/ Rural Production Cooperative (RPC)
Mountainous	Kordkuy	Chaman Savar
	Gorgan	**Chaharbagh**
	Gorgan	Shahkuh
	Galikesh	**Farsian**
	Kalaleh	Khezr Olya
Hilly	**Aliabad-eKatool**	**Mohammad Abad**
	Gorgan	Gerankuh
	Azadshahr	**Fazel Abad**
	Minudasht	Qareh Cheshmeh
	Maraveh Tappeh	Lohondor
Plain (Irrigation Network)	**Aq Qala**	**Vahdat and Resalat RPCs**
	Aq Qala	**Payvand RPC**
	Aq Qala	Hemmat RPC
	Bandar E Torkaman	Parto Banavar RPC
	Bandar E Torkaman	Sabz Dasht E Ghaleha
	Gonbad	**Korand RPC**

Bold text in the table indicates villages/rural production cooperatives (RPCs) where farm household surveys are carried out.

Photos

Meeting with the RIFR Medicinal Plant Research Area

Visit to the IMP laboratory

Consultations with relevant MOJA departments

Visit to SWRI research plots

Mountainous area: Pine trees and drip irrigation tubes on slopes

Mountainous area: Soil run-off prevention project on sloping land

Mountainous area: River near the reservoir

Mountainous area: Reservoir in depressions

Photos

Hilly area: Interview with medicinal plant women's group

Hilly area: Erosion control weirs in rivers

Hilly area: Reservoir maintenance by JAO

Hilly area: Valve point leading from the reservoir

Plain: Irrigated farmland of the Payvand union

Plain: Irrigation hose reel with JAO support

Plain: The channel leading from the Atrak River to the reservoir

Plain: Damask rose cultivation

Photos

Agriculture Seminar at Gorgan

Introduction of good practices in Japan

Farm household survey (Hygiene protocol)

Farm household survey (Interview)

Medicinal plant cultivation field

Sowing cumin seeds by agricultural machinery

Medicinal plant processing factory

Traditional pharmacies dealing with medicinal plant products

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ACRONYMS AND ABBREVIATIONS

ACECR	Academic Center for Education, Culture and Research
APERDRI	Agriculture Planning Economic and Rural Development Research Institute
AREEO	Agricultural Research, Education and Extension Organization
ASC	Agricultural Service Center
CORC	Central Organization for Rural Cooperatives
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GGP	Grass-Roots Human Security Project
Golestan ANREC	Golestan Agricultural & Natural Resources Research & Education Center
ICT	Information and Communication Technology
IMP	Iranian Institute of Medicinal Plants
JAO	Jihad-e Agriculture Organization
MCTH	Ministry of Cultural Heritage, Tourism and Handicrafts
MoE	The Ministry of Energy
MOJA	Ministry of Jihad-e Agriculture
MOU	Memorandum of Understanding
NUMAC	National Union of Medicinal Plants Agricultural Cooperatives
O＆M	Operation and Maintenance
PBO	Planning and Budget Organization
RIFR	Research Institute of Forests and Rangelands
RPC	Rural Production Cooperative
SWRI	Soil and Water Institute
VC	Value Chain
WUAs	Water Users Association

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 Background

In the Islamic Republic of Iran (hereinafter referred to as "Iran"), agriculture is a key industry, accounting for 18% of the country's working population and 10% of GDP. The “2025 Vision of Iran”, which sets out the country's medium- and long-term goals, emphasizes the importance of the agricultural sector and lists "improving the profitability of farmers" and "improving the livelihoods of the rural population" as priority objectives. In addition, a national development plan, “ the 6th National Development Plan Economic, Social and Cultural Development Five-Year Plan (2017-2021)" , aims to strengthen market competitiveness to expand agricultural exports, and to realize specific figures such as the introduction of converted crops on a total of 500,000 hectares of sloping land to increase the production of strategic crops and the introduction of 600,000 hectares of water-saving irrigation per year to improve water productivity.

Iran's agriculture is characterized by a wide range of agricultural products such as wheat and other grains which are the core of food security, and herbs and citrus fruits, due to the country's diverse climatic zones. Especially, it is widely known that Iran is the world’s leading producer of pistachio and Crocus sativus. In addition, Medicinal plants, flowers, livestock and fishery products are also important export products, and to improve the competitiveness of the market for a wide variety of agricultural, forestry and fishery products, and to increase the earnings and livelihoods of farmers and other local people are the central theme of the agricultural sector.

Golestan Province, the target area of this study, is located in the north-east of Iran, bordering Turkmenistan in the north. Geographically, the province is divided into plains and mountains, and agriculture in the area varies from wheat and other cereal crops cultivated in the plains with irrigation from the Gorgan River (and also Atrak and Gharasu Rivers) to fruit trees and horticultural crops cultivated in the hills and mountains, depending on the geomorphological conditions. The annual precipitation ranges from 250 to 600 mm, and agricultural productivity depends on the amount of precipitation as in other parts of Iran, and there is a high risk of water shortage and flooding.

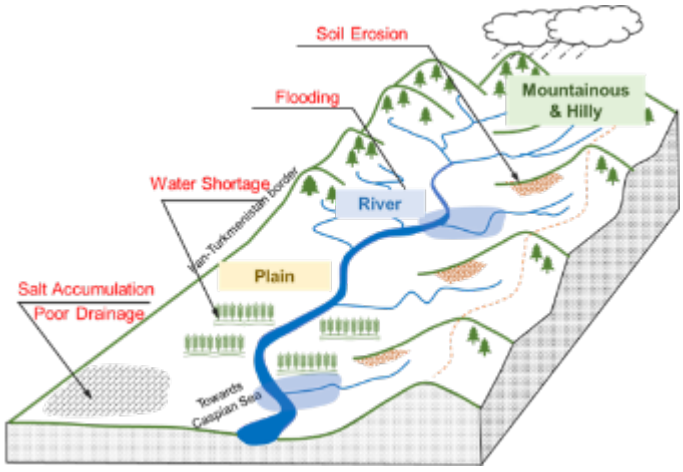


Figure 1.1.1 An Overview of the Regional Characteristics in Golestan Province
Source: JICA study team

JICA has implemented the five-year project " Establishment of participatory water management system in Golestan province " in the region since 2009 to strengthen the water management capacity of irrigated farmland in the plains, thereby contributing to improved water productivity and agricultural productivity. However, the region remains vulnerable to water risks as the floods severely inundated the region in March 2019, it damaged approximately 250,000 hectares of farmland, including irrigated

farmland, with a total damage cost of [1]$260 million. In addition, soil erosion and loss due to recent deforestation and clearing of hilly slopes are severe, and it accelerate the water risk.

Based on the situation, the Government of Iran has requested a project in Golestan Province to demonstrate and promote the introduction of conversion crops, including medicinal plants to help improve the livelihoods of flood-affected farmers and reduce flood and other water risks. To contribute to the formation of the project, it was decided to carry out the survey.

1.2 Purpose of the Study

With the above background in mind, the study will be conducted with the following two objectives.

- Grasping the current state of farming in the Golestan province
- Data gathering and analyzing information to contribute to the consideration of effective approaches for the stabilization of farmers' livelihoods

1.3 Implementation Structure of the Study

The study will be carried out under the work implementation structure shown in Figure 1.3.1 with the aim of maximizing work efficiency and output within the constraints of COVID-19, and with the support and cooperation of local partner companies and experts. The Team Leader is in charge of communication with local stakeholders and management of the project.

The two main themes of "farming" and "water use" will be investigated efficiently by appointing a person in charge of each theme. Data collection, analysis and approaches to agricultural management, such as consideration of conversion crops, selection of medicinal plants and evaluation of their applicability, consideration of measures to prevent soil loss, and land use planning based on environmental characteristics, will be undertaken by a specialist of the " Crop Conversion and Medicinal Crops" and "Land Use and Soil Management" groups, and the "Team Leader / Agricultural Planning" group will be responsible for compiling this information as a consistent output. On the other hand, matters related to efficient water use and potential reuse of wastewater, as well as flood water system operation measures and operation and maintenance policies at the community level, will be addressed by the “Water Use/Irrigation Planning”. This will be supported by the “Resilience strengthening/Drainage Systems” and “Water Use and Irrigation Planning 2”.

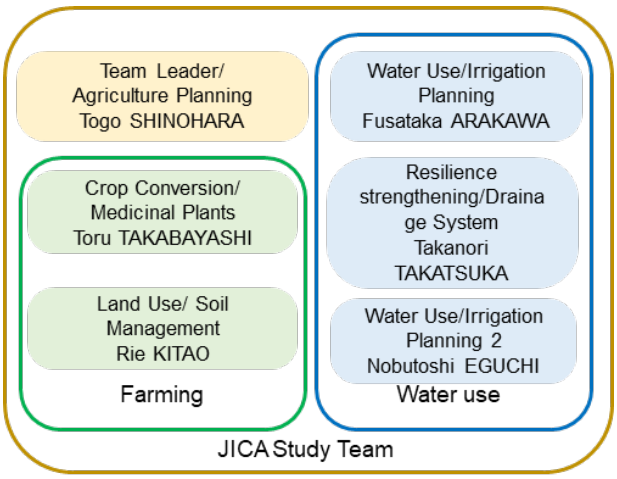


Figure 1.3.1 Implementation Structure
Source: JICA study team

Due to the current situation of COVID-19 infection in Iran and Japan, we have to assume that most of the work of this study will be carried out in Japan. During this in-country work, we have been collecting information through the Internet and literature. In addition, we have been working closely

[1] Tehran Times, Golestan flood incur loss of $260 million on agriculture sector, Mar. 24, 2019

with JAO and local consultants to promote on-site data information and to ensure smooth implementation of the survey under constrained conditions.

Regular online meetings

Physical meetings with local partners

1.4 Itinerary of the Study and Key Interviewees

The overall itinerary of this study is shown in Table 1.4.1. The duration of the study is 10 months, from April 2021 to February 2022, three on-site surveys are planned during the study. The 1st and 2nd fieldwork have carried out as follows so far.

- 1st fieldwork: Consultations with relevant organizations and data collection in Tehran

Togo SHINOHARA	Team leader/agricultural planning	13 October - 4 November
Nobutoshi EGUCHI	Water use/irrigation planning2	13 October - 25 October
Toru TAKABAYASHI	Crop conversion/medicinal plants	22 October - 4 November

- 2nd fieldwork: Data collection in Tehran and site visits in Golestan province

Fusataka ARAKAWA	Water use/irrigation planning	4 November - 25 November
Rie KITAO	Land use/soils management	9 November - 25 November

- 3rd fieldwork: Organizing workshop in Golestan province and consultations with relevant organizations in Tehran

Togo SHINOHARA	Team leader/agricultural planning	19 January - 7 February
Fusataka ARAKAWA	Water use/irrigation planning	21 January - 29 January
Toru TAKABAYASHI	Crop conversion/medicinal plants	19 January - 7 February

Table 1.4.1 Overall Process of the Study

Work Item \ Period	2021									2022	
	4	5	6	7	8	9	10	11	12	1	2
Preliminary survey											
[1] Development of Work Plan	△										
1st Survey in Iran											
[2] Explanation and Discussion on Work Plan								Behind the schedule due to Covid-19			
1st Survey in Japan											
[3] Data gathering on agriculture and rural development from Golestan province (Web, literature and remote)											
[4] Data gathering on state of farming and land use in Golestan province (Web, literature and remote)											
[5] Consideration of convertible crop in Golestan province (Web, literature and remote)											
[6] Data gathering on water use in Golestan province (Web, literature and remote)											
2nd survey in Iran											
[7] Consideration of grasping issues and their remedies								Behind the schedule due to Covid-19			
2nd survey in Japan											
[8] Consideration of demonstration Extension approach on medicinal plants for improvement of farmer's livelihoods and the reduction of future flood risk											
[9] Consideration of farming plan approach											
[10] Consideration of water resource approach											
[11] Consideration of priority											
[12] Development of Interim report							△		△		
3rd survey in Iran											
[13] Explanation of Interim report											
[14] Implementation of work plan											
3rd survey in Japan											
[15] Development and discussion on draft final report									△		△
[16] Development of final report											△

Study in Japan :
Study in Iran :
Report : △

Source: JICA study team

Information was collected through interviews with the various agencies involved in this study. Table 1.4.2 shows the main contacts made during the 1st and 2nd fieldwork.

Table 1.4.2 Key Interviewees (1st and 2nd Fieldworks)

Institutions	Where to interview	Method
Government and public authorities	Plan and Budget Organization (PBO)	In person
	International Affairs Department, MOJA	In person
	Horticulture Department, MOJA	In person
	Soil and Water Department	In person
	Trade and Export Department	In person
	Central Organization for Rural Cooperatives (CORC)	In person / online
	Golestan JAO	In person / online
	Golestan Regional Water Company	Online
	Agricultural Service Centers in Golestan	Online
	Golestan General Department of Natural Resources and Watershed Management	In person / online
Research and educational institutions	Medicinal plants and by-products research division, Research Institute of Forests and Rangelands (RIFR)	In person and facility visits
	Iranian Institute of Medicinal Plants (IMP), Academic Center for Education, Culture and Research (ACECR)	In person and facility visits
	Soil Conservation and Watershed Management Research Institute (SCWMRI)	In person and facility visits
	Soil and Water Research Institute (SWRI)	In person and facility visits
	Golestan Agricultural and Natural Resources Research and Education Center	Online
	Gorgan University of Agricultural Sciences and Natural Resources	Online
International organizations	FAO Iran Office	Online
Private and others	Farmers, cooperatives, and private companies related to medical plants and herbs	In person

Source: JICA study team

1.5 Scope of the Study

The target areas and crops for this survey were narrowed down by consultation between the Iranian government and the survey team and were agreed at the wrap-up meeting of the 1st field survey.

A total of seven representative village/rural cooperatives (RPCs) from mountain, hilly and plain irrigation networks were selected for the study area based on the agro-environmental characteristics of Golestan Province (details of the selection process are listed in CHAPTER 6). Detailed surveys (including farmer household surveys) will be conducted to determine approaches to addressing the issues at each selected site. A total of 17 crops were selected based on wild or grown varieties in the Golestan Province considering their cultivation characteristics and marketability (details of the selection process are given in CHAPTER 4). For each of the selected crops, value chain (VC) issues are identified and exit strategies are discussed. However, the selected regions and crops in this study are listed for the purpose of considering effective approaches and it does not mean to limit the regions and crops that will be targeted in future project development. In other words, it is important to target regions and crops that can maximize the impact of the approaches.

CHAPTER 2: POLICY AND ADMINISTRATIVE INSTITUTIONS RELATED TO AGRICULTURE AND RURAL DEVELOPMENT

2.1 Relevant Policies and Programmes

2.1.1 Agriculture in General

The Government of Iran has drawn up IRAN VISION 2025 (The 20-Year National Vision of the Islamic Republic of Iran)[2], which sets out the path for the country's economic, political, social and cultural development over the 20 years from 2005 to 2025, with nine goals for agricultural development.

1. Sustainable agricultural development
2. Food security and export-oriented production systems
3. Improved farming systems
4. Modernization of agriculture
5. Efficient use of water for agriculture
6. Infrastructure development and provision to encourage people's involvement in the agricultural sector
7. Production by improving marketing, reducing production costs and establishing a rational pricing system and increased shareholder returns
8. Adequate subsidies for the development of agricultural infrastructure (taking into account environmental norms)
9. Improving the livelihoods of the rural population, including farmers, villagers and migrant workers

Furthermore, the country's national development plan, the Sixth Five-Year Economic, Social and Cultural Development Plan[3] (2017-2021), sets out specific numerical targets to achieve these goals. The plan not only aims to achieve food security and self-sufficiency in basic agriculture, livestock and fisheries, but also to promote the export of agricultural products and strengthen their competitiveness in international markets. In addition to the production sector, investment in technologies such as refrigeration, processing and packaging, as well as in integrated facilities, indicates a policy of strengthening and developing the entire agricultural value chain (VC). Table 2.1.1 provides targets and plans for agriculture. Another important issue addressed is the improvement of farmers' livelihoods, including subsidies and investments to cope with the influx of people from rural to urban areas, and to reduce income disparities, as a result of recent urbanization.

[2] It has been developed by the Expediency Discernment Council of the System
[3] The 7th plan is currently being prepared for formulation and is not in the public stage. Therefore, at this point (February 2022), the 6th Plan is still being applied.

Table 2.1.1 Targets and Action Plan for Agriculture in the Sixth Five Year Plan for Economic, Social and Cultural Development

Target	Plans
Achieving food security and self-sufficiency, while strengthening our competitiveness in international markets to expand our export capacity	• Improved cultivation management (improved varieties, mechanization, etc.) • Timely and fair payment to farmers • Promotion of the production of strategic crops (renewal of 500,000 ha of orchards) • Appropriate use of input materials • Strengthening research and extension departments • Introduction of standards for food safety and quality control • Establishment of a monitoring system from production to consumption • Support for processing, packaging and other infrastructure • Strengthening the network of small farmer groups, etc.
Ensuring market stability	• Establishment of a farmers' insurance fund to compensate for production risks • Soil improvement with organic inputs (500,000 ha/year) • Support for technology and inputs for orchard renewal • Government subsidies, especially to promote investment in the processing sector, etc.
Achieving food diversity and food security	• Development of refrigeration, processing and packaging facilities and promotion of the food chain industry • Agglomeration and standardization of agricultural products • Reduction of the gap between agricultural production income and consumer wages (by 10%) • Promotion of investment in the agricultural sector, etc.

Source: JICA study team compiled based on the Sixth Five Year Plan for Economic, Social and Cultural Development

2.1.2 Water Resources, Irrigation and Drainage

The principal law in Iran's water policy is the Iran Water Law and the Manner of Water Nationalization, approved in 1968, which declares that water is "the property of the country and belongs to everyone". This law grants water rights to the people and makes the government responsible for the development of water-related infrastructure. In addition, in 1983, the Law on Equitable Water Distribution was introduced, making all water resources in the country the property of the country, with the Ministry of Energy responsible for the distribution of water to the various sectors.

The main objectives of these laws are to improve the regulation of water demand and water allocation, to optimize the use of water for agriculture, to introduce water pricing between different sectors, to carry out renovation and maintenance of irrigation facilities and to control environmental pollution. In addition, for each river basin, actions are advocated to increase the share of surface water in total water consumption in the future and to reduce the share of groundwater. In particular, the rapid urbanization of recent years has led to an increasing demand for water in the domestic and industrial sectors, and the effective use of limited water resources has become an urgent issue. In this context, the aforementioned "2025 Vision of Iran" sets out five objectives for water resources development.

1. Establishment of an integrated water resources management system
2. Increased water productivity
3. Development of water resources and reduction of losses
4. Development of a master plan for water resources development, modernization and private investment
5. Control of excess water run-off, efficient use of shared water along the border

In order to achieve the above targets, the Sixth Five-Year Plan for Economic, Social and Cultural Development (2017-2021) has developed a plan with specific figures (Table 2.1.2). Initiatives related to irrigation and drainage include improving the efficiency of irrigation water use and modernizing irrigation infrastructure. In addition, soft measures such as improvement of farming techniques, irrigation drainage technology and proper allocation of irrigation water are also promoted as policies. In addition, limited water resources are prioritized for drinking water, sanitation, industry, services and agriculture, and improving water quality through sewage treatment is a key priority. The modernization of agriculture, including greenhouse cultivation, pipelines, reuse of wastewater and the use of new technologies, has been a feature of the policy in recent years, with a shift from horizontal expansion of arable land to vertical expansion, including the introduction of greenhouse cultivation and increased productivity.

Table 2.1.2 Targets and Action Plan for Water Resources in the Sixth Five Year Plan for Economic, Social and Cultural Development

Target	Plans
Improving water productivity and promoting the appropriate use of groundwater and surface water	• Improving water and land productivity through appropriate crop selection • Watershed management, water catchment, water and soil conservation, introduction of modern water-saving irrigation of 600,000 ha/year • Greenhouse cultivation, water reuse, prevention of illegal water abstraction, proper water management • Introduction of a new water-saving cropping pattern • Sediment removal and repair of cannates • Enhanced monitoring of groundwater use • Preferential use of dam water for drinking water • Granting of water rights to farmers, etc.
Improving water supply and use systems	• Securing drinking water by improving water use efficiency and introducing desalination facilities • Tax revenue from mineral water to be used for ecotourism development • Use of profits from sewage treatment to expand sewage treatment facilities, etc.
Expansion of municipal sewage systems	• Aggressive investment in the expansion of sewage treatment facilities, etc.

Source: JICA study team compiled based on the Sixth Five Year Plan for Economic, Social and Cultural Development

2.1.3 Medicinal Plants

Medicinal plants are discussed in this study as crops that contribute to improving farmers' livelihoods. In Iran, due to the country's diverse climatic conditions, a wide variety of medicinal plant species grow naturally or are cultivated and are traditionally used, especially in rural areas. In addition, medicinal plants such as saffron and damask rose are important export products of the country, so the promotion of medicinal plants is an important part of the current agricultural policy which aims not only to improve the livelihood of farmers but also to promote the export of agricultural products. In fact, the Sixth Five-Year Plan for Economic, Social and Cultural Development (2017-2021) also mentions the promotion of medicinal plants, with a specific figure of 250,000 ha of medicinal plants to be planted within the period.

Table 2.1.3 shows the target values for saffron and damask rose, which are the main medicinal plants, and other medicinal plants set by the Ministry of Jihad-e-Agriculture (MOJA) in response to the 6th

Five-Year Plan for Economic, Social and Cultural Development. MOJA has set a target value of 280,000 ha as of 2021 and has set a target of achieving the development of a planting area of 105,000 ha in 5 years.

Table 2.1.3 Targets to be Achieved for Planting Area of Medicinal Plants

	2017 (ha)	2018 (ha)	2019 (ha)	2020 (ha)	2021 (ha)	Total (ha)
Saffron	4,898	2,675	3,273	3,831	2,073	16,750
Damask Rose	3,981	2,633	3,257	3,709	2,056	15,636
Others	21,727	10,553	14,741	17,105	8,778	72,904
Plan	30,606	15,861	21,271	24,645	12,907	105,290
Plan (Total)	206,058	221,919	243,190	267,835	280,742	

Source: MOJA

Figure 2.1.1 shows the achievement status of the target. Although the achievement rate was as low as 45% in 2017, it has been steadily proceeding with development to achieve the target, and the area of new medicinal plants to be planted is expanding. As of 2019, the achievement status is about 80% of the target. Although the 7th Economic, Social and Cultural Development Five-Year Plan is in preparation for formulation, it is expected that the promotion of cultivation of medicinal plants will continue to be positioned as a priority for development.

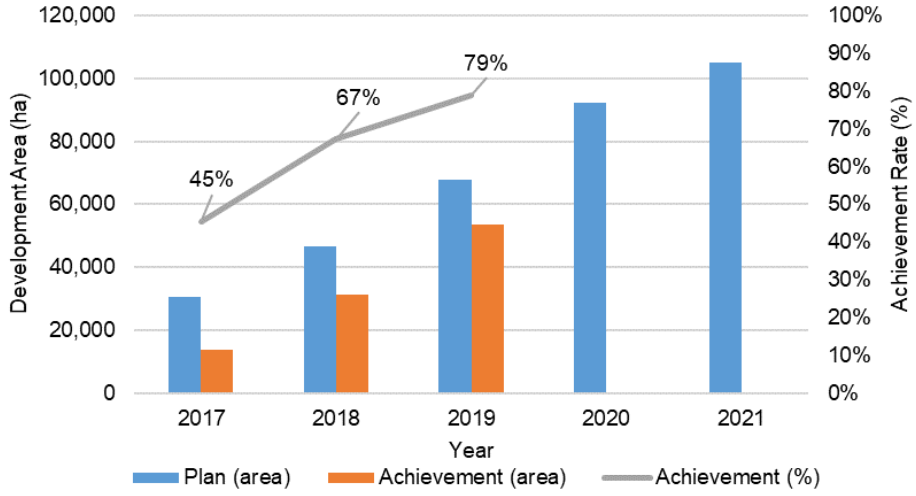


Figure 2.1.1 Cumulative Target and Achieved Planting Area of Medicinal Plants

Source: MOJA

In addition, the National Document on Medicinal Plants and Traditional Medicine (2013), compiled by the Supreme Council of the Cultural Revolution, sets out the following specific objectives, strategies and activities for the period up to 2025

[Target]

- With medicines derived from medicinal plants, obtaining 20% share of the domestic pharmaceutical market.
- Iran's medicinal plant-related medicines capture 3% share of chemical products on the world market.
- Establishment of a registration system for the protection of country's endemic or endangered medicinal plant species.
- Reducing the area of medicinal plants collected from the natural environment to 200,000 ha by 2025.
- Increasing the area under medicinal and essential oil plants to 500,000 ha by 2025.

[Strategy]

- Reviewing, amending, simplifying, and updating relevant laws, regulations and standards.
- Research and development of related technologies and the establishment of an educational system for them.
- Management of seed and other resources, with an emphasis on the development of cultivation, breeding and processing techniques.
- Protection of endemic species and prevention of leakage of their samples or information.

[Activities]

- Create articles of incorporation, plans, etc. for the purpose of amending or simplifying the law and submit them to the competent authority.
- Preparation and compilation of national standards for medicinal plants and their products in the field of import and export.
- Establishment of a national laboratory and an international research and development centers in the field of medicinal plants and herbal products by 2025.
- Establishment of a legal body to establish the relationship between producers and consumers or pharmaceutical companies.
- Export promotion in the field of medicinal plants and herbal products.
- Promoting the introduction of advanced science and technology from other countries.
- Establishment of monitoring systems for markets and centers that provide products and services in the field of medicinal plants, including pharmacists (traditional pharmacies).
- Support for the commercialization of new products, methods or processes related to medicinal plants and traditional medicines.
- Support for the establishment of production centers for medicinal plants, including seeds, saplings and seedlings.
- To support the modernization and renewal of the industries associated with the processing of medicinal plants.
- Development of the quantity and quality of medicinal plants to prevent damage to forests and pastures caused by excessive harvesting.
- Establish a database of national medicinal plants and herbal products.
- To strengthen and develop the gene bank of medicinal plants, either endemic to Iran or endangered.
- Compilation and publication of a list of national priority medicinal plants.

The "List of priority medicinal plants" as indicated in the above activities is shown in Table 2.1.4. For these 24 priority medicinal plants, a 10-year plan on processing and technology of medicinal plants has been developed, which includes activities such as "Registration of indigenous and cultivated varieties of medicinal plants for the conservation of plant genetic resources", "Preparation of production fields, seeds, seedlings, etc. of medicinal plants and production standards", and " Preparation of protocol and instruction manual for management and certification of seeds and seedlings of medicinal plants".

Table 2.1.4 List of Priority Medicinal Plants as Given in National Documents on Medicinal Plants and Traditional Medicine

No.	English name	Scientific name	No.	English name	Scientific name
1	Damask Rose	*Rosa × damascena*	13	Purple Barrenwort	*Echinacea purpurea*
2	Pumpkin	*Cucurbita pepo*	14	Hissop	*Hyssopus officinalis*
3	Time (various type)	*Thymus vulgaris*	15	Maria thistle	*Silybum marianum*
4	Chamomile	*Matricaria chamomilla*	16	Dragon's head	*Dracocephalum*
5	Savoury (carious type)	*Satureja*	17	Passion fruit	*Passiflora edulis Sims*
6	Mint	*Mentha*	18	Marjoram	*Origanum majorana*
7	Cumin (various type)	*Cuminum cyminum*	19	Saffron	*Crocus sativus*
8	Coriander	*Coriandrum sativum*	20	Sage	*Salvia officinalis*
9	Tarragon	*Artemisia dracunculus*	21	Aloe Vera	*Aloe vera*
10	St. John's wort	*Hypericum perforatum*	22	Fennel	*Foeniculum vulgare*
11	St. John's wort	*Valeriana officinalis*	23	Calendula	*Calendula officinalis*
12	Rosemary	*Salvia rosmarinus*	24	Roselle	*Hibiscus sabdariffa*

Source: Ten-Year Plan for the Processing and Technology of Medicinal Plants (2016), Seed and Plant Certification and Registration Institute-AREEO-MOJA, in collaboration with Medicinal Plants Standardization Working Group of Medicinal Plants Science and Technology Development Headquarters under the vice presidency of Science and Technology

2.2 Relevant Administrative Institutions

2.2.1 Ministry of Jihad-e-Agriculture (MOJA)

The MOJA is responsible for agriculture and rural development. MOJA was established in 2000 through the merger of the Ministry of Agriculture and the Ministry of Development, and is responsible for overall agricultural policy and planning, oversight of agricultural and rural development activities, and budget execution, with a provincial agriculture office (JAO) in each province. In addition, as shown in the organizational chart in Figure 2.2.1, MOJA has seven bureaus and related institutions and public corporations under its umbrella, and functions as a supervisory body for research, study, education and extension in agriculture, water and soil conservation, watershed management and plant protection, as well as for activities of agricultural production associations and public works related to agriculture. The contact points for this study are the Department of Medicinal Plants of the Department of Horticulture of MOJA and the Department of Horticulture of Golestan JAO (red box in the figure). In addition, the study plans to examine approaches to mitigate water risks, and information is being collected with the cooperation of other departments and organizations, such as the Water and Soil Department of MOJA.

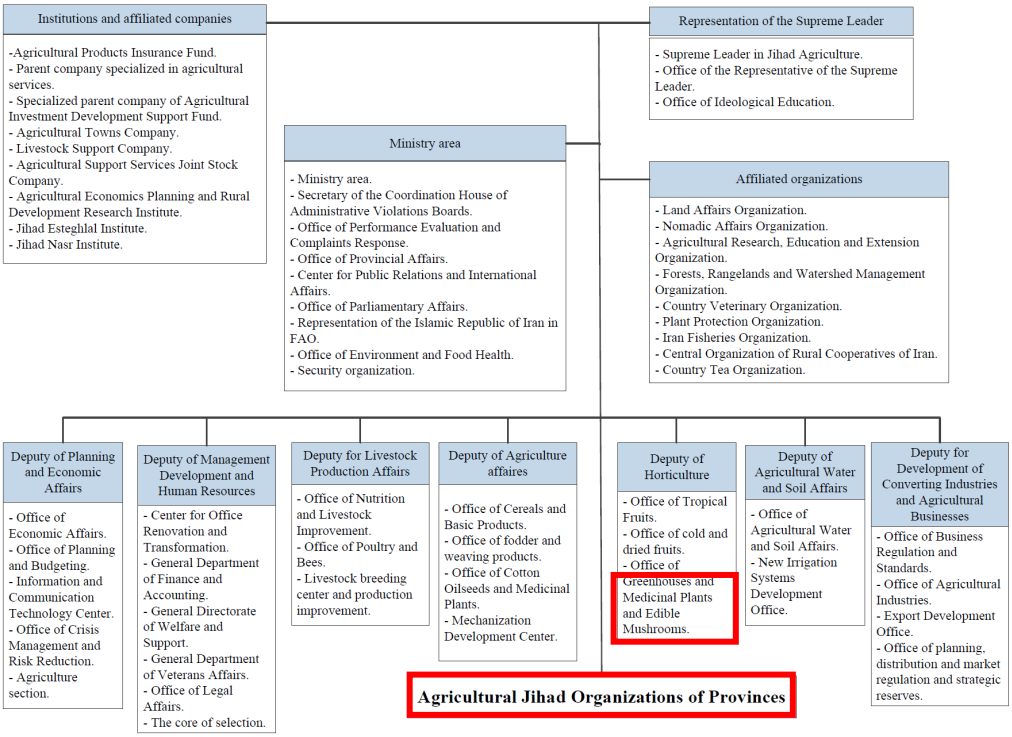


Figure 2.2.1 Organizational Chart of MOJA

Source: MOJA

The departments within MOJA have been reorganized in recent years. Previously, agricultural product processing and trading (including imports and exports) were under the jurisdiction of the Ministry of Industry, Mines and Trade, but since 2013 all agricultural, livestock and fishery products (including medicinal plants) have been transferred to the jurisdiction of MOJA. In other words, the scope of control of MOJA, which had been in charge of the production of agricultural products, has been expanded, and all value chain nodes from the production to processing and distribution are now under the jurisdiction. This makes it possible for MOJA to integrally strengthen the agricultural product value chain.

Figure 2.2.2 shows the organization chart of the Jihad-e Agriculture Organization (JAO) in Golestan Province. Golestan JAO has four sub-bureaus, and the horticultural department, which is the counterpart, is located under the plant production improvement sub-bureau (red frame in the figure). In addition, the agricultural extension department, agricultural mechanization department, and water and soil department, which are related to this study, are assigned as independent departments from the sub-bureaus. Golestan JAO's headquarter is located in the provincial capital, Golgan city, and there are township/city offices in 12 townships and cities.

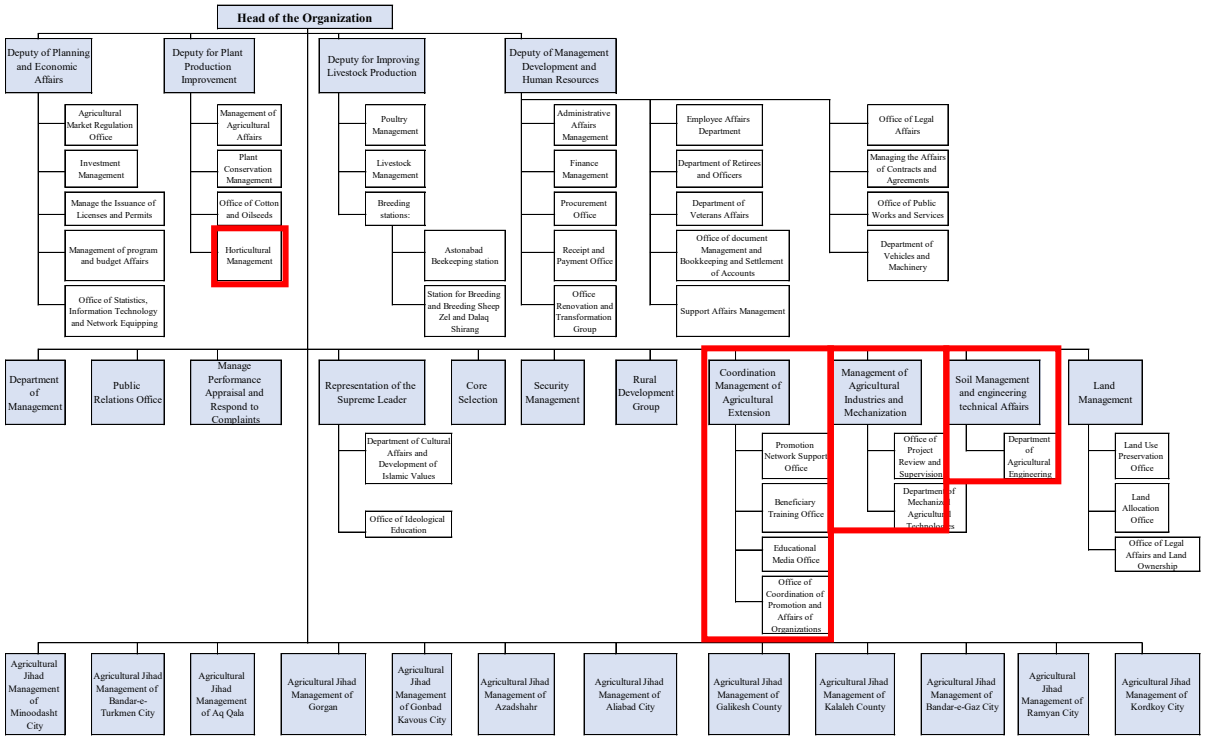


Figure 2.2.2 Organizational Chart of Golestan JAO

Source: Golestan JAO

Figure 2.2.3 shows the organization chart of the Minoodasht City Office, which is the capital of Minoodasht township, as an example of a township/city office. The agricultural service center (ASC), which is described later, is under this city office.

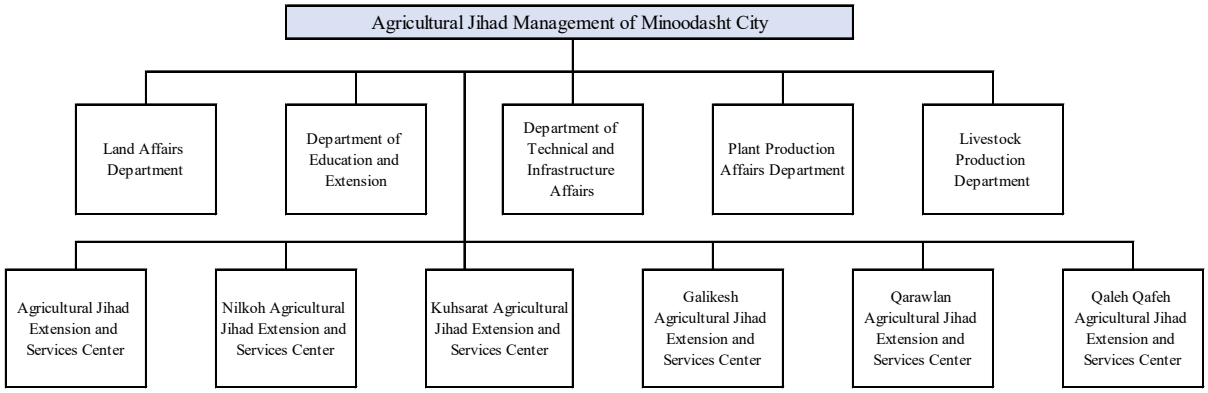


Figure 2.2.3 Organizational Chart of Minoodasht City Office, Golestan JAO

Source: Golestan JAO

2.2.2 Academic Research Institutions

The public institutions responsible for the research and development of medicinal plants covered by this study as conversion crops are the Forest and Grassland Research Institute (RIFR-AREEO[4]), part of the MOJA, and the Institute of Medicinal Plants (IMP[5]), part of the Academic Centre for Educational and Cultural Research (ACECR).[6]

The RIFR is a natural resources research organization established in 1968, with 11 research areas, a genetic resources bank and a national botanical garden at its headquarters, and research branches in each province (Figure 2.2.4). One of the research areas is the area of medicinal plants and their by-products (red frame in the figure), which includes physiological and ecological studies of medicinal plants in different regions, studies of cultivation management systems (from sowing to production and processing), and studies of functional components. RIFR also produce publications such as an illustrated book on medicinal plants in Iran. In cooperation with MOJA and JAO, RIFR have conducted training courses for farmers (from production to processing) and are actively involved in extension activities as well as research.

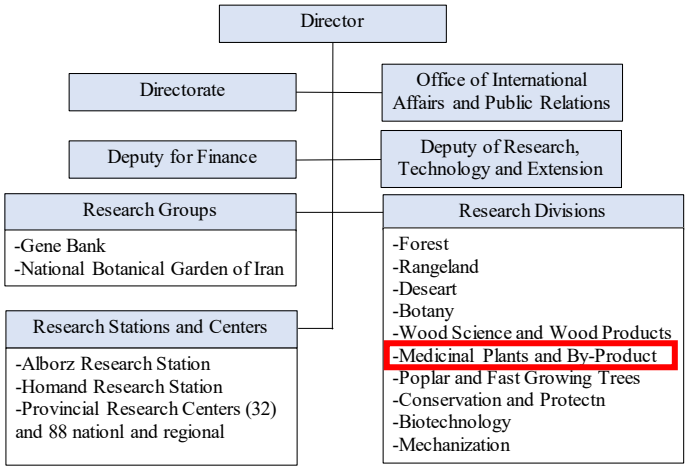


Figure 2.2.4 RIFR Organization Chart
Source: RIFR

IMP, established in 1998, is a research institute specialized in medicinal plants and conducts research and development on seeds, seedlings, production and processing based on the concept of value chain development. The institute aims to establish a database of medicinal plants in Iran, which will be accessible online in the future. Another notable activity of the institute is its work in the processing field, especially in product development. In collaboration with the private sector, the Institute has developed products such as nutritional supplements (tablets and syrups) and has paved the way for their production and sale. The institute also cooperates with JAO to support farmers in introducing medicinal plant processing machinery (introduction and training).

An introduction to the nutritional supplements developed by IMP

2.2.3 Cooperatives

The Central Organization of Rural Cooperatives (CORC)[7], an affiliate of the MOJA, plays an

[4] Research Institute of Forests and Rangelands, Agricultural Research, Education and Extension Organization
[5] Iranian Institute of Medicinal Plants
[6] Academic Center for Education, Culture and Research
[7] Central Organization for Rural Cooperatives

important role in Iranian agriculture. CORC was established in 1963 to promote the development and strengthening of rural and agricultural organizations and provides policy (guaranteed crop prices and loan services), supervision, consulting and training for its members. CORC has a large network of 8,302 cooperatives with a total membership of over 7 million. The CORC network is huge, with 8,302 cooperatives nationwide and a total membership of over 7 million (Table 2.2.1). Each cooperative has its own superstructure of federations - district, province and even national federations.

Among the National Federations, the National Union of Medicinal Plant Agricultural Cooperatives (NUMAC)[8] was launched in 2018 to achieve the goals of the National Document on Medicinal Plants and Traditional Medicine (2013) mentioned above. NUMAC is an umbrella organization for existing agricultural and rural women's associations that have been dealing with medicinal plants and provides technical and financial support for production and processing of medicinal plants.

Table 2.2.1 Networks and Facilities Owned by CORC

Network	Rural Cooperatives	2,758 (341 district and provincial unions) Number of members: 4,340,196
	Agriculture Cooperatives	2,043 (126 districts and provincial unions) Number of members: 1,070,118
	Rural Women Cooperatives	314 57,933 members
	Rural Production Cooperatives	1,490 (66 districts and provincial unions) 419,054 members
	Agro-Corporation	33 9,221 members
	Agricultural Guild Systems	452 in districts, 33 in provinces Number of members: 1,108,776
	Council of Agricultural Elite	335 in districts, 31 in provinces 70,941 members
	Coordination and Supporting Councils	241 in township, 28 in provinces
Facilities	Consumer Shops	1,803
	Gas station	7,881
	Direct Supply Booth	2,229
	Permanent Supply Center for Agricultural Products	310
	Supply Center for Agricultural Inputs	2,798
	Capacity of Warehouse	31,000,000 Metric tons
	Capacity of Cold Storages	63,000 Metric tons
	Food Processing Units (Sorting, Packaging, Drying etc.)	315
	Milk Collection Centers	247

Source: CORC

In rural areas, there are three types of cooperatives: rural cooperatives, agriculture cooperatives, and rural women cooperatives. Of these, rural cooperatives are in charge of social, cultural and economic activities. Agriculture cooperatives are responsible for activities related to improving agricultural technology, efficient use of water, sustainable agriculture and livelihood improvement. In addition, rural women cooperatives are responsible for activities related to improving women's livelihoods, such as small-scale industries (bread making, textiles, etc.).

In Golestan Province, which is the target area of this study, there are 14 unions, 112 agriculture cooperatives, 68 rural cooperatives, and 8 rural women cooperatives, each of which is engaged in its activities. In the farm household survey conducted in this study, 56% of the farm households belong to the agriculture cooperatives, while only 1% of the households belong to the rural cooperatives. Furthermore, according to an interview survey conducted with agriculture cooperatives in Golestan

[8] National Union of Medicinal Plants Agricultural Cooperatives

Province, the specific activity contents of the cooperatives are field maintenance, water management (Setting of water distribution rules, formation of groups, water distribution and its monitoring, operation and maintenance of irrigation facilities), extension and training of agricultural technology, fertilizer and seed provided at low cost by the government, supply of agricultural machinery and equipment, and activities related to soil improvement. The size of the cooperative varies, and in areas with irrigation schemes, more than 1,000 members belong, and have tractors and office facilities, while there is also a small cooperative with 7 members, which is formed by neighboring farmers.

The issues faced by the cooperatives that grows medicinal plants are market instability, insufficient information of product needs, and limited opportunities to participate in training. And the issues faced by cooperatives that grow wheat and other crops are the market recession, low cost-effectiveness of agriculture, rising land prices, and a decline in the youth employment rate.

2.2.4 Formation of Study Committees

In the course of this study, while discussing with the Iranian side the scope of the study and the issues to be addressed in the field, in order to enhance the effectiveness of the study process, a study committee was established at the MOJA headquarters (to be established at the time of the first field survey in October), and a working group was established at the Golestan JAO (to be established in July after the start of the study, with a kick-off meeting in October). Table 2.2.2 shows the member list of the study committee established in MOJA Headquarters. Chaired by the Adviser to Deputy of the Horticulture Department, in addition to staff of the Horticulture Department and Water and Soil Department, researcher from RIFR-AREEO under MOJA, Soil and Water Institute (SWRI[9]), and Agriculture Planning Economic and Rural Development Research Institute (APERDRI[10]), and officers from International Department of MOJA and Planning of Budget Organization (PBO[11]) are members and are promoting project formation through the support of this study.

Table 2.2.2 List of Study Committee Members by MOJA HQ

No.	Organization/Department	Position	Position on Committee
1	Deputy of Horticulture	Adviser to the Deputy Minister	Head
2	Golestan JAO	Head of JICA office in the Golestan JAO	Coordinator
3	Deputy of Horticulture	Consultant of Medicinal Plants Department	Member
4	Golestan JAO	Manager of Horticulture	Member
5	Deputy of Water and Soil	Head of International Affairs	Member
6	Golestan JAO	Manager of Water and Soil	Member
7	Water and Soil Institute	Faculty member and head of land suitability department	Member
8	Agricultural Economics Planning and Rural Development Research Institute	Faculty member	Member
9	Agricultural institute of education and extension	JICA office expert	Member
10	Vice President of Business Development	Expert	Member
11	Information and Communication Technology Center	Expert	Member
12	Research Institute of Forests and Rangelands	Head of the medicinal and by product Division	Member
13	Planning and Budget Organization	Expert	Member
14	Soil Conservation and Watershed Management Research Institute	Faculty member- Director of Water Resources Development Group	Member
15	International Affairs Department	JICA office expert	Member
16	Deputy of Horticulture	Adviser to the Deputy Minister	Member

[9] Soil and Water Institute
[10] Agriculture Planning Economic and Rural Development Research Institute
[11] Planning and Budget Organization

No.	Organization/Department	Position	Position on Committee
17	Deputy of Horticulture	Adviser to the Deputy Minister and in charge of plans and programs	Member
18	Deputy of Horticulture	Ministry of Agriculture, Horticulture Deputy soil management & evaluation expert	Member
19	Deputy of Horticulture	Responsible for parliamentary affairs and coordination of provincial affairs	Member
20	Deputy of Horticulture	Head of Public Relations	Member
21	Deputy of Horticulture	Responsible for International Relations	Member

Source: MOJA

Table 2.2.3 shows the list of members participating in the working group established by the Golestan JAO. It is to be welcomed that the members of the working groups set up in Golestan are not only from other departments in the JAO and from the watershed management offices under the same MOJA, but also from the Regional Water Company, Rural Cooperative Organization, Chamber of Commerce, Universities, and research institutes. While the collaboration with other departments, ministries, private sector and research institutes is usually limited, it is highly appreciated that the JAO and Golestan Province have been coordinating through this working group since the study stage.

Table 2.2.3 List of Working Group Members by Golestan JAO

No.	Members
1	Golestan Rural Cooperative Organization
2	Soil and Water Bureau Management Golestan JAO
3	Soil and Water Bureau Management Golestan JAO
4	Golestan Agricultural and Natural Resources Research Education Center
5	Executive manager of the projects for medicinal plants Golestan JAO
6	Medicinal plants Expert Golestan JAO
7	Executive Manager of the projects for sloping areas Golestan JAO
8	Chamber of commerce in Gorgan
9	Gorgan University
10	University Jihad of Golestan Province / Academic Center for Education, Culture and Research
11	Regional Water Company of Golestan
12	General Department of Natural Resources and Watershed Management of Golestan Province

Source: Golestan JAO

2.3 Status of Other Donors' Support in the Agriculture Sector and Same Region

Although support from other donors in the field of agriculture and rural development is very limited, there is some support provided by one of the UN agencies, the United Nations Food and Agriculture Organization (FAO). FAO's current support in the same sector and region as the one covered in this study includes the five activities listed in Table 2.2.4. In particular, the second activity in the table includes the Golestan Province, which is being assessed and risk assessed for the 2019 floods, and the activities are planned to be consolidated into a study and action plan (to be completed in December 2021). As water risk reduction is one of the target areas of this study, it is recommended to be considered the use of the results of this activity and collaboration.

Table 2.2.4 Relevant FAO's Activities (On-going)

No.	Code	Title and Contents
1	gcp/rne/009/swe	Implementing the 2030 Agenda for Water Efficiency/Productivity & Water Sustainability in Near East North Africa • Covering Qazvin province in western Tehran • Establishment of a monitoring system for the water balance • Improving agricultural water productivity, value chain development, etc.
2	TCP/IRA/3703	Technical Support to Water and Soil Rehabilitation for Improved Climate Resilience in Golestan, Khouzestan and Lorestan Provinces • Covering the provinces of Golestan, Khuzestan, Lorestan and Baluchistan • Flood damage assessment and risk assessment for 2019 • Consideration of measures and development of an action plan
3	TCP/IRA/3802	Building Capacity toward Sustainable Intensification of Oilseed Crops in Iran, addressing the Soybean Value Chain - Phase II of TCP/IRA/3604 • Targeting Golestan and Khuzestan provinces • Oilseed crop (soybean) value chain development
4	GCP/IRA/068/GCR	Green Climate Fund (GCF) Readiness Programme of the Islamic Republic of Iran • Strengthening the capacity of NDAs
5	GCP/IRA/066/JPN	Integrated Programme for Sustainable Water Resources Management in the Urmia Lake Basin • Integrated Plan for Sustainable Water Resources Management in the Lake Ormier Basin (FAO collaboration)

Source: FAO

2.4 Status of Japan's Cooperation

Japan has three priority areas of cooperation with Iran (medium-term objectives) and three development issues (sub-objectives).

- Strengthening economic and social infrastructure
  - Promoting stable and high-quality economic growth
  - Creating a resilient society
- Sustainable development
  - Conservation of the natural environment, environmental pollution control, global warming
- Strengthening relations with the international community and the surrounding region
  - Strengthening relations with the international community and the surrounding region

Of these, this study is particularly concerned with the strengthening of economic and social infrastructure and sustainable development. The study will examine effective approaches to the promotion of medicinal plants, which are expected to create jobs and improve the livelihoods of local people. In addition, recovery from climate change related disasters such as floods and droughts, and water risk reduction for disaster prevention and mitigation will contribute to sustainable development.

A related project under the current JICA's cooperation is the "Participatory Forest and Grassland Management Capacity Enhancement Project in the Upper Karoon River Basin". The project aims to strengthen the implementation of the integrated watershed management promoted by the Iranian government, to strengthen the watershed management system with the participation of local people and to improve the livelihood of local people in the Karoon River Basin. The project is promoting afforestation as a soil conservation, which includes perennial medicinal plants and herbs, which will be referred to in the selection of medicinal plants for consideration in this study.

In addition, in Iran, the Grant Assistance for Grassroots Projects, which is regarded as a "quick aid" that can respond quickly to local needs, was launched in 1999, and 132 projects have been implemented to date. One of the projects closely related to medicinal herbs, which will be examined in this study, is the "Medicinal Herb Processing Facility Development Project" in Tehran and Mazandaran provinces, which aims to promote employment and generate income for women by developing processing facilities and introducing equipment for processing. It is important to consider combining these efforts with Japan's technical cooperation and to promote organic linkage between the support schemes.

CHAPTER 3: FARMING AND LAND USE IN THE GOLESTAN PROVINCE

3.1 Crop Production

3.1.1 Major Crops (Staple, oil and horticultural crops)

The total area of agricultural land in the Golestan province is about 760,000 ha, including mixed "pasture and agricultural land" areas. The main crops are wheat, rice, barley, oilseed, cotton, soybean and fodder maize, which together account for 90% of the total. In particular, among staple crops, the cultivated area of wheat is about 350,000 ha, which occupies the majority of the total agricultural land area and is positioned as a strategic crop.

Tomatoes (5,800 ha), watermelons (3,200 ha), and cucumbers (650 ha) are the top three horticultural crops, but their cultivated area is small, and the cultivated area is limited compared to other crops (see Figure 3.1.1). Rice and fodder maize are irrigated at 100% and soybean at around 90%, while only about 40% of the wheat area is irrigated, with the ratio of irrigation varies depending on the crop (see Figure 3.1.2).

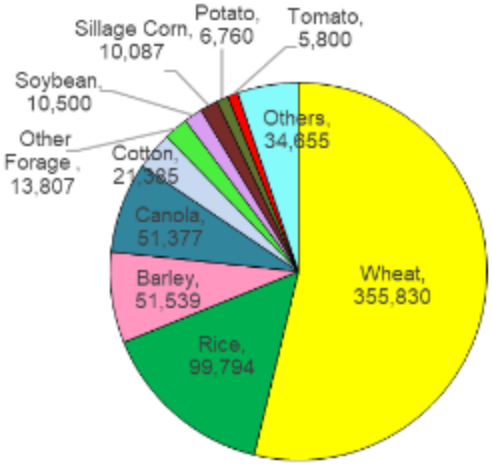


Fig. 3.1.1 Main Cropping Areas in Golestan (ha)
Source: Golestan JAO (2020/2021)

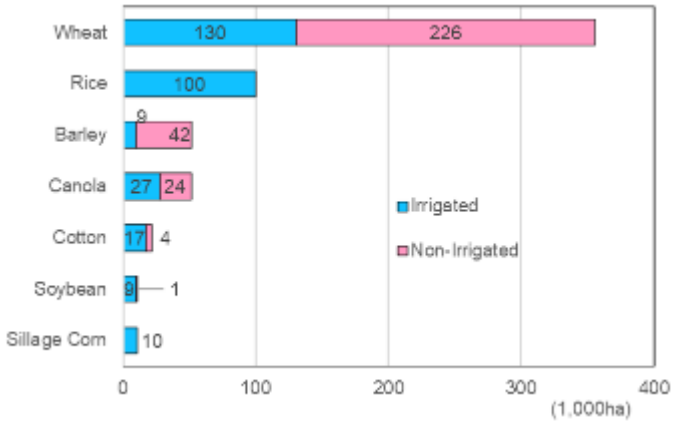


Figure 3.1.2 Irrigated and Non-irrigated Area of Major Crops (Thousand ha)
Source: Golestan JAO (2020/2021)

3.1.2 Fruit Trees and Medicinal Plants

In the Golestan Region, fruit trees and medicinal plants are crops that have attracted particular attention in recent years. In fact, according to agricultural statistics, until 2018, fruit trees occupied about 30,000 hectares (about 5% of the total agricultural land), but in 2019, including medicinal crops, the area under cultivation increased to 39,000 hectares, and development is steadily progressing toward achieving the goals of the 6th Economic, Social and Cultural Development Five-Year Plan, which started in 2017.

The main fruit species grown are olive, peach, orange, plum, walnut, pomegranate, nectarine and pear. The category of medicinal plants was established in 2017 and the area under cultivation has increased rapidly to become the crop with the largest area planted in 2019. Figure 3.1.3 shows the change in area planted between 2015 and 2019 for the six fruit trees with the largest area planted. The area of olives has decreased significantly since 2017, while that of peaches and oranges has increased slightly. The Golestan JAO intends to further promote the cultivation of fruit trees and medicinal plants, with the aim of increasing the area to 60,000 ha.

In addition, while orange and peach orchards are irrigated, medicinal plants are rarely irrigated (see Figure 3.1.4). It is expected that the area under medicinal plants will continue to increase in Golestan, where water scarcity is a challenge for medicinal plants and other crops with relatively low water requirements.

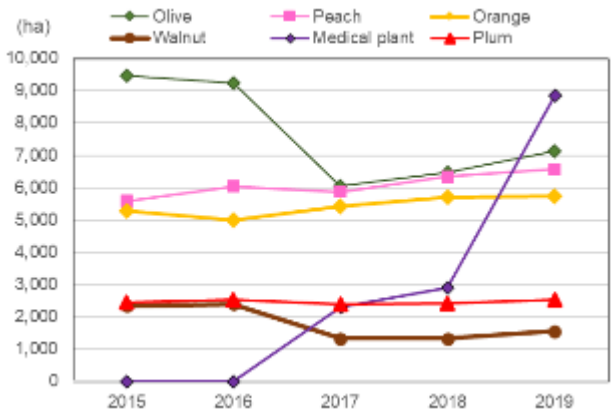


Figure. 3.1.3 Main Fruit-Growing Areas in Golestan (ha)
Source: Golestan JAO

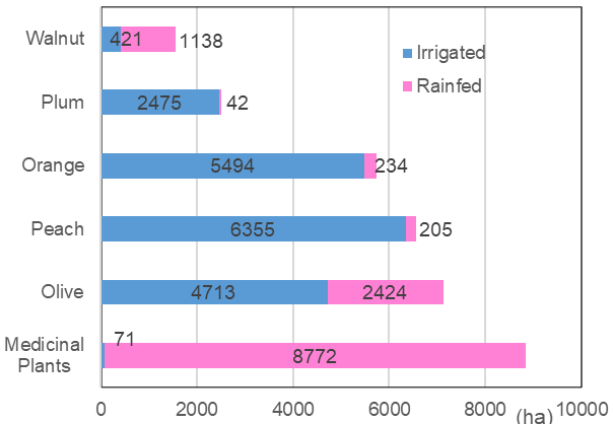


Figure 3.1.4 Irrigated and Non-irrigated Area of Main Fruit Trees (ha)
Source: Golestan JAO (2019 data)

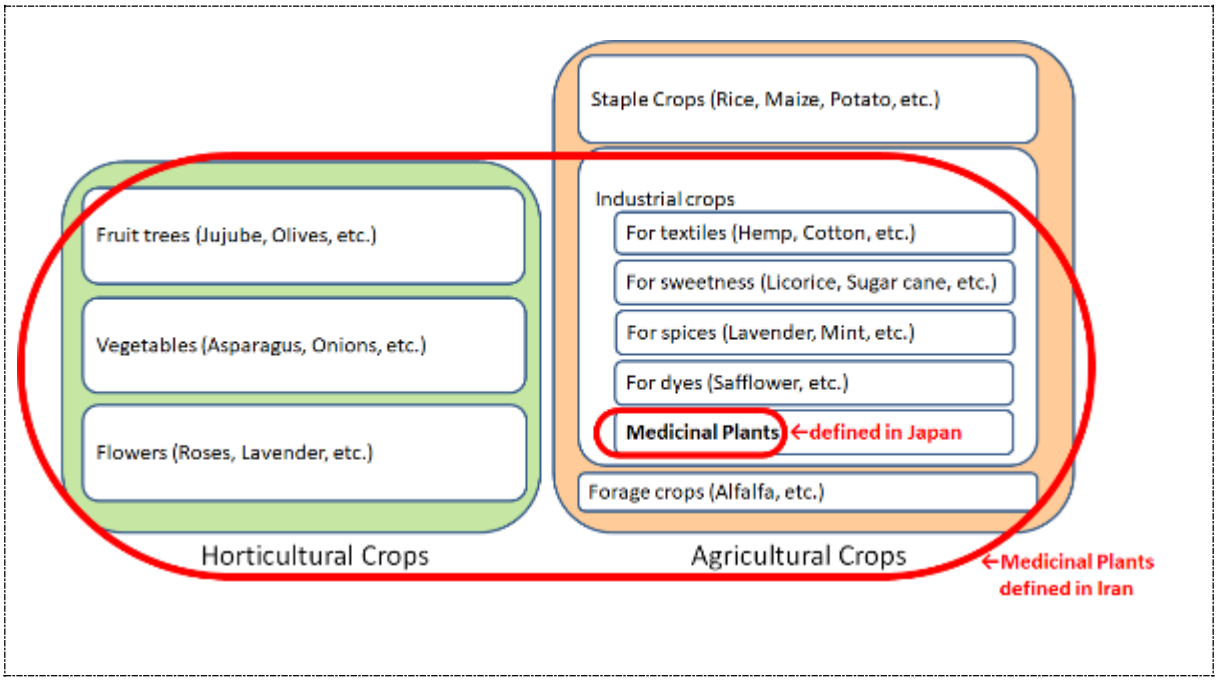
3.1.3 Medicinal Plants

Golestan province has a diverse topography and climatic conditions, and many medicinal plants grow naturally or are cultivated there. A study on the collection and identification of native medicinal plants in Golestan was carried out by the Golestan ANREC ([12]Golestan ANREC), an affiliate of the MOJA, for five years from 2001 in Golestan, and 409 species belonging to 95 genera were identified. Of these, 45 species of medicinal plants are traditionally used in Golestan.

BOX. Definition of medicinal crops in Iran and Japan

Medicinal plants in Iran, citing the definition of "National Documents on Medicinal Plants and Traditional Medicine" approved at the 735th meeting dated April 25, 2013, are defined as "all or part of a plant that promotes, prevents, or treats the health of humans, animals, and other plants, fresh or dried plants, or the active ingredient extracted from it". On the other hand, the definition of medicinal crops shown in the document of the Ministry of Agriculture, Forestry and Fisheries of Japan is "a crop that is mainly used as a raw material for Chinese herbs and has been processed into a shape that makes it easy to use roots, stems, fruits, etc., and is also convenient for storage and transportation". In short, it can be said that it is a "health-friendly" plant in Iran and a "designated as a raw material for Chinese herbs" in Japan, and many of Iran's medicinal plants are recognized as "functional plants" in Japan. Therefore, the medicinal plants handled in this study are not limited to plants that have useful ingredients that can be used as so-called pharmaceutical raw materials, and include horticultural crops such as fruit trees, flowers, and herbs that are recognized to have functionality.

[12] Golestan Agricultural & Natural Resources Research & Education Center



(1) Medicinal plants seen in the Golestan province

The medicinal plants seen by the Golestan province include 83 species of trees and shrubs, 189 species of perennial herbs and 137 species of biennial and annual plants. Classified by habitat (forest, grassland and farmland), 156 species grow in forests, 98 in grassland, and 47 in farmland and road margins, with 108 species common to all three categories. Table 3.1.1, Table 3.1.2 and Table 3.1.3 show five typical medicinal plants growing naturally in each habitat. Plants that grow in forests are suitable for the natural environment of mountains or hills, and there are many plant species that can grow as tall trees or even in relatively low sunlight. It is a plant species that can be expected to have a soil conservation effect.

Table 3.1.1 Medicinal Plants Seen in the Forests of the Golestan Province (Five Typical Species)

No.	*Scientific Name*	English Name	Distribution
1	*Berberis vulgaris L.*	Barberry	Golestan National Park
2	*Juniperus communis L.*	Juniper	Kordkooy, Gorgan, Azadshahr, Golestan National Park
3	*Melissa officinalis L.*	Lemon balm	Gonbad, Golestan National Park
4	*Mentha arvensis L.*	Corn mint	Bandar-e-gaz, Gorgan, Aliabad, Golestan National Park
5	*Salvia sclarea L*	Sage	Golestan National Park

Source: Medicinal plants of Golestan Province, Golestan ANREC

Plants that grow in grasslands are suitable for sunny environments in mountains or hills, and many are shrubs. It contains plants that can grow even under relatively dry and high salt conditions.

Table 3.1.2 Medicinal Plants Seen in the Grasslands of the Golestan Province (Five Typical Species)

No.	*Scientific Name*	English Name	Distribution
1	*Echium amoenum Fisch. ex Mey*	Echium amoenum	Kordkooy, Gorgan, Aliabad, Golestan National Park, Golidagh
2	*Ephedra distachya L.*	Ephedra distachya	Golestan National Park
3	*Ferula gumosa Boiss*	Ferula gumosa	Marave tappeh, Dashte Kaalpoosh
4	*Salicornia europaea L.*	Glasswort	Gomishan, Bandar-e-Turkmen, Aq Qala, Gonbad
5	*Valeriana sisymberifolia Vahl.*	Valerian	Gorgan, Aliabad, Ramian, Golestan National Park

Source: Medicinal plants of Golestan Province, Golestan ANREC

Plants that grow on farmland and road margins include those that are suitable for sunshine conditions and soil / moisture conditions on hills or flatlands.

Table 3.1.3 Medicinal Plants Seen in the Farmland and Road Margins in the Golestan Province (Five Typical Species)

No.	*Scientific Name*	English Name	Distribution
1	*Cannabis sativa L.*	Cannabis	Bandar-e-gaz
2	*Euphorbia chamaesyce L.*	Prostrate spurge	Minudasht
3	*Humulus lupulus L.*	Hops	Bandar-e-Gaz, Gaz, Kordkoy, Gorgan, Aliabad, Galikesh
4	*Papaver Rhoeas L.*	Corn poppy	Gonbad
5	*Salix alba L.*	Willow	Most areas of the province

Source: Medicinal plants of Golestan Province, Golestan ANREC

Table 3.1.4 shows 10 typical medicinal plants that grow naturally in the three growing environments. These plants can be expected to grow relatively in any condition.

Table 3.1.4 Medicinal Plants Commonly Seen in the Above Three Habitats in Golestan Province (Ten Typical Species)

No.	*Scientific Name*	English Name	Distribution
1	*Achillea millefolium L.*	Yarrow	Gorgan, Bandar-e-torkman
2	*Berberis integrima Bge.*	European barberry	Golestan National Park
3	*Capparis spinosa L.*	Capers	Most areas of the province
4	*Ephedra intermedia Schramk et C.A. Mey*	Ephedra	Golestan National Park
5	*Glycyrrhiza glabra L.*	Licorice	Aq Qala, Gorgan, Golestan National Park, Maraveh Tappeh
6	*Olea europaea L.*	Olive	Bandar-e-Gaz, Gorgan, Aliabad, Azadshahr, Maraveh Tappeh
7	*Orchis masculata L.*	Early purple orchid	Gorgan, Golestan National Park
8	*Plantago major L.*	Broadleaf plantain	Aliabad, Golestan National Park
9	*Silybum marianum (L.) Gaertn.*	Marian thistle	Most areas of the province
10	*Ziziphus jujuba Miller*	Jujube	Kordkoy, Gorgan, Kalaleh

Source: Medicinal plants of Golestan Province, Golestan ANREC

(2) Production volume and production area of medicinal plants in Golestan Province

The area of medicinal plants cultivated in Golestan Province in 2020 was 3,762 ha, which is the 14th largest area of medicinal plants cultivated in Iran by province. Black cumin and Echium, which have the highest cultivation area in the country, are produced in most of townships and are the representative medicinal plant species in Golestan Province.

Although cumin ranks fourth in the country in terms of production area, it is cultivated in only two townships, Maraveh Tappeh and Gonbad-e Kavus, and is not a common plant species in the whole province. The yield per unit area (t/ha) in the first three provinces in terms of cultivated area is 0.5-0.6 t/ha, while the yield in Golestan Province is 0.3 t/ha, which is low. Saffron, one of Iran's most popular medicinal plants and an

Figure 3.1.5 Location of Townships in the Golestan Province
Source: Wikipedia

export item, is the eighth most cultivated plant in the country.

Table 3.1.5 Cultivated Area and Production of Medicinal Plants in Golestan in 2020

ID	Rank in Country	Scientific name	English name	Area (ha)	Production (t)	Production (t/ha)
	14		Medicinal plants	3,359.0	2,157.0	
1	1	*Echinacea purpurea (L)*	Purple coneflower	5.0	-	-
2	1	*Nigella Sativa L.*	Black cumin	554.3	346.5	0.63
3	3	*Tagetes L.*	Marigolds	2.0	3.0	1.50
4	3	*Salvia splendens*	Scarlet sage	2.8	13.4	4.80
5	4	*Cuminum cyminum L.*	Cumin	2,100.0	620.0	0.30
6	4	*Echium amoenum Fisch. & C.A.Mey.*	Echium	95.7	21.9	0.23
7	5	*Mentha x piperita L.*	Peppermint	33.8	127.6	3.78
8	7	*Aloysia citrodora*	Lemon verbena	4.2	4.4	1.04
9	8	*Crocus sativus L.*	Saffron	519.0	2.0	0.004
10	9	*Thymus vulgaris L.*	Thyme	12.7	15.6	1.23
11	9	*Matricaria recutita (L.)*	Chamomile	2.5	0.4	0.16
12	9	*Hibiscus sabdariffa L.*	Roselle	3.0	0.1	0.03
13	13	*Salvia rosmarinus Spenn.*	Rosemary	1.2	0.0	0.00
14	14	*Aloe vera(L.) Burm.f.*	Aloe vera	1.57	287	182.80
15	16	*Lavandula angustifolia Mill.*	Lavender	1.7	0.6	0.36
16	18	*Cymbopogon citratus (DC.) Stapf*	Lemon grass	0.6	-	-
17	30	*Rosa × damascena*	Damask rose	15.0	11.0	0.73
			Other	3.9		

Source: Golestan JAO (2020/2021)

(3) Cultivation of the main medicinal plant species by county in the Golestan Province

Table 3.1.6 shows the area under cultivation and production of the main medicinal plants by district in Golestan Province. The area cultivated medicinal plants in Golestan Province in 2020 was 3,762 ha, which is the 14th largest area of medicinal plants in provinces of Iran.

The medicinal plant with the largest area of cultivation is cumin (more than 70% of the total area of cultivation in the oblast), which is cultivated in only three counties in the north-east of the oblast (Maraveh Tappeh, Kalaleh and Gonbad-eKavus). The second largest area of medicinal plants is that of Black cumin, which is cultivated in almost all the counties, with the largest area in Gorgan in the south-west of the province. The third is saffron, with the largest area under cultivation in Azadshahr in the central part of the province.

As can be seen from the distribution of the area under medicinal plant cultivation, the cultivation of medicinal plants in the province of Golestan has a regional character depending on the species. This can be attributed to the diversity of the agricultural production environment (water or land use, climate such as temperature and rainfall, and so on.) in the state of Golestan, and the introduction of medicinal plant cultivation should take into account the production environment characteristics of each plant species.

Table 3.1.6 Cultivated Area and Production of Medicinal Plant by Township in Golestan Province in 2020

No.	TS	Scientific name	English name	Area (ha)		Production (ton)	Area increased in 2020 (ha)
1	Gorgan	*Aloysia citrodora Paláu*	Lemon verbena	281.6	0.35	0.6	0.1
		Nigella sativa L.	Black cumin		238.0	135	238
		Mentha × piperita	Peppermint		10.5	300	6.5
		Echium amoenum Fisch. ex Mey	Echium		2.6	0.3	2.6
		Rosa × damascena	Damask Rose		26.0	30	0
		Crocus sativus	Saffron		2.3	0.0035	0.32
		Hibiscus sabdariffa L.	Roselle		1.5	0	1.5
		Crocus sativus L.	Saffron		0.3	0.0002	0
2	Ramian	*Nigella sativa L.*	Black cumin	67.0	31.2		31.2
		Echium amoenum Fisch. ex Mey	Echium		4.61	6	
		Thymus vulgaris L.	Thyme		4	4	
		Crocus sativus L.	Saffron		20		8.5
		Lavandula spica L.	Lavender		0.1	0.25	
		Echinacea Purpurea L.	Purple coneflower		5		5
		Matricaria recutita (L.)	Chamomile		0.5		0.5
		Dracocephalum L.	Dragonhead		0.6		0.6
		Aloe Vera(L.) Burm.f.	Aloe vera		0.25	50	
		Stevia rebaudiana	Stevia		0.35	0.172	0.35
		Aloysia citrodora	Lemon verbena		0.35	0.283	0.35
3	Aliabad	*Echium amoenum Fisch. & C.A.Mey.*	Echium	174.8	4		
		Lavandula spica L.	Lavender		0.6		
		Mentha x piperita L.	Peppermint		4.6		
		Aloysia citrodora	Lemon verbena		1		
		Thymus vulgaris L.	Thyme		4		
		Salvia officinalis L.	Sage		0.6		
		Nigella Sativa L.	Black cumin		160		
4	Galikesh	*Aloysia citrodora*	Lemon Verbena	23.6	1.5	1.8	0
		Nigella Sativa L.	Black cumin		5.5	3.85	27
		Echium amoenum Fisch. & C.A.Mey.	Echium		10	2.2	0.8
		Calendula officinalis	Calendula officinalis		2	0	0
		Mentha x piperita L.	Peppermint		0.2	0.5	0
		Thymus vulgaris L.	Thyme		0.2	0.16	0
		Hyssopus officinalis L.	Hysop		0.2	0.7	0.0
		Salvia officinalis L.	Sage		0.2	0.24	0.0
		Avena sativa L.	Oats			0	1.5
		Crocus sativus L.	Saffron		3	0.03	5
		Rosa × damascena	Damask Rose		0.8	0.65	0
5	Kordkoy	*Nigella Sativa L.*	Black cumin	96.2	80	80	50
		Mentha x piperita L.	Peppermint		13	390	5
		Echium amoenum Fisch. & C.A.Mey.	Echium		0.2		0.2
		Stevia rebaudiana	Stevia		3		3
6	Bandar-e Gaz	*Nigella Sativa L.*	Black cumin	3.5	3.5	2.31	3.5
7	Gomishan	*Nigella Sativa L.*	Black cumin	1.8	1.8	0.9	1.8
8	Torkaman	*Nigella Sativa L.*	Black cumin	5.8	5.8	2.9	5.8
9	Aq Qala	*Nigella Sativa L.*	Black cumin	10.5	10.5	5.25	10.5
9	Maraveh Tappeh	*Cuminum cyminum L.*	Cumin	935.0	850	297	850
		Crocus sativus L.	Saffron		0.25	0	
		Rosa × damascena	Damask Rose		80	0	
		Thymus vulgaris L.	Thyme		2.5	0	
		Salvia rosmarinus	Rosemary		1.2	0	
		Lavandula spica	Lavender		1.0	0	
10	Minudasht	*Crocus sativus L.*	Saffron	89	80	0.32	19
		Echium amoenum Fisch. & C.A.Mey.	Echium		5	1	0
		Nigella Sativa L.	Black cumin		2	1.4	6.85
		Rosa × damascena	Damask Rose		2	0.1	0
11	Azadshahr	*Crocus sativus L.*	Saffron	483	355	1.82	20
		Echium amoenum Fisch. & C.A.Mey.	Echium		65	32.5	0
		Rosa × damascena	Damask Rose		40	48	2
		Nigella Sativa L.	Black cumin		17	10	12
		Salvia officinalis	Sage		2	3	1
		Mentha x piperita L.	Peppermint		4	160	3
12	Gonbad	*Cuminum cyminum L.*	Cumin	1260.8	1250	625	
		Hibiscus sabdariffa L.	Roselle		1.5	2.2	
		Echium amoenum Fisch. & C.A.Mey.	Echium		4	2	
		Mentha x piperita L.	Peppermint		2	80	
		Thymus vulgaris L.	Thyme		2	6	
		Aloe vera(L.) Burm.f.	Aloe vera		1.3		
13	Kalaleh	*Cuminum cyminum L.*	Cumin	329.5	300	120	
		Nigella Sativa L.	Black cumin		29.5	15	
	Total				3762.0		

Source: Golestan JAO

3.2 Agricultural Extension Systems

3.2.1 Agricultural Extension by Government

In Iran, the Agricultural Research, Education and Extension Organization (AREEO), a MOJA-affiliated organization, is responsible for research, education and extension in the agricultural sector (Figure 2.2.1). AREEO has provincial offices in each province of the country and provides research, education and extension services tailored to the needs of the agricultural sector and MOJA at the provincial level.

In addition, Agricultural Service Centers (ASCs) have been established under the umbrella of the JAO as extension agencies in Golestan. There are 14 counties in Golestan, each with two to five ASCs, for a total of 44 ASCs in the province. According to the Golestan JAO, in December 2021 there were 292 agricultural extension workers in the province. This means that each ASC has an average of six to seven extension workers. The main responsibilities of the ASCs are as follows

- Collection of statistical data
- Examining the challenges and constraints of the agricultural and rural development sector and making recommendations on them
- Monitoring of the project and reporting to the relevant authorities
- Technical guidance (consultation), training and extension services for farmers, guidance on value addition and differentiation of agricultural products
- Farmer participation in demonstration plots and cultivation trials
- Farmers' organization

For example, the Jilin ASC in Gorgan has a total of 11 staff members and covers about 10,000 ha of farmland. The ASC provides the agronomic technical services mentioned above and visits the site once a week to check for pest and disease outbreaks. It also subsidizes wheat, barley, oilseed and cotton seeds and urea fertilizer, assists in obtaining permits for greenhouses and introduces farmers to banks. The Khorramarud ASC in Azad Shahr has seven staff and provides similar services to the Jilin ASC. The Khorramarud ASC has seven staff and provides services similar to those of the Jilin ASC. They are trying to introduce horticultural and medicinal crops but there is difficulty to find out where to sell and develop markets for the crops grown.

There is also a female extension worker who can train men and women together in agricultural techniques. They also provide training based on a development programme for the youth of the villages. In Iran, civil servants such as agricultural extension workers are allowed to participate in commercial activities, and the female staff of the ASC in Ali Abad grow and sell their own lavender, etium, sage (*Salvia officinalis)* and lemon verbena.

3.2.2 Agricultural Extension by Private

In addition to governmental support, there are also services provided by the private sector in Iran. The difference between the two is that the private companies charge a fee for consultation and inputs, while the ASC has statistical data, based on which the private companies sometimes provide subsidized fertilizer distribution support. Private sector services are more costly, but have the advantage of being quicker to respond, so relatively large fruit and livestock producers tend to opt for private sector services.

Both private extension services and ASC have about the same level of technology, but the private sector has a larger budget.

According to the JAO, as of December 2021, seven private agricultural extension companies have been identified in Golestan province, each with around 10 extension staff. For example, there is an extension service provider called Pishgaman Kesht Paidar Company in Gorgan, which has 11 staff members covering 1,000 ha of farmland (300 farmers), providing guidance on crop selection and work planning, introducing buyers to farmers, and producing high quality legume seeds. The farmers and the company communicate through SMS and other applications to introduce and suggest suitable agricultural, horticultural and medicinal crops to the farmers according to soil and weather conditions and government policies.

3.2.3 Support for Nomadic Peoples, Rural Women and Youth

(1) Support for nomadic peoples

The population of nomadic peoples in Golestan is 23,000, of which 19,000 are Kurds and the rest Turkmen. The Kurdish people have a large migratory range, moving from Golestan to Khorasan, while the Turkmen people move within Golestan. They live and move in the eastern part of the province. The Kurdish people stay in Golestan between October and March, during which time they engage in farming. The Iranian government does not have a settlement policy for them, but some of them have settled in the eastern cities of Gombad and Marayubad.

Their main livestock are sheep, camels, and cattle, but sheep are by far the most common. In recent years, the lack of water has made grazing difficult, and non-agricultural land that used to be available for grazing has been converted to agricultural land, reducing the amount of land available for grazing. There have also been cases of livestock dying because they had taken mountain roads to avoid trouble (interview with the Nomadic Peoples Support Office, 2021).

The Nomadic Peoples Support Office under the JAO in Golestan Province provides support to nomadic peoples in the form of assistance to promote livestock production, livelihood support such as training on how to make bread, and technical support for the cultivation of medicinal plants. It also provides small loans at low interest rates. Special emphasis is placed on supporting the cultivation of medicinal plants, and guidance is given on the value chain, covering production, packaging and marketing. At present, nomadic peoples are cultivating medicinal plants. In collaboration with Gombad University, research is underway on medicinal plants with efficacy against livestock diseases. The office is also monitoring the safe movement of the nomads.

(2) Support for rural women

The Golestan JAO has one rural women's livelihood officer to rural women, and one person in charge in each of the 14 cities in the province, all of whom are women. The main activities are: (i) establishment of a credit union exclusively for women; (ii) skills training to improve livelihoods; (iii) loans for women; (iv) training and development of women leaders; (v) training of women facilitators; and (vi) introduction of businesses for rural women. The skills training includes pesticide-free cultivation of crops such as strawberries and cucumbers, cultivation of medicinal crops, marketing, accounting, branding, packing techniques, value chain, business plan development, sericulture, home mushroom cultivation and beekeeping.

(3) Support for youth

In recent years, with the increasing urbanization in Iran, the reduction of agricultural labor in rural areas has become a challenge. In this context, efforts are being made to support young people to take up farming, and AREEO and the Agricultural Training and Extension Organization under the umbrella of MOJA will launch the activities of the "Comprehensive Plan for the Development of Rural and Nomadic Youth Capacity" in March 2021 to promote the formation and establishment of "Rural and Nomadic Youth Associations" in rural areas by ASCs. The same preparatory activities have started in Golestan province.

3.3 Other Governmental Support System

3.3.1 Guaranteed Purchase

Iran has a purchase price guarantee system for agricultural products to promote strategic crops. Farmers who wish to grow price-guaranteed crops can sign a contract with ASC at the time of cultivation planning, and if they go to an intermediary with this contract, they can receive seeds and fertilizer as cultivation aids. Also, geographical features of farmers' fields are registered in ASC, and can usually receive technical guidance by visiting agricultural extension servants several times from planting to harvest. Quality is checked at the time of shipment of agricultural products, and those that do not meet the quality are traded at a price lower than the guaranteed price.

Table 3.3.1 shows the purchase price of the price guarantee crop. The purchase price has been changed every year since the increase in material prices due to inflation in recent years. However, the purchase price is also affected by the government budget, so it is not a satisfactory price for farmers amid soaring agricultural material prices.

Table 3.3.1 Authorized Prices for Strategic Crops (2019-2021)

Crop	Authorized price（Real/kg）(% increase year-on-year)		
	2019(1398)	2020(1399)	2021(1400)
Wheat	22,000	40,000 (182%)	75,000 (188%)
Camelina	—	—	165,000 (—)
Barley	16,300	23,798 (146%)	34,000 (143%)
Rapeseed	46,602	78,000 (167%)	150,000 (192%)
Safflower	40,850	62,438 (153%)	109,576 (175%)
Cotton	48,761	75,000 (154%)	154,638 (206%)
Sunflower	41,565	64,274 (155%)	122,319 (190%)
Maize	17,000	24,650 (145%)	35,250 (143%)

Source: Golestan JAO

Table 3.3.2 shows a comparison between government purchase price and market price. In recent years, market prices have exceeded government purchase prices, and farmers tend to sell their crops in higher markets. The government has responded by adjusting the purchase price, but the price has not stabilized.

Table 3.3.2 Governmental and Market Prices for Strategic Crops

Crop	Governmental prices (rials/kg) (2020-2021)	Market prices (rials/kg) (2020-2021)
Wheat	51,000	Around 55,000
Barley	23,798	Around 50,000
Canola	78,000	97000 to 117000
Rice (Group One)*	82,511	Around 400,000
Rice (Group Two)*	72,438	350,000
Rice (Group Three)*	59,146	300,000
Soybean	66,300	140,000 to 200,000
Cotton	75,000	120,000 to 140,000

* Rice is divided into groups 1, 2 and 3 according to quality. Group 1 has the highest quality.
Source: The government price information of the products is announced by the Ministry of Jihad-e-Agriculture, "world economy" ww.eghtesadonline.com, "newspapers websites" donya-e-eqtesad.com", Iran Statistics Center, JAO

3.3.2 Access to Agricultural Materials

As a subsidized project by the government, access support for farmers' materials is being provided. In Golestan Province, there are three subsidies shown in Table 3.3.3, and farmers can purchase these materials at low cost by subsidizing seeds, fertilizers, and livestock fattening materials (feed). However, regarding seeds, the target crops are limited to strategic crops and forage crops, and currently, medicinal plants that are candidates for conversion crops are not included.

Table 3.3.3 Subsidies for Agricultural Inputs

Service	Description	Source of Budget	Beneficiary	Achievement
Allocated subsidies for agricultural seeds	Producer support Wheat, Barley, Soybean, Canola, Vetches	MOJA – Golestan JAO	Cooperative – Private seed producer Co. - Individual	Number of farmers varies each year
Allocated subsidies for Livestock inputs	Producer support Corn, Bran, Barley, Soybean, Concentrate	MOJA – Golestan JAO	Cooperative - Individual	Poultry producer: 1076 Livestock producer: 508
Allocated subsidies for Fertilizer	Producer support & Increase crop yield Urea, Phosphate, Potash, Ammonium Sulfate, Potassium Chloride, Diammonium Phosphate, Triple Superphosphate, Potassium Sulfate	Agricultural Support Services Co.	Individual	Number of farmers varies each year

Source: Golestan JAO

3.3.3 Access to Finance

Agricultural financial support projects for farmers are under the jurisdiction of MOJA. In Golestan Province, various financing services are provided for various purposes through government-affiliated Agricultural Bank of Iran and private banks (Table 3.3.4). Golestan JAO is responsible for introducing, guiding and managing the use of these financing services to farmers. On the other hand, the scale of these support projects fluctuates greatly from year to year due to the influence of the Iranian government budget, and the current situation is that only limited number of farmers can benefit from it (interview with Golestan JAO).

Table 3.3.4 Financial Support Programs

Service	Description	Source of Budget	Beneficiary	Achievement
Prosperity	Interest rate: 18% Purpose: All Agricultural Production Max. Amount: 10 billion tomans, depending on the proposed plan Repayment: one year	All banks (Public/ Private)	Individual	61 farmers (2020)
Special line of mechanization	Interest rate: 15% Purpose: Agricultural Machinery Max. Amount: 10 billion tomans, depending on the proposed plan Repayment: five years	Iran Agriculture Bank (Public)	Individual	1849 farmers (2020) (1500~2000 every year)
Paragraph A Note 18	Interest rate: 14% Purpose: All Agricultural Production Max. Amount: 10 billion tomans, depending on the proposed plan Repayment: five years	Iran Agriculture Bank (Public)	Individual	78 farmers (2020)
Omid Entrepreneurship Fund	Interest rate: 4% Purpose: All Agricultural Production & Rural women credit fund Max. Amount: 10 billion tomans, depending on the proposed plan Repayment: five years	Omid Entrepreneurship Fund (Private)	Individual	225 farmers (2020)
Sustainable rural employment	Interest rate: 6% Purpose: All Agricultural Production Max. Amount: 10 billion tomans,	Iran Agriculture Bank (Public), Omid	Individual	5 farmers (2020)

Service	Description	Source of Budget	Beneficiary	Achievement
	depending on the proposed plan Repayment: five years	Entrepreneurship Fund (Private)		
Paragraph A of Article 52	Interest rate: 14% Purpose: All Agricultural Production Max. Amount: 10 billion tomans, depending on the proposed plan Repayment: five years	Iran Agriculture Bank (Public)	Individual	46 farmers
Working Capital	Interest rate: 18% Purpose: Working capital for agriculture (food and oil crops) and horticulture production Max. Amount: 10 billion tomans, depending on the proposed plan Repayment: one year	Iran Agriculture Bank (Public)	Individual	4909 farmers

Source: Golestan JAO

3.4 Land Use

3.4.1 Soil

According to the "Soil Map of Iran" of FAO (1961), saline soils and saline marshes are distributed in the Caspian Sea coastal area in the north-western part of Golestan province, and deserts in the north-eastern part near the border of Turkmenistan. These soils are low in nutrients such as nitrogen and phosphorus and water deficient, making the environmental conditions difficult for agriculture. On the other hand, from the central to the southern part of the Golestan there is a widespread mixture of brown soil, brown forest soil and rocky debris soil-brown soil-rangeena[13] Brown soils and brown forest soils are relatively high in nutrients, but the southern part of the region is dominated by slopes. This means that farming in the northern part of Golestan is difficult because of the soil conditions, while agricultural production in the south is limited by the slopes. On the other hand, the plains of the central part of the province are more suitable for agriculture.

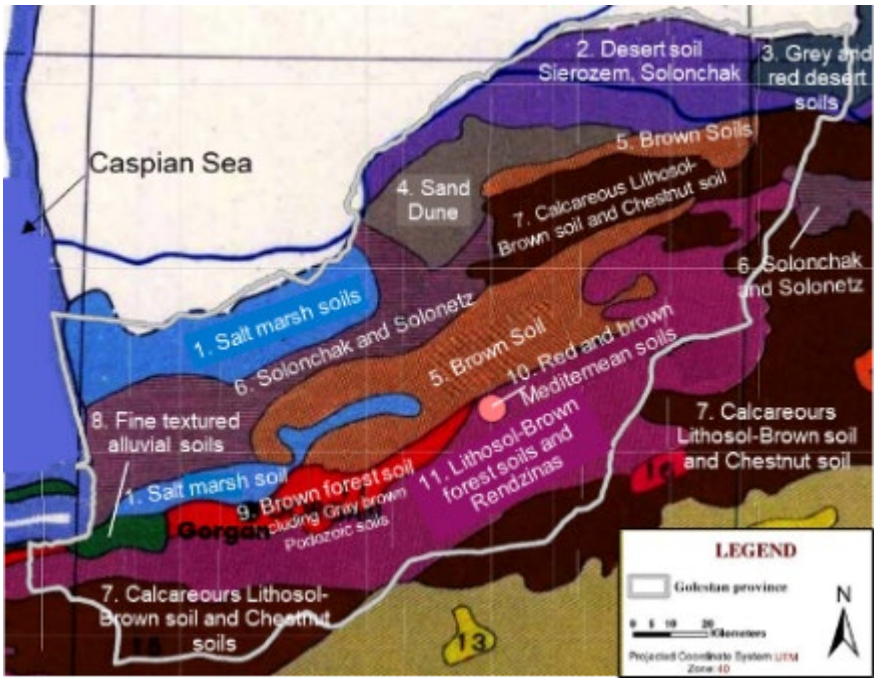


Figure 3.4.1 Soils of the Golestan Province

Note: The above figure is from the FAO's Soil Map of Iran (1961), Source: JICA study team (2021)

[9] Soils of limestone and peatstone parent material with high fertility, distributed on slopes and used for pasture.

The following is an overview of the different soils distributed in the Golestan Province.

1. Salt-Marsh Soils: These are marshy all year round and contain saline soils. Vegetation is sedge and reed, but rice production is possible in some areas.

2. Desert Soils - Sierozem- Solonchak (semi-desert soils - Solonchak): includes both desert and saline soils. Subsistence agriculture is possible where irrigation water of adequate quality is available, but often there is no vegetation or only a few salt-tolerant plants.

3. Grey and Red Desert Soils: These soils have a thin, compacted crust on the surface and are also referred to as desert pavements. The soils are very poor in humus, containing only about 0.1-0.2% in the surface layer. The soil is entirely calcareous and alkaline. There is often an accumulation of soluble salts in the soil.

4. Sand Dune: Sand dune soils are common in the arid regions of Iran and consist of loose sand deposits that occur in deserts and coastal margins, which are composed of coarse sand. The vegetation consists of shrubs and short grasses. It is sometimes used as pasture but is not productive.

5. Brown Soils: these are the most widespread in Iran and occur in semi-arid climates with little or no rainfall in summer. In terms of organic matter content, they lie between chestnut and semi-desert soils. It is often used as grassland, although it is also used as agricultural land. The surface layer contains an average of 2-3% organic matter.

6. Solonchak and Solonetz: Solonchak is a saline soil and Solonetz an alkaline saline soil. Due to the excessive accumulation of salt, only salt-tolerant plants can grow there. Solonchak contains large amounts of soluble salts and little organic matter. Solonetz is highly alkaline (pH>8.5) with low permeability, and therefore its productivity is low.

7. Calcareous Lithosols-Brown Soils and Chestnut Soils: These soils are developed on hillsides where brown and chestnut soils occur. On slopes there is little development of soil structure as the surface layer is removed by erosion. Steeply sloping areas are not suitable for cultivation, but gently sloping areas can be cultivated.

8. Fine-textured Alluvial Soils: essentially free of salts, but with a slight patchy distribution of saline soils. They contain small to moderate amounts of organic matter and little available phosphate. The soils are suitable for irrigated agriculture and can be used to grow cotton, sugar beet, vegetable crops, fruit trees and sometimes wheat and other cereals.

9. Brown Forest Soils: these are soils with a mixed organic and mineral forest humus layer and without clay or aluminum oxide deposits. The vegetation is dominated by deciduous forest (mainly beech, oak and oak) with some scattered coniferous trees. The sloping terrain makes it difficult to grow crops other than fruit trees.

10. Red and Brown Mediterranean Soils: These soils are found in the transition zone from forest to grassland and are dominated by oak woodland. Even under forest vegetation, the surface organic matter is low, around 1.5%. Wheat is grown on the slopes, and citrus and other horticultural crops where irrigation is available.

11. Lithosols-Brown Forest Soils and Rendzinas: These are found on steep slopes, with a thin soil layer and in some places exposed rocks due to soil erosion. The vegetation is dominated by deciduous trees

such as beech, fir and elm, but there are also areas of bare ground due to excessive logging. Under proper management, fruit trees and crops can be produced, but inappropriate use of agricultural land can lead to environmental damage.

Thus, even within the Golestan province, land use, vegetation and cultivable crops vary greatly according to topography, soil and climatic conditions.

Desert areas around the border of Turkmenistan

Southeastern hills of golestan. The colour of the soil suggests a high organic matter content.

3.4.2 Land Use

The total area of the Golestan Region is about 20,000 km^2. The total area of agricultural land, including mixed pasture and agricultural land, is about 7,600 km^2 and accounts for 38% of the total area, which is further divided into rain-fed and irrigated agricultural areas. Forest and pasture areas are about 450,000 ha and 860,000 ha account for 22% and 43% of the total area, respectively, and are further divided into three categories based on their vegetation density: High, Medium and Low. (See Table 3.4.1). In addition, salt soil is widely distributed around the border with Turkmenistan for about 100,000 ha (5% of the total), making it extremely difficult to cultivate crops in this area. The land use map of Golestan Province is shown in Figure 3.4.2.

Table 3.4.1 Land Use in the Golestan Province

Land Use		Area (ha)	Rate
Farm	Dry farming	342,675	17%
	Irrigation farm (no water restrictions)	253,484	13%
	Irrigation farm (with water restrictions)	25,959	1%
	Garden & Farm	13	0%
	Range & Farm	135,702	7%
	Sub-total	**757,833**	**38%**
Forest	High forest	55,316	3%
	Medium forest	153,816	8%
	Low forest	242,573	12%
	Sub-total	**451,705**	**22%**
Rangeland	Low rangeland	90,658	5%
	Medium rangeland	333,039	17%
	High rangeland	439,128	22%
	Sub-total	**862,825**	**43%**
Salt land area		103,788	5%
Others		79,864	4%
Total		**2,011,846**	**100%**

Source: Golestan Agricultural Research Center, 2013

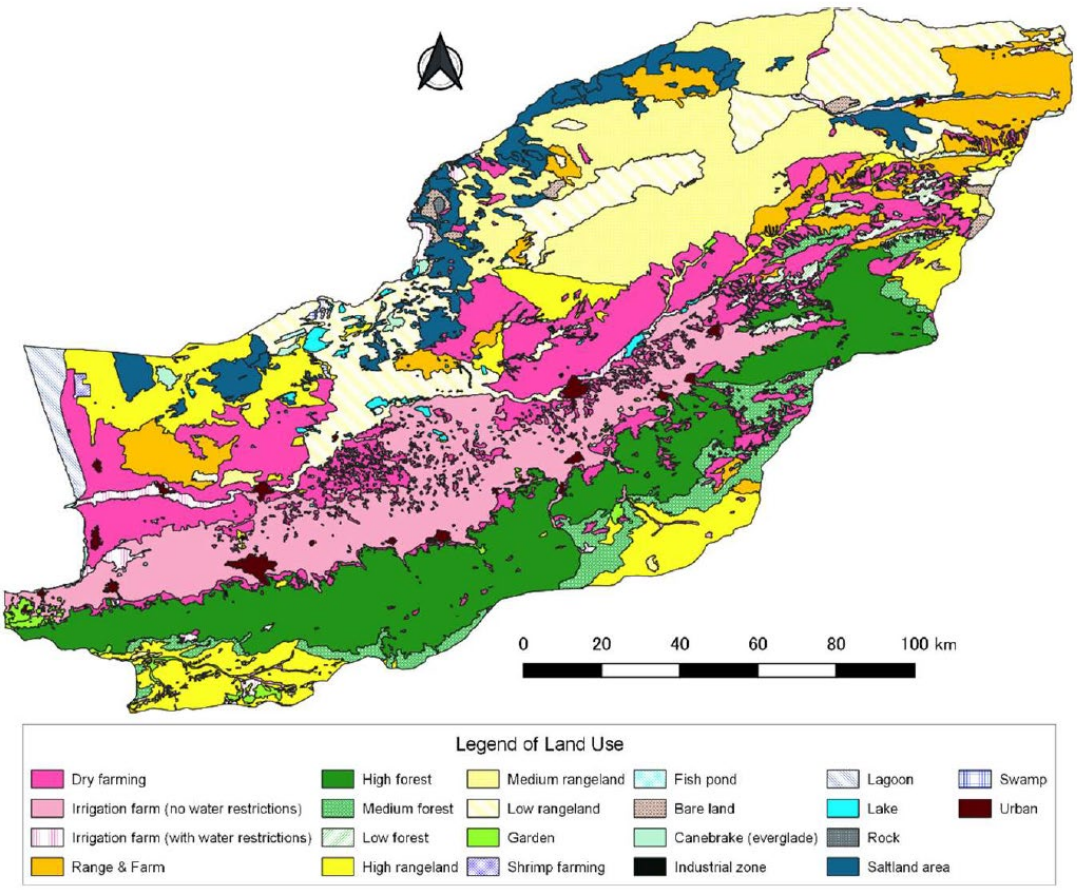


Figure 3.4.2 Land Use Map of Golestan Province
Source: Compiled by JICA study team based on data from Golestan Agricultural Research Center

The northern part of Golestan is mainly used for grazing land, and water shortage and salt accumulation are problem. In the northern part of the river, rain-fed agriculture is practiced, mainly wheat and barley. In the south of the river, irrigated agriculture is practiced. To the south, the slopes are covered with forests, while the mountainous areas in the southern part of the province are used for grazing. In short, land use in Golestan is strongly influenced by topographical conditions, soil conditions and the amount of water resources available.

Wheat fields on the plains of south-west Golestan

Deciduous forests along the rivers of southern Golestan

3.4.3 Changes in Land Use

As in all over the Iran, urbanization is taking place in Golestan province. As a result of this

urbanization, land use has also changed significantly (Table 3.4.2): according to the 2020 research report[10], in 1984 forests covered 31.5% of Golestan's area, but by 2018 they had decreased by 100,000 hectares (-16%) to 26.5% of the province's area. On the other hand, the area of urban areas, such as housing, has almost quadrupled, although in a smaller proportion, and the area of agricultural land has increased by 80,000 hectares (+14%). The share of agricultural land in the province's total land area has increased from 29.9% in 1984 to 33.9% in 2018, overtaking the share of forests and grasslands, making agricultural land the largest land use category. This change in land use shows that the urbanization of the Golestan province has led to an increase in the area of urban housing, a decrease in the area of forests and an expansion of agricultural land, a trend that is expected to continue.

Table 3.4.2 Changes in Land Use in the Golestan Province

Land Use	1984		2018		Change	
	Area (ha)	Rate	Area (ha)	Rate	Area (ha)	Rate
Urban	5,543	0.3	23,770	1.2	18,227	**329**
Forest	639,419	**31.5**	538,251	**26.5**	-101,168	**-16**
Rangeland	654,666	32.2	670,162	33.0	15,496	2
Farming	606,647	**29.9**	688,787	**33.9**	82,140	**14**
Water area	24,937	1.2	34,486	1.7	9,549	38
Barren lands	93,165	4.6	41,102	2.0	-52,063	-56
Total	2,030,287	100	2,030,287	100	-	-

Source: JICA study team using data from the Journal of Research on Protection and Conservation of Forests and Rangelands of Iran - Volume 19- (2020) to calculate changes over time.

3.4.4 Current Status and Challenges of Farming at Hilly Area

Hills are gently sloping areas located between mountains and plains. In these hilly areas, agriculture is mainly carried out with rainwater. In some cases, rainwater or surface water is stored in small reservoirs and drip irrigation is used. Wheat is often grown on hilly terrain because of the difficulty of irrigating sloping land due to water resources and topographical conditions. In Iran, the productivity of wheat in rainfed areas is only 40-50% of that in irrigated areas, and hilly farming is stabilized by a combination of pastoralism and irrigated agriculture[11].

However, when grazing areas and farmland are adjacent to each other, livestock can invade farmland and cause damage to crops. In addition, when using agricultural machinery on sloping land, the tractor must pass at right angles to the contour line to prevent the machine from overturning, which can also cause soil erosion.

Sheep in the mountainous area of Fazelabad (Southern part of the province). The area is surrounded by wheat fields and fenced.

Tillage by tractor (Mohamad Abad). Erosion can occur along the ridges during rainfall.

[10] Scientific Journal of Research on Protection and Conservation of Forest

[11] Goto (1998), "Socio-economic characteristics of semi-arid land agriculture", Journal of Commerce and Economics 23-4 (Kanagawa University Economic Association)

According to the Farm household survey (JICA study team, 2021), it responds that soil erosion has occurred in all mountainous, hilly, and plain areas, and its proportion is higher in mountainous areas. However, it should be noted that heavy rain erosion occurs even on plain area. Causes of erosion include heavy rain, steep slopes, eroded soil, and few trees. On the other hand, farmers are implementing measures such as tree planting, contour cultivation, terrace construction, etc., but the ratio of implementing measures is less than 10% of the respondents even in mountainous areas, seems that the situation is technically difficult to put into practice.

Department of Natural Resources and Watershed Management in Golestan Province has also pointed out soil erosion as an issue, such as afforestation projects on slopes (consigned to a contractor), distribution of tree seeds and seedlings to residents, promotion of tree planting, fences for livestock prevention, installation and construction of check dams are being carried out. As for the management after planting, the contractor is in charge of monitoring and management for three years until the tree grows. In order to prevent feeding damage by livestock, the Department decides the tree species, such as planting coniferous trees (mainly cedar) that do not allow livestock to enter, but recently there are cases where pear trees are planted in response to the wishes of farmers. In addition, engineering measures such as terrace work are being implemented at about 200 locations, and the work is outsourced to a contractor. Although cooperation between government agencies and farmers is permitted to some extent for soil conservation, it is considered necessary to further strengthen it in the future.

In recent years, there has been a shift to more profitable crops than wheat for the reasons mentioned above, and from the point of view of soil conservation, the Golestan JAO recommends a shift to fruit trees with a large root zone and medicinal plants with a large area of land cover, in order to satisfy both soil conservation and improvement of farmers' livelihoods with limited water resources. The following photos show olive planting using the micro-catchment method and an olive planted on a slope, both of which are being undertaken in the province of Golestan.

Olive planting with Micro-catchments in Maravesh Tapeh (North-eastern part of the State), (2021)

Olive in Minu Dasht (Southern part of the State) (2018/2019)

(All photos provided by Golestan JAO)

CHAPTER 4: CONVERSION CROPS IN THE GOLESTAN PROVINCE

4.1 Characteristics of Crops Expected as Conversion Crops

4.1.1 Effect of Water and Soil Conservation

The hills of Golestan Province were once covered with broad-leaved forests such as *Carpinusbetulus*. However, the Province's forest coverage has declined from about 640,000 hectares to 540,000 hectares over the last three decades (Figure 3.4.2). Currently, most of them are cultivated as agricultural land. It has been reported that soil erosion due to rainfall is more likely to occur in the cultivation of single-year crops such as wheat because the tillage period and the rainy season overlap, and the risk of soil erosion is particularly high on slopes such as hills[12]. In addition, the March 2019 floods have severely damaged Golestan Province and increased the need for water and soil conservation. Therefore, it is recommended to switch to perennial or permanent crops that have soil conservation effects on slopes.

There are thousands of medicinal plants that grow in Iran, and many of them are perennial or parmanent plants, so they are expected to be candidates for conversion crops on slopes. Taking sage (*Salvia lavandulifolia* L.), rosemary (*Rosmarinus officinalis* L.), thyme (*Thymus baeticus* L.) as examples. It has a morphological feature in which the roots are spread widely in the soil to hold the soil strongly, and the fine leaves and stems forms a carpet on the surface soil. Cultivation tests have revealed the effect of suppressing soil erosion by cultivating these along the contour lines of the slope[13]. Cultivation tests have shown that contour lone plots of thyme, rosemary and sage have 95, 94, and 77% reduction in soil erosion, respectively, compared to conventional tillage plots. Furthermore, since these medicinal plants are expected to be profitable to farmers (see the next section 4.1.2), they have an advantageous feature of being able to achieve both a water-soil conservation effect and profitability of farmers.

Rosemary that is effective for soil conservation. Roots can be widened even on slopes (Golestan Province)

On the other hand, in the plains, there is concern about the expansion of areas where it is difficult to cultivate wheat and barley, which have relatively low salt tolerance, due to the progress of soil salt accumulation. In Aq Qala, which was visited by the JICA study team, it is reported that the alkalinity is a little high in rainwater fields, or salt accumulation is becoming more serious, and cumin is cultivated in fields where it is difficult to cultivate wheat due to salt damage. Furthermore, since cumin has a problem with mold disease (*Alternaria*), which tends to occur during high temperature and drying, it might be necessary to introduce other potential crops with high salt tolerance and high marketability. Crop with high salt tolerance includes crops such as quinoa[14] and licorice[15], and some farmers have actual cultivation experience in the field, so these crops are considered to be promising as conversion crops in salt affected fields.

[12] S. Ayoubi et.al., Assessing Impacts of Land Use Change on Soil Quality Indicators in a Loessial Soil in Golestan Province, Iran (2011)
[13] Víctor Hugo Durán Zuazo et.al., (2008)Environmental and Agronomic Benefits of Aromatic and Medicinal Plant Strips for Rainfed Almond Orchards in Semiarid Slopes (SE, Spain) :The Open Agriculture Journal, 2008, 2, 15-21
[14] Fatemeh Razzaghi, et. al., The salt tolerance of quinoa measured under field conditions（2011）
[15] Khabibjon Kushiev, et. al., The role of licorice for remediation of saline soils（2021）

4.1.2 High Profitability

When considering the possibility of spreading to farmers when introducing converted crops, it is important to keep in mind the profitability of farmers. Farmers will, of course, select highly profitable crops by comparing their profitability with the crops they are currently cultivating. Table 4.1.1 shows the results of a survey of profitability comparisons of food crops, horticultural crops and medicinal plants conducted in Razavi Khorasan Province, which is located in the east of Golestan. Horticultural crops and medicinal plants are more profitable than food crops such as wheat and barley. In addition, although the profit of horticultural crops is high, the Cost-benefit (B / C) value is lower than that of medicinal plants. This shows that the income is high, but the cost is also high. It is generally known that labor costs account for a high proportion of the total expenditure for growing these fruit and vegetables, and the management of these crops is vulnerable to labor shortages and rising wages[16]. In Golestan Province, it is reported that the ratio of labor costs to agricultural costs is large, and it is a burden on their farming business[17], so it is conceivable that the introduction of medicinal plants with low cost and high profitability is highly acceptable to farmers.

Table 4.1.1 Comparison of Income and Expenditure of Medicinal Plant Cultivation in Razavi Khorasan Province

(Ten Rials/ha)

	English name	Gross income	Net income (B)	Production cost (C)	Cost-benefit (B/C)
Major crop	Wheat (irrigated)	1,350,623	379,657	970,955	0.4
	Barley (irrigated)	1,247,668	327,511	920,157	0.4
	Barley (rainfed)	104,361	45,169	59,192	0.8
	Wheat (rainfed)	127,379	16,075	111,304	0.1
Medicinal plant	Echium amoenum	51,367,593	44,810,174	6,557,419	6.8
	Anethum graveolens	34,320,000	28,547,996	5,772,004	4.9
	Summer savoury	8,037,143	6,655,429	1,381,714	4.8
	Descurainia sophiya	6,821,296	6,077,861	743,735	8.2
	Cuminum cyminum	5,824,000	4,682,000	1,142,000	4.1
	Glycyrrhiza glabra	5,148,182	4,204,523	943,659	4.5
Vegetable, etc.	Potato	12,679,220	8,890,458	3,788,762	2.3
	Tomato	6,093,912	3,170,145	2,922,704	1.1
	Corn	2,592,963	1,287,151	1,305,812	1.0
	Onion	4,515,076	1,288,986	3,226,090	0.4
	Cucumber	3,335,401	284,816	3,050,585	0.1

Source: Cost Analysis-Advantages of Medicinal Plant Cultivation-Case of Khorasan Razavi Province[18]

Many Golestan farmers grow wheat and barley, which are covered by the government's guaranteed purchase. The main reason for cultivating these crops is that the government subsidizes seeds and fertilizers, and that a certain amount of profit can be expected from the past farming experience under normal weather conditions. However, in addition to the harsh production environment due to climate change in recent years, the rise in product sales prices has

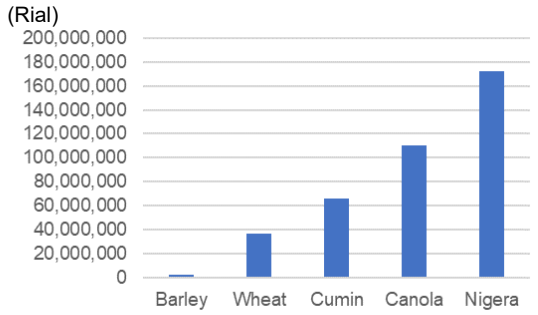


Figure 4.1.1 Comparison of Profitability of Food Crops and Medicinal Plants (2021)
Source: Golestan JAO

[16] Economic Research Service, U.S. D.A, Labor costs on specialty crop farms accounted for 3 times as much of their total cash expenses as the average for all U.S. farms(2018) USDA ERS - Chart Detail
[17] Majid Rostami, Hoda Mohammadi, An Assessment of the Sustainability of Agricultural Systems in Golestan Province Iran (2018)
[18] Seyyed Ahmad Mohaddes Hosseini, Ahmad Sadeghi, Cost Analysis-Advantages of Medicinal Plant Cultivation-Case of Khorasan Razavi Province (2017)

not caught up with the soaring input material costs and labor wages due to the high inflation rate, and profits are declining (Farm household survey, JICA study team, 2021). Under such situation, the introduction of medicinal plants as a highly profitable conversion crop is being considered. A recent study by Golestan JAO also found that cumin and nigella, which are medicinal plants and are often used as spices, are more profitable than wheat and barley, which are the main food crops (Figure 4.1.1).

4.2 Current Status of the Value Chain

Regarding medicinal plants that are being considered for introduction as conversion crops, the current status and issues of the value chain, including cultivation, processing, distribution and sales in Golestan Province, and export to outside Iran, will be described in this section. Furthermore, regarding agritourism, which has been attracting attention in Iran in recent years, the efforts in Golestan Province will be mentioned.

4.2.1 Cultivation

Various medicinal plants are cultivated in Golestan Province, but the plant species that can be cultivated vary depending on the production environment such as altitude, climate and topographical conditions. Farmers are highly interested in the cultivation of medicinal plants, and damask roses and *Nigella sativa* are cultivated in a relatively large area. Some farmers also have experience in growing lemon balm and mint on a small scale, and there are services such as consultation meetings by ASC on cultivation management and distribution of free seedlings, thus farmers are technically capable of cultivating a variety of medicinal plants.

Harvesting of the Damask Rose (Hand-picking of the Petals)

According to interviews with farmers who grow damask roses in mountainous and hilly areas, it is necessary to use a tractor to excavate the planting holes when planting damask roses, but most of the other cultivation management work is done manually. Labor shortages in May and June, when Damask roses are harvested, and the aging and declining population of rural areas are major limiting factors for the spread and introduction of various medicinal plants as well as Damask roses. In addition to water shortages in the summer, wind damage and feeding damage by grazing livestock are also issues in cultivation in the area.

Furthermore, although farmers currently ship their products directly to processing factories and sell them to collectors, some farmers are willing to introduce small-scale processing facilities to improve profits with the aim of further improving profits.

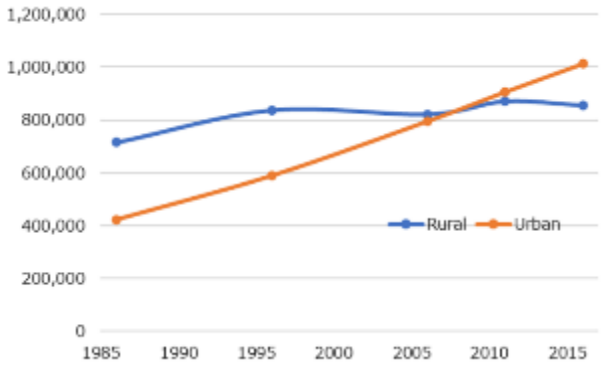
Sage Harvesting (Hand-picking of Leaves)

In the plains of Golestan Province, the

cultivation of cumin, which requires less water than wheat and is relatively salt-tolerant, is being introduced in fields where irrigation is not available. Labor shortages have become an issue in this region as well, and although the combine harvesters used for wheat have been used as substitutes, there is a large amount of harvest loss, and there is a strong need for mechanization for harvests that require labor. In addition, due to the effects of climate change, soil salt accumulation is progressing due to a decrease in rainfall, and farmers are calling for the introduction of varieties with even higher salt and drought resistance.

BOX. Population outflow from rural areas to urban areas

In Iran, with the progress of urbanization, population outflow from rural areas to urban areas is occurring on a nationwide scale. The same is true in Golestan Province, where the rural population was larger than the urban population until the 1990s, but in 2006 it was about the same, after which the urban population overtook the rural population, and the gap is widening. As a result, the labor force in rural areas is declining. The government intends to actively provide subsidies and support for youth to start farming, and to promote mechanization to save labor in agricultural work.



Population trends in urban and rural areas of Golestan Province
Source: Statistics Center of Iran - Detailed Results of the General Population and Housing Census of 2016.
Golestan Province Management and Planning Organization - Deputy of Statistics and Information.

4.2.2 Processing

The processing of medicinal plants (from secondary processing onwards) is often carried out in clusters in processing facilities. For this reason, processing facilities are located close to cities with good transport links. In the Golestan province, it is common for farmers to bring in their product directly or for collectors to bring it in, and there is little contract farming with farmers. In other cases, farmers collect their own raw materials from nature.

Table 4.2.1 shows the medicinal plant processing facilities in the Golestan province and the contents of their processing. Steam distillation of dried material is the most common processing method, which is carried out not only in large processing plants but also in traditional small-scale processing plants. Some factories have not only distillation facilities but also dryers, as petal plants such as damask rose deteriorate quickly after harvesting and drying is important to maintain their quality. On the other hand, the production of essential oils using the more technically advanced solvent extraction methods is less common. There are also limited examples of processing for the pharmaceutical industry. Some of the larger processing plants produce not only essential oils but also syrups and soft drinks.

Interviews with processors located in Golestan Province have given a positive opinion that they would like to expand the scale of production due to the recent growing needs for medicines and dietary supplements using medicinal plants in Iran and overseas. In fact, the products are exported not only

domestically but also to Iraq, Oman, Uzbekistan and so on. However, there is a problem in procuring raw materials, and when purchasing from local farmers, defective products are mixed in and price troubles occur. Therefore, instead of purchasing from farmers in Golestan Province, they purchase raw materials from advanced production areas with stable quality. In other words, at present, the raw materials cultivated and produced by farmers in Golestan Province do not meet the standards that can be treated as pharmaceutical raw materials and have not reached the sellers who need them. In the future, when introducing medicinal plants as conversion crops, it is necessary to build a production and shipping system for raw materials of particularly stable quantity and quality (active ingredient amount) so as to meet the needs of processors.

Table 4.2.1 Medicinal Plant Processing Facilities in the Golestan Province and Their Status of Processing

No	City name	service center	Traditional	Industrial / Semi-Industrial	Amount (wet weight / dry weight) tons	Processing								Place of obtaining a license
						dry (乾燥)	packing (梱包)	Distillation (蒸留)	Essence (抽出)	Lubrication (滑油)	Herbal Tea	Traditional medicine (including ointment, poultice, etc.)	An industrial medicine of plant origin (製薬原料)	
1	Aliabad	Kamalan		*	10	*								
2	Aq-Qala	Environs		*	500								*	Industry and Mining Organization
3	Azadshahr	Farsian		*	25 tons wet-5 tons dry	*	*	*						Agricultural Jihad Organization
4	Azadshahr	Khormarood		*	15 tons wet - 2.2 tons dry	*								Unlicensed
5	Azadshahr	Khormarood		*	50					*				
6	Galikesh	Yanghagh	*		75			*						Unlicensed
7	Galikesh	Golestan Village	*		30	*								Unlicensed
8	Gonbad-e-Kavoos	Atrak	*		20	*		*						Unlicensed
9	Gonbad-e-Kavoos	Atrak		*	20	*	*				*			Agricultural Jihad Organization
10	Gorgan	Jelin		*	500								*	Agricultural Jihad Organization
11	Gorgan	Varsan Village		*	70						*			Agricultural Jihad Organization
12	Gorgan	environs	*		200	*								
13	Gorgan	Nodeh Malek	*		7	*								
14	Gorgan	Nodeh Malek		*	20			*						Industry and Mining Organization
15	Gorgan	environs	*		40	*								
16	Kordkooy	Chaharkooh		*	500	*		*	*					Agricultural conversion industries
17	Kordkooy	Gorji mahalle		*	200		*	*						
18	Minudasht	Qal'e Qafeh	*		25			*						Unlicensed
19	Minudasht	Dozein	*		50	*								in progress
20	Ramian	Qal'e Miran	*	*	50	*	*	*			*			Gorgan Agricultural Jihad

Source: JICA study team

4.2.3 Distribution (Marketing)

Medicinal plants are not usually sold in the fresh food market where vegetables are sold but are generally sold to specialists or to intermediate wholesalers connected to them. Medicinal plants are

traded at a higher price than wheat, barley, rapeseed, etc., and farmers will trade directly with their customers. There are traditional private pharmacies specializing in medicinal plants everywhere in Iran, and it can be seen that the use of medicinal plants is widespread. In fact, there are about 30 stores in Gorgan city. In addition to selling health supplements such as syrups and tablets commercialized by processors, these traditional pharmacies sell medicinal plants purchased directly from local farmers by sorting, drying and adjusting them on their own. Table 4.2.2 shows the medicinal plants purchased from local farmers interviewed at traditional pharmacies in Gorgan. Although the purchase amount as one store is smaller than that of the processor, the items handled are wide and it is the most common exit of the medicinal plant value chain. As mentioned above, at present, traditional private pharmacies are sorting, drying and adjusting on their own, and it is considered that there is room for farmers to add value through primary processing.

Medicinal plants displayed in traditional pharmacies

Table 4.2.2 Medicinal Plants and Their Efficacy Purchased from Farmers by Traditional Pharmacies in Gorgan

#	English Name	Efficacy
1	Maidenhair fern	Treatment of coughs, throat afflictions, and bronchitis.
2	Alcea	Loss of appetite, diuretic and febrifuge.
3	Camelthorn	Diaphoretic, diuretic, expectorant, and laxative. The treatment of rheumatism.
4	Lemon Beebrush	Calming effect, reduce gut spasms, aid digestion and to treat diarrhea and flatulence.
5	Pot marigold	Skin problems, Bites and stings, sprains, wounds, sore eyes, varicose veins.
6	Common chicory	stomachache, gallstones, as a mild laxative and as a general tonic for the liver
7	Orange blossom	The dried peel is used in the treatment of anorexia, colds, coughs.
8	Saffron	Carminative, diaphoretic, emmenagogue, expectorant, sedative, and stimulant.
9	Cumin	Minor digestive complaints, chest conditions, and coughs, and treat rotten teeth.
10	Echium	Antitussive, aphrodisiac, demulcent, diaphoretic, vulnerary, Fevers, headaches, chest conditions etc.
11	Eucalyptus	Antiseptic, Relieving coughs and colds, sore throats, and other infections.
12	Fumaria officinalis	Visceral obstructions, particularly those of the liver, and in eruptive diseases of the skin(eczema) .
13	Persian hogweed	Convulsions, inflammation, and fungal diseases.
14	Lavender	Digestive disturbance, headache of the nervous origin
15	Peppermint	Anodyne, antiseptic, carminative, diaphoretic, refrigerant, stomachic, tonic, and vasodilator.
16	Pennyroyal	Antiseptic, anti-spasmodic, diaphoretic, emmenagogue, sedative, and stimulant.
17	Mint	Fevers, headaches, digestive disorders, Antiemetic, antispasmodic, carminative, diuretic.
18	Black cumin	The digestive system, soothing stomach pains and spasms
19	Salep	Irritations of the gastro-intestinal canal.
20	Wild rue	Digestive, diuretic, hallucinogenic, narcotic, and uterine stimulant.
21	Bladder cherry	Infections, cystitis and other urinary tract inflammations (urethritis, Pyelonephritis) .
22	Damask rose	Aperient, astringent, cardiac, and tonic.
23	Rosemary	Nervous tension, low mood and headache.
24	Silybum marianum	Treatment of liver and gall bladder diseases, jaundice, cirrhosis, hepatitis and poisoning.
25	Thyme	Alleviate symptoms of bronchitis, catarrhs and respiratory infections.
26	Tribulus terrestris	Anthelmintic, aphrodisiac, astringent, carminative, demulcent, diuretic, emmenagogue, and tonic.
27	Urtica	Anemia, excessive menstruation, hemorrhoids, arthritis, rheumatism, and skin complaints, especially eczema.
28	Viola	Anti-inflammatory, diaphoretic, diuretic, emollient, expectorant, and laxative.
29	Jujube	Antidote, diuretic, emollient, and expectorant.
30	Truffle	Lowering cholesterol.

Source: JICA study team compiled based on information from Zargari, 2014; Mozaffarian, 2011; pfaf.org; Hayat, 2013, Monique Simmonds,et.al. MEDICINAL PLANTS Kew Royal Botanic Gurden(2016) , PLANTS FOR YOUR FOOD FOREST https://pfaf.org/user/Default.aspx

4.2.4 Export

(1) Export items

Looking at the export of medicinal plants in Iran, it is characteristic that exports as raw materials for pharmaceuticals are limited, with many as fragrance raw materials such as damask rose and nastran, coloring agents such as saffron and safflower, and spices such as cinnamon and cumin. As for export items, the export value of saffron is outstanding, accounting for more than 40% of the total export value as of 2020. This is followed by onions (Persian shallot, garlic) and damask roses (essential oil, rose water, dried petals). Although it is a comparison of actual results at two points in time, it can be seen that the export volume of medicinal plants is showing steady growth.

Table 4.2.3 Iran's Exports of Medicinal Plants (2019/2020)

.No	Name of exported goods	2019		2020	
		Weight (t)	Price Millions of dollars	Weight (t)	Price Millions of dollars
1	Rose essential oil	9,648.6	8.6	5,130.2	6.5
2	Turmeric	47.4	0.1	139.9	0.2
3	Pepper	347.0	0.2	387.5	0.5
4	Cinnamon	33.4	0.1	5.9	0.0
5	Nutmeg / Cardamom	0.3	0.0	1.7	0.0
6	Ginger	21.7	0.1	9.1	0.0
7	Other spices	368.4	1.3	1,950.1	2.9
8	Cloves	0.0	0.0	0.4	0.0
9	Flax	0.0	0.0	10.3	0.0
10	Oatmeal	0.0	0.0	0.0	0.3
11	Cultivated medicinal herbs	57,860.0	42.2	100,200.0	68.1
12	Onion (Persian shallot, garlic)	466,140.0	177.4	532,160.0	163.6
13	Rose water	4,081.7	6.2	3,350.1	3.7
14	Saffron	283.0	297.0	325.0	191.0
15	Dried rose petals	195.4	1.3	302.7	1.6
16	Barberry	326.2	0.6	435.6	0.3
17	Jujube	106.9	0.4	348.2	0.2
18	Safflower	302.1	4.2	73.8	0.6
19	Nastran	0.0	0.0	34.6	0.0
	Total	539,762.4	539.6	644,865.0	439.7

Source: MOJA

(2) Destination countries

The largest trade in medicinal plants takes place in neighboring Middle Eastern countries (Iraq, Afghanistan, UAE), with Germany, Spain and other countries in Europe, and Hong Kong and China in Asia. In these countries, there are many imports mainly as raw materials such as spices, coloring agents and fragrances. In the future, if it is planned to export as pharmaceutical raw materials in addition to existing export products, it will be necessary to establish a GACP (Good agricultural and collection practice) and introduce a traceability system to build a shipping system that can clear the quality standards of imported raw materials in each country.

Table 4.2.4 Iran's Major Medicinal Plant Exports and Major Exporters (2020)

No.	Item	Export volume (kg)	Export value (USD)	Main export destinations
1	Cumin	9,326,410	104,903,208	Hong Kong, UAE, Spain, Pakistan
2	Saffron	311,728	801,068,873	Hong Kong, UAE, Spain, China, Afghanistan
3	Coriander	20,109,580	80,916,088	Pakistan
4	Camellia sinensis	4,885,748	50,131,715	Germany, UAE
5	Ferrulla	196,254	15,111,107	Afghanistan, India
6	Rose water	2,266,236	12,496,098	Iraq, Kuwait, UAE
7	Henna	2,311,348	10,073,106	Iraq, Germany, UAE
8	Time	48,916	2,284,536	UAE, Oman
9	Dried rose flowers	20,162	735,071	Pakistan, Turkey, Germany, Iraq
10	Japanese hollyhock	25,524	660,576	Germany, Austria
12	Rose essential oil	114	554,383	Germany, Austria

Source: MOJA

(3) Export to Japan

Japanese imports of medicinal plants from Iran are limited. More than 80% of Japan's current medicinal plant imports are from China. In order to avoid the supply risk of importing from one country, a small number of products are imported from other countries, but the dependence on China remains high. Japan's needs are high for products that are consumed in Japan and imported from China are low (e.g. senna, an ingredient in laxatives). As many of the medicinal plants imported by Japan are raw materials for pharmaceuticals, traceability and safety must be ensured, and the plants must comply with the GACP.

4.2.5 Agritourism

In recent years, agritourism has attracted a lot of attention in Iran. Agritourism is defined as spending leisure time in lush rural areas to enjoy the nature, culture and interaction with people, and to experience farming and other activities to deepen the understanding of agriculture. In addition, the added value of this activity is expected to revitalize the economy and society of rural areas, and in recent years, this activity has been spreading worldwide, including Iran and Japan.

In Iran, the Ministry of Culture, Heritage, Handicrafts and Tourism (MCTH)[19] has agreed on guidelines and technical standards for agritourism initiatives and has started issuing agritourism permits in 2020. Golestan is one of the provinces where agritourism initiatives are being promoted and the first agritourism permits in the country have been issued in Golestan. The first agritourism permit in the country was issued in the province of Golestan. In August 2021, the Provincial Department of Culture and Heritage and the Department of Traditional Crafts and Tourism signed an MOU to "issue agritourism permits, identify and develop tourism capacities in the agro-industry, monitor the performance of certified farms, form an advisory committee and support the agricultural sector". Promotion of agritourism will be promoted[20].

Specific activities of agritourism may include outdoor recreation (fishing, hunting, wildlife study, horseback riding), educational experiences (canning tours, cooking classes, tea and coffee tasting), entertainment (harvest festivals and barn dances), hospitality services (farm stays, guided tours, or outfitting services), and direct sales on the farm (roadside stands), but there are also actual agritourism

[19] Ministry of Cultural Heritage, Tourism and Handicrafts
[20] MOU expected to boost agritourism across Golestan, Tehran Times, 2021

initiatives that make use of medicinal plants. In Fazelabad (Azadshahr), located in the hills we visited, there is a private agricultural company that grows medicinal plants (e.g. etium, lemon verbena, lavender, stevia, sage) and processes and packages the harvest into flavorings, beverages and dried fruits for sale. These new initiatives will not only attract tourists as agritourism but will also contribute to the creation of local employment and increase the income of the local population.

The study team being briefed on the activity

Some of the Products We Offer

4.3 Candidates for Conversion Crops

This study is conducted to understand the current status and challenges of vegetables, fruit trees, flowers and herbs, which are defined as medicinal plants in Iran as candidates for conversion crops. Findings are listed below.

- The promotion of medicinal plants is also enshrined and promoted in the Sixth Five-Year Plan for Economic, Social and Cultural Development.
- In addition, it occupies an important place in the current agricultural policy, which **aims not only to improve farmers' livelihoods but also to promote the export of agricultural products.**
- Research and development have been carried out by RIFR and IMP, and in recent years they have been working on **value addition (processing technology and product development) based on the idea of value chain development.**
- The main crops in Golestan are oilseed crops, wheat, rice and barley, while farmers are increasingly interested in fruit trees and medicinal plants for **their profitability, as they can be grown on a small, intensive scale and can be processed to add value.**
- However, different species of medicinal plants are cultivated in different regions, and the **characteristics of each production environment should be taken into account** when introducing them.
- In the value chain, production is challenged by **the shortage of quality seed and the heavy workload of harvesting,** while processing requires the **introduction of advanced processing technologies to add value.**
- With urbanization, **deforestation and expansion of agricultural land are progressing**, and in recent years, the agricultural land area ratio has been replaced by the forest area ratio in Golestan Province. From the viewpoint of **water and soil conservation**, the introduction of medicinal plants with superior properties such as soil erosion control and salt tolerance are

required.

- In recent years, **agritourism has been promoted**, which is expected to increase consumption in the local market.
- It is expected to be a **new farming opportunity for settled nomadic tribes, women and youth.**
- MOJA and JAO recommend the conversion to medicinal plants that are **highly profitable for farmers and have superior production environment characteristics** and focus on **not only improving the livelihood of farmers but also satisfying both water and soil conservation**.

Based on the understanding of the current situation and issues, it was decided that the selection of medicinal plants to be included in this study should be based on "characteristics of production environment " and "profitability and marketability", and the selection process should be carried out in consultation with the Iranian side including MOJA and Golestan JAO, taking into account the considerations shown in Table 4.3.1.

Table 4.3.1 Notes on the Selection of Medicinal Plants

Characteristics of production environment	●	Native or cultivated in the Golestan region.
	●	Excellent growth characteristics as a conversion crop (drought tolerance, cold tolerance, salt tolerance, etc.)
	●	Perennial or high land coverage, without digging up roots, and with soil conservation benefits.
Profitability and Marketability	●	Has a good outlet as a market (including exports)
	●	Potential for value addition through processing
	●	Able to meet the market needs

Source: JICA study team

4.3.1 Agricultural and Environmental Characteristics

Golestan Province is rich in meteorological environment, and it is necessary to select conversion crops that have the characteristics required by the weather and cultivation environment conditions of each planned area. The cultivation environment classification of Golestan Province is roughly divided into three categories: mountains, hills, and plains, and the cultivation environment characteristics required for each classification are summarized in Table 4.3.2.

Table 4.3.2 Characteristics of Conversion Crops in Each Growing Condition

Type	Temperature	Soil Conservation	Salt Tolerance	Drought Tolerance
Mountainous	Low	✓		✓
Hilly		✓		✓
Plain	High		✓	✓

Source: JICA study team

Based on the list of medicinal plants that are already grown in Golestan Province (409 species), 17 species of medicinal plants with the above cultivation environment characteristics (soil conservation, salt and drought tolerances) are listed and organized by each environmental category by MOJA, Golestan JAO and the JICA study team (Table 4.3.3). First, considering the soil conservation effect in mountainous areas and hilly areas, juniper, jujube, and myrobalan, which grow even at relatively low temperatures and are resistant to drought, are mentioned as woody plants. In addition, herbaceous perennial plants include damask rose, lavender, peppermint and hops. These herbaceous plants can also

be cultivated between trees of woody plants that take a long time to harvest, and because there is no need to cultivate large fields after planting and the foliage is prosperous throughout the year, the soil conservation effect can be expected. Furthermore, in fields where soil erosion is reduced by planting plants with high soil conservation effects in contour lines, it is possible to consider cultivating annual crops such as shallot and lemon verbena, which are expected to generate income in a short period of time and are highly marketable. For the same reason, early purple orchid, which grows for 4-5 years, is also listed as a high-profit plant in mountainous areas. In addition, although there is no risk of soil erosion in the plains, nigella and cumin, which require less water than wheat, are used as conversion crops in large-scale agricultural land where it is becoming difficult to cultivate wheat due to the decrease in rainfall. In addition, given that the problem of salt accumulation has become apparent, salt-tolerant ephedra, licorice and Jerusalem artichoke are also listed.

Table 4.3.3 Candidate Conversion Crops suitable for the Growing Condition in Golestan Province

No	Medicinal Plant	Area			General Information			
	English	mountain	Hilly	plain	Temperature (℃)	Annual (A) Perennial(P)	Preferred Soil Type	Water requirement
1	Early Purple Orchid	✓	✓		20-25	P	Sandy, Loamy, Heavy clay very acid soil	Dry
2	Damask rose	✓	✓		15 - 30	P	Sandy, Loamy, Clay, Well-drained	Moisture
3	Juniper berry	✓	✓		10-25	P	Sandy, Loamy, Neutrality to alkaline	Heavy dry to moisture
4	Lavender	✓	✓		15 - 25	P	Sandy loam	Moisture
5	Black Myrobalan	✓	✓		10-30	P	Sandy, Loamy Clay, Well-drained, acid	Heavy dry to moisture
6	Rosemary		✓		20 - 25	P	Loamy, Well-drained, slightly acidic	Slightly dry
7	Jujube	✓	✓		10-25	P	sandy, loamy, clay, Neutrality to alkaline	Dry to moisture
8	Peppermint	✓	✓	✓	15-20	P	sandy, clay, Drainage	Constantly moist
9	Caper	✓	✓	✓	10-20	P	Loamy	Salinity & drought
10	Lemon verbena		✓		10-20	P	sandy, loamy, well-draining	Moisture
11	Hop	✓	✓		20 - 25	P	sandy, loamy, Neutrality alkaline soil	Dry to moisture
12	Shallot		✓	✓	15-20	A	Sandy, Loamy, Neutrality to alkaline	Moisture
13	Ephedra		✓	✓	15-30	P	Sandy, Loamy, Well-drained, Neutrality	Few Moisture
14	Licorice		✓	✓	15-20	P	Sandy, Loamy Neutrality to alkaline	Moisture
15	Nigella	✓	✓	✓	15 - 20	A	Drained, Fertility	Dry to moisture
16	Cumin	✓	✓	✓	20-30	A	sandy, loamy soil, alkaline	Dry to moisture
17	Jerusalem artichoke		✓	✓	18-32	A	Slightly Alkaline	Few Moisture

Source: JICA study team

4.3.2 Profitability and Marketability

Table 4.3.4 shows the farmer's income and expenditure by cultivated crop in Golestan Province. For major food crops, crops covered by the government's purchase guarantee are highly profitable when irrigated, especially wheat and barley, which are doubled by irrigation. Although rice, which requires a large amount of water, has high profits, the area where it can be cultivated is limited in Golestan Province. As for horticultural crops, onions that are harvested at one time have higher B/C values than other horticultural crops, compared to tomatoes that are harvested for a long time. Medicinal plants are nearly three times more profitable than grains (under rainfed conditions) such as wheat and barley, which are

the main food crops. Moreover, when comparing medicinal plants and horticultural crops, the profit of horticultural crops is high, but the B/C value is lower than that of medicinal plants. This shows that the income is high, but the cost is also high.

From the above results, it can be considered that the introduction of medicinal plants as conversion crops which has potential to contribute to the improvement of farmers' livelihoods.

Table 4.3.4 Balance Sheet of Medicinal Plants and Major Crops and Horticultural Crops in Golestan Province (2021)

	crop	Irrigate /Rainfed	Economic useful life(year)	Unit price (Rials/ha)	Yield (kg/ha)	Gross income (Rials/ha)	Net Income (B) (Rials/ha)	Production cost (C) (Rials/ha)	B/C
Major Crop	Wheat	Irrigated	1	51,000	4,200	214,200,000	129,200,000	85,000,000	1.5
	Wheat	Rainfed	1	51,000	2,200	112,200,000	62,200,000	50,000,000	1.2
	Barley	Irrigated	1	50,000	3,800	190,000,000	115,000,000	75,000,000	1.5
	Barley	Rainfed	1	50,000	2,200	110,000,000	67,000,000	43,000,000	1.6
	Paddy		1	230,000	4,200	966,000,000	555,000,000	411,000,000	1.4
	Soybean		1	66,300	2,600	172,380,000	77,880,000	94,500,000	0.8
	cotton		1	75,000	2,500	187,500,000	85,650,000	101,850,000	0.8
	Fodder corn		1	10,000	35,000	350,000,000	142,000,000	208,000,000	0.7
	Canola	Irrigated	1	78,000	2,100	163,800,000	106,050,000	57,750,000	1.8
	Canola	Rainfed	1	78,000	1,700	132,600,000	90,600,000	42,000,000	2.2
Medicinal plant	Peppermint	Irrigated	3-4	40,000	12,500	500,000,000	100,958,462	399,041,538	0.3
	Lemon balm		3-4	50,000	12,000	600,000,000	294,676,923	305,323,077	1.0
	Borage		3-4	200,000	4,000	800,000,000	298,603,077	501,396,923	0.6
	Cumin	Rainfed	1	400,000	500	200,000,000	107,325,000	92,675,000	1.2
	Nigella	Rainfed	1	550,000	800	440,000,000	311,700,000	128,300,000	2.4
	Thyme	Irrigated	5-7	700,000	1,000	700,000,000	343,847,861	356,152,139	1.0
Vegetable / Fruit	Tomato		1	30,000	40,000	1,200,000,000	335,000,000	865,000,000	0.4
	Onions		1	21,000	25,000	525,000,000	322,000,000	203,000,000	1.6
	Watermelon		1	21,000	51,000	1,071,000,000	313,000,000	758,000,000	0.4
	Citrus		20	40,000	30,000	1,200,000,000	376,000,000	824,000,000	0.5
	Peach		20	70,000	15,000	1,050,000,000	425,000,000	625,000,000	0.7

Source: Golestan JAO

In order to aim for stable farmer's livelihood improvement, not only farmer's profitability but also marketability are important indicators, and it is important to switch to crops that can surely secure advantageous sales destinations.

Table 4.3.5 shows the current processing and market conditions in Golestan Province for the 17 species listed. At present, Damask roses require relatively high-level processing such as distillation for rose water, and Nigella requires relatively high-level processing such as essential oil production, but most of them are on the market in simple states such as drying and/or raw. It is considered that there is ample room for adding value through modernization of processing in order to improve the livelihood of farmers.

Early purple orchid, lemon verbena, hops, shallot, licorice, and cumin are listed as having high marketability. All of these are currently shipped not only to markets within Golestan Province but also to markets outside the region and are considered to be particularly effective items when considering exit strategies. Furthermore, cumin is an export item, so its marketability is very high. It was clarified that

some of the plant species listed as candidates by paying attention to the characteristics of the production environment such as soil conservation effect and high salt tolerance are sufficiently marketable.

On the other hand, cultivation practices of some plant species that local pharmaceutical companies and processors have recognized as having high marketability have not been established in Golestan Province. Future issues include ensuring stable quantity and quality through the establishment of cultivation practices (including primary processing technology).

Table 4.3.5 Marketability of Candidate Conversion Crops

		Name	Processing Status									Market (M.) Status			
	Area	English	Dry	Packaging	Distillation	Lubrication	Herbal Tea	Raw sale	Home processing	Traditional medicine	Industrial material	M. Potential	Local M.	M. out of province	Export
1	Mountainous	Early Purple Orchid						*				High		*	
2		Damask rose	*	*	*							Moderate	*		
3		Juniper berry										No information available			
4		Lavender	*	*						*	*	Moderate	*	*	
5		Black Myrobalan										No information available		*	
6		Rosemary	*	*						*	*	Moderate	*	*	
7	Hilly	Jujube	*	*								Moderate	*		
8		Peppermint	*	*				*		*		Moderate	*	*	
9		Caper							*			Low	*	*	
10		Lemon verbena	*	*								High	*	*	
11		Hop									*	High	*	*	
12		Shallot	*					*				High	*	*	
13	Plain	Ephedra										No information available			
14		Licorice						*				High		*	
15		Nigella	*			*						Moderate	*	*	
16		Cumin	*	*				*				High	*	*	*
17		Jerusalem artichoke							*			Low	*		

Source: Golestan JAO

4.3.3 Selection of Conversion Crops

Based on the list of medicinal plants (409 species) that are already grown in Golestan Province, 17 species were listed by MOJA, Golestan JAO and JICA study team. Subsequently, information on cultivation environment characteristics, farm profitability and marketability (actual and potential of processing/market) was organized for these 17 species. Furthermore, based on the field survey, Table 4.3.6 shows nine plant species that are considered to be particularly effective as conversion crop species with high marketability according to the cultivation environment of each of the mountains, hills, and

plains. Species with a particularly high soil conservation effect are selected in the mountains and hills, and salt-tolerant species are selected in the plains. In the future, further studies should be conducted on approaches for the introduction of these medicinal plant species. As mentioned above, since there are few established cultivation management practces, it is desirable to introduce and disseminate these practices after demonstrating cultivation tests in each cultivation environment. In addition, regarding marketability, it is necessary to clarify bottlenecks not only at the cultivation stage but also at each stage such as processing and distribution / sales inside and outside the region by conducting detailed value chain analysis for each conversion crop.

Although not included in the 17 species, quinoa, passionflower, raspberry, thyme, fennel, savory, hyssop, etc. are also excellent in cultivation environment characteristics, processing suitability, and marketability, and there is a possibility without narrowing the target. Certain plant species will be considered as candidate conversion crops in the future.

Table 4.3.6 Promising Candidate Conversion Crops (Short List)

	English	Soil conservation	Low water requirement	Salt Tolerance	Marketability
Mountainous	Damask rose	*			**Moderate**
	Lavender	*			**Moderate**
Hilly	Jujube	*			**Moderate**
	Lemon verbena				High
	Hop	*			**High**
	Shallot				**High**
Plain	Licorice			*	**High**
	Nigella			*	Moderate
	Cumin		*	*	**High**

Source: JICA study team

CHAPTER 5: WATER USE IN THE GOLESTAN PROVINCE

5.1 Natural Environment

5.1.1 Climatic Conditions

Golestan Province borders the Caspian Sea coast of northern Iran and the border of Turkmenistan. The province covers an area of 23,116.6 km2 (about 1.3% of the total land area) and is bounded in the south by the East Alburz mountain range with mountains of 2,000 m in height. Some of the richly forested areas in the mountains have also been designated as national parks.

On both sides of the Gorgan River, which flows through the centre of the Golestan Oblast, the land slopes are gentle, and the Gorgan plain extends to the Caspian Sea. From the northern part of the Gorgan River to the border with Turkmenistan, the region is arid. Although the oblast has a Mediterranean climate, it is rich in climatic conditions and diverse natural environments, with the forested Alburz Mountains in the south and arid areas in the north.

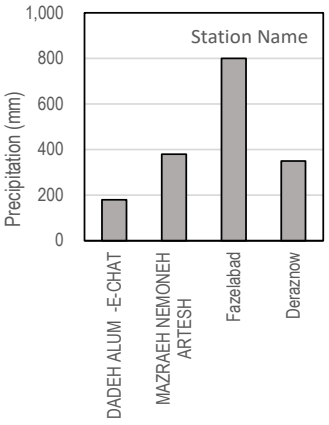


Figure 5.1.1 Annual Precipitation (Dryland, Plain, Hilly, Mountainous Areas)

Source: JICA study team

The Golestan Province has a wide variety of natural conditions, from plains to mountain ranges, and the annual rainfall varies from about 200 to 800 mm. There is also a wide range of temperature distribution in the region, from arid areas with large temperature disparities, to warm plains, warm hills and cool mountains. In particular, in desert areas, precipitation is low, and evaporation is high due to high temperatures. Figure 5.1.1 shows precipitation data for the Golestan Province and Figure 5.1.2 shows temperature data.

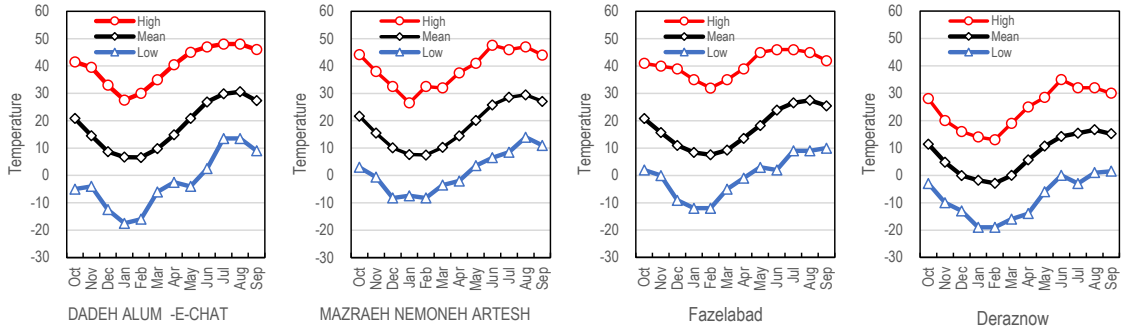


Figure 5.1.2 Varied Temperature Variations in the Golestan Province (From Left to Right: Arid, Plain, Hilly and Mountainous Areas)

Source: JICA study team

5.1.2 Geographical Topographical Conditions

From the East Alburz Mountains in the south to the north, Golestan Province has a gradual topographical situation of mountains, hills, plains and Turkmen desert. On the left bank of the Gorgan River, which flows through the centre of Golestan, there are hills and plains from the East Alburz Mountains in the south, while on the right bank there are plains and Turkmen desert areas.

The altitude of the desert areas in the northern Golestan Province is low and humid, with a small difference in altitude, linked to the Caspian Sea, and the groundwater table is generally high. Due to the

high temperatures in these desert areas, the high groundwater table leads to a high rate of evaporation from the ground surface due to capillary action, which in turn leads to the accumulation of salts in the groundwater on the surface after evaporation, causing salt damage.

The East Alburz Mountains are richly forested and snow-covered in winter. The mountain range is formed by several small basins, from which small rivers flow into the Gorgan plain. The small rivers enable the cultivation of fruit trees, vegetables and field crops on the hills between the mountains and the plain.

5.1.3 Water Resources

The Gorgan, the main river in the Golestan Province, flows from its source in the mountains to the south-east into the Caspian Sea to the west. This river also flow through gently sloping terrain from east to west. Several dams have been built upstream on the Golestan River, including Vosmugir, Golestan and Vostan.

In the north-east of Golestan Province, around the border with Turkmenistan, flows the Atrak River. The Atrak River is a rapid stream which flows 600km westwards from the mountainous areas of north-eastern Iran to the south-eastern edge of the Caspian Sea in Turkmenistan. The river is used mostly for irrigation and therefore the river flows into the Caspian Sea only during floods.

Figure 5.1.3 shows the monthly flow of the Gorgan River. In the springtime, when the snow melts from the Alburz Mountains, an abundance of water flows through both rivers into the Gulf of Gorgan and the Caspian Sea, but in the summer the flow is much lower and is characterised by large seasonal fluctuations. The Gorgan River is fed by a number of tributaries from the Alburz Mountains to the south-east of the region. Non-river water resources include springs and groundwater.

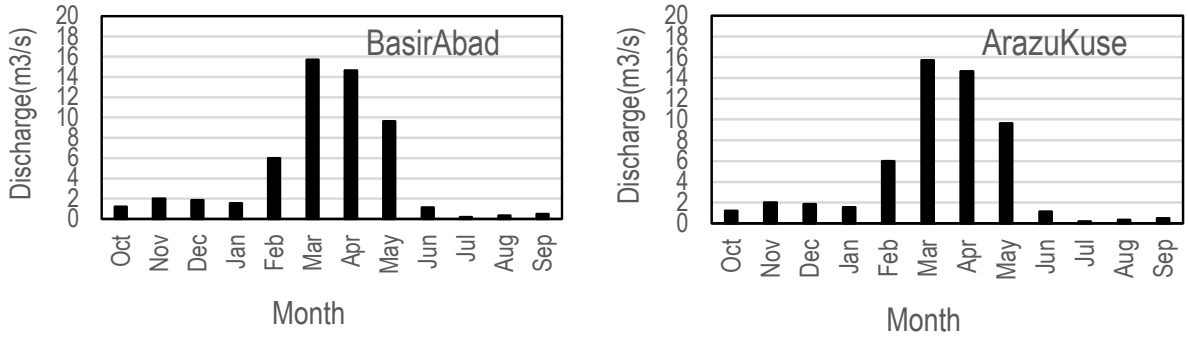


Figure 5.1.3 Monthly Change in River Flow in the Gorgan River

Source: JICA study team

View of the Gorgan River (Parto Banavor area)

A Branch River Flowing Through the Mountains (Charbagh Area)

Lushu Spring (FazelAbad Area)

Groundwater Extraction by Wells (FazelAbad Area)

5.2 Water Use

5.2.1 Organizations in Charge of Water Use and their Scope

Surface water and groundwater are managed by the Ministry of Energy and the Regional Water Supply Corporations, which have the company to grant permits for water use. The priorities for the use of water resources are (i) drinking water, (ii) industrial water, and (iii) agricultural water. Projects relating to water supply, such as dams, reservoirs and main canals, are under the jurisdiction of the Regional Water Company. As the ministry dealing with water resources, the Regional Water Company, a subordinate body of the Ministry of Energy, is the supplier of water, while the MOJA, which has jurisdiction over agriculture, is the user of water.

(1) Ministry of Energy (MoE)

The Ministry of Energy is responsible for the development of water resources in various sectors and plays a role in the planning, development, management and conservation of water resources. In addition to dams built on rivers, it also builds several irrigation and drainage systems. Irrigation and drainage systems in general and large groundwater projects in particular are also generally constructed by the Ministry of Energy. The Ministry of Energy, through the Regional Water Company, is responsible for the management and maintenance of the main irrigation infrastructure and the supply of irrigation water to farmers. In recent years, however, there has been a tendency to transfer some of the water management

to farmers' groups.

Water rights for surface water are managed by the Regional Water Company. When a user needs to take water from a river due to pumping, reservoir construction, etc., the user fills in the prescribed application form and submits it directly to the Regional Water Company. After an expert has carried out a site survey based on the application, a permit for water use will be issued. In the case of groundwater, the regulations stipulate that a prescribed application form must be submitted to the Regional Water Company before a new well can be drilled. As in the case of river abstraction, a permit for the extraction of wells and the use of groundwater is issued only after an expert has carried out a site survey based on the application.

The Regional Water Company collects water abstraction tariffs annually for water use. The tariffs are set in the Iranian National Water Law and are reviewed every few years by the Council of Ministers, including the Ministries of Energy and MOJA. The level of charges varies from province to province and according to the type of irrigated crops. The monitoring of water withdrawal is carried out by the officials of the subordinate bodies of the Regional Water Company.

(2) Ministry of Ministry of Jihad- e-Agriculture (MOJA)

When MOJA is responsible for the management of rainfed and irrigated agriculture in Iran, including tertiary and quaternary canals, irrigation development and management MOJA is the user side of water resources in the field of agricultural production. MOJA also has provincial bureaus at the provincial level, which carry out extension activities and research programs to improve agricultural productivity.

If MOJA wants to carry out a new water use, it has to propose the project to the Ministry of Energy and obtain a permit. However, since water use and distribution management are important for both the Regional Water Company and MOJA, the two institutions hold regular meetings. For both irrigation and drainage canals, the Ministry of Energy manages the larger canals (primary and secondary canals) and the MOJA Water and Soil Department manages the later ones. The MOJA then pays a user fee to the Regional Water Company for the use of surface water and groundwater. However, as Qanat and Spring are privately owned, they do not require a permit from the Ministry of Energy or a water fee.

5.2.2 Current Status of Irrigation Systems

(1) Irrigation situation

The average annual rainfall in the region is between 200 and 600 mm, with relatively high rainfall period in winter and early spring, but low rainfall and high temperatures in summer result in high evaporation. Irrigation is therefore essential for the cultivation of cotton, oilseed rape, vegetables and pulses. Where irrigation facilities are not available, drought-tolerant crops such as fruit trees, wheat and grasses are grown, but irrigation is also essential to ensure consistent yields.

In the plains, where river water is available, irrigation water is obtained from dams or pumped from river water. In areas where river water is not available, wells are used as a source of water, but the size of the wells is small. The most common irrigation methods are basin irrigation and furrow irrigation, in which fields are flooded before sowing or planting, and the amount of water required for harvesting is soaked into the soil root zone in advance.

Irrigation systems in the plains are generally based on pumped water because the elevation of rivers is low compared to the elevation of farmland. As shown in Figure 5.2.1 as an example, in addition to pumps for pumping water and distribution facilities such as canals, secondary and tertiary canals, there are also check gates in the canals to control irrigation water, through gates for diversion and abstraction, and drainage canal to discharge excess water downstream Irrigation canal Generally, irrigation canals are lined to prevent seepage loss from canal and drainage canal is earthen type. Some area also has large reservoirs within the irrigation system to store irrigation water.

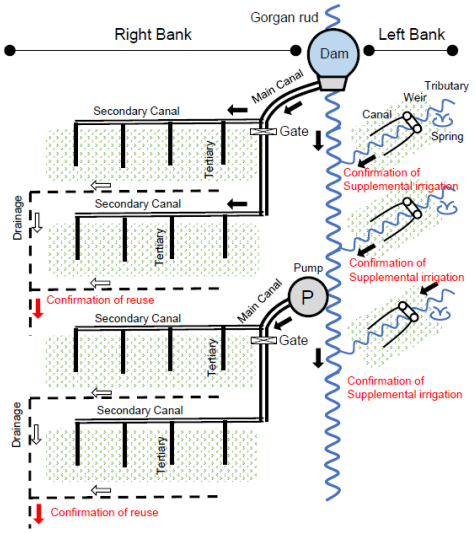
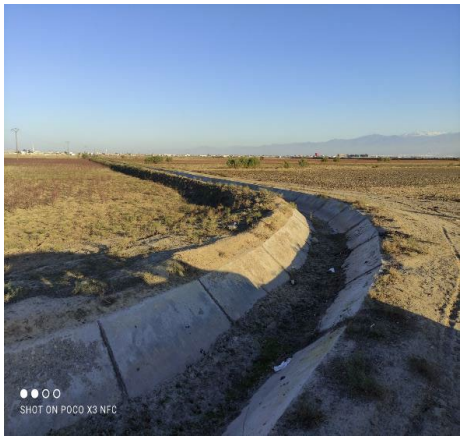


Figure 5.2.1 Example of an Irrigation System for a Plain Area

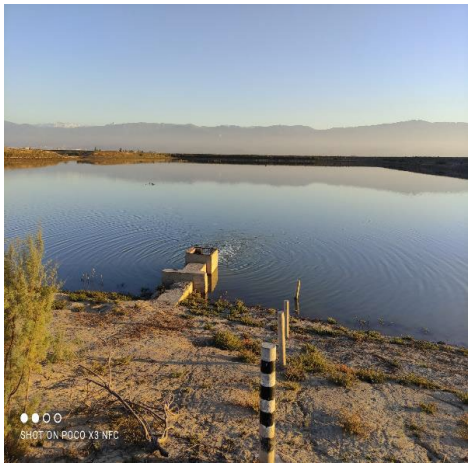
Source: JICA study team

Irrigation Pump (Payvand RPC)



Main Canal (Parto Banavor Area)

Diversion Gate to the Branch Canal (Parto Banavor Area)



Water Reservoir in the Irrigation Area (Parto Banavor Area)

On the other hand, in the hilly areas, there are no large rivers flowing through the plains like the Gorgan. Therefore, the main sources of irrigation water are tributary rivers, wells and springs formed in small basins in the mountains. The drainage water generated during periods of high rainfall is stored in reservoirs in depressions in the middle of the basin and is used as a source of irrigation water. In the hilly areas, where rainfed agriculture is predominant, the water sources from reservoirs are used for supplementary irrigation. Irrigation methods used include inter-row irrigation and drip irrigation. The main irrigation facilities include fixed weirs, reservoirs, canals and other distribution facilities on branch rivers, as well as water storage tanks, drip irrigation and wells used by the farmers themselves.

Figure 5.2.2 shows a schematic representation of the irrigation system in a hilly area (Gerankooh area) as an example. The Shast Kaleteh River, a tributary of the Gorgan River, is used as the source of water, which is canaled from a fixed weir in the river to a reservoir (Kafshigiri Lagoon) with a total length of 7 km. Wheat and soybeans grown in the Gerankooh hills are grown in the rainfed area and in the irrigated area fed by the reservoir. In addition to reservoirs, some irrigation areas are fed by wells.

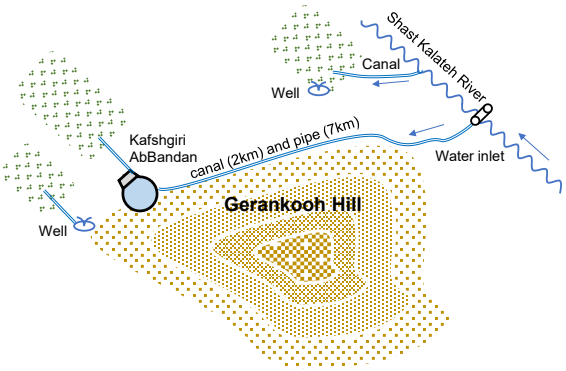


Figure 5.2.2 Example of an Irrigation System for a Hilly Area

Source: JICA study team

Fixed Weir on a Branch River (Gerankooh Area)

Conduit from the Fixed Weir to the Reservoir (Gerankooh Area)

(2) Status of drainage

In terms of drainage conditions, the region is an alluvial plain, which means that flat land forms the plains, except for the mountainous and hilly areas around the Alburz Mountains. Here, heavy clay soils are widespread and prone to poor drainage. Particularly in the areas close to the Caspian Sea, high groundwater levels lead to high salt accumulation and large areas of wetlands.

In the irrigated areas of the plains, drainage canals are relatively well developed and many earthen canals can be observed. In some fields, culvert drains have also been installed, with perforated pipes connected every 30 to 50 metres to lower the groundwater level in the field.

In the mountainous and hilly areas, where drainage canals are not as well developed as in the plains,

rainfall in the basin is channeled into reservoirs for irrigation. Reservoirs also have the effect of reducing peak river flows by storing drainage water generated from the basin during periods of high rainfall, thereby delaying the inflow of water from tributary rivers into major rivers such as the Gorgan.

Erosion Control Weirs in the Mountains (Vala Area)

Hillside Reservoir and Sediment Trap (FazelAbad Area)

5.2.3 Current Status and Challenges of Water Management Organizations

Until the early 1990s, agricultural water management was part of the community's responsibility at the local level. The removal of silt accumulation in canals and the reinforcement of canals were the responsibility of local communities. And these communal organizations were responsible not only for water management but also for other communal activities such as weddings, funerals, religious ceremonies, education, etc. Decisions were made in communal meetings chaired by the village elders and attended by the heads of households.

Thus, the traditional mechanism for agricultural water management in rural areas has been informal community organizations in villages. Therefore, in many irrigation systems, such organizations do not deal with the allocation of water quantities between irrigation systems that are adjacent in water use, so some users of irrigation systems in a village had to coordinate their water allocation with other villages. However, this coordination mechanism was not always smooth and could lead to disputes between villages over water allocation.

The Government is therefore promoting the establishment of Water Users Associations (WUAs) and encouraging them to devolve authority for the management of irrigation systems. This is an initiative to coordinate water allocation in a more efficient and effective way than the traditional local authorities by holding responsibility and authority at the local level. Given that the development of water resources in Iran will be very limited in the future, achieving efficient use of water and proper water allocation is an urgent issue.

Table 5.2.1 summarizes the project implementers and users of each irrigation facility. Although this is an example from Kafshgiri village, other irrigation facilities are managed and owned in a similar manner. As shown in the table below, except for wells and simple water tanks, the JAO is the project implementer, the association is the facility owner, and O&M is the village committee member. As each facility is related to water, the licensing authority for use is the Regional Water Company under the Ministry of Energy.

Table 5.2.1 Examples of Management Categories for Each Irrigation Facility

Water Resource and Distribution Facilities	Project implementer	Owner	Operation and Maintenance	Approver for usage
Inlet at Kalateh River	JAO	cooperative	Village Board / Rural Mayor	Water Company
Canal and Pipeline	JAO	cooperative	Village Board / Rural Mayor	Water Company
Lagoon (AbBandan)	JAO	cooperative	Village Board / Rural Mayor	Water Company
Outlet valve and canal	JAO	cooperative	Village Board / Rural Mayor	Water Company
Well	private	private	private	No need
Water tanks	private	private	private	No need

Source: JICA study team

5.3 Status of Reused Water

5.3.1 Status of Agricultural Drainage Facilities

The reuse of wastewater in the agricultural sector in the Golestan province is mainly seen in the way in which the volume of water during high rainfall that flows from small watersheds in mountainous and hilly areas is stored in reservoirs by improving natural depressions and used to irrigate downstream areas. On the other hand, in the plains, existing irrigation systems have drainage canals, but there are no examples of the use of the drainage water for irrigating farmland again in the downstream areas of the same irrigation system. The following table shows the status of agricultural drainage facilities in the hilly and plain areas of the country.

(1) Hilly areas

In the hilly areas to the south-east of the Gorgan River, natural rivers act as drainage canals during periods of high rainfall and there is no large systematic drainage network. However, depending on the topographical conditions of the hills, natural swamps and depressions have been modified to form reservoirs (Ab Bandan; Persian name). The reservoirs are temporary water reservoirs for agricultural use, receiving water from rivers during normal times and floods, as well as drainage water from agricultural and forest lands in the upper reaches of the reservoirs by means of small drains and canals constructed for the purpose of conveying water to the reservoirs.

A Canal Connecting the Drainage of the Basin to the Reservoir (Shahkooh Area)

Reservoir (Shahkooh Area)

There are also farmers and farmer groups who have built and use small reservoirs (concrete or dug-in), which are not as large as the reservoirs improved in the hilly depressions, but which collect drainage water from small rivers from the upper reaches and serve as a complementary source of irrigation water.

Dug-in Reservoir (Fazelabad Area)

Valve to Regulate Reservoir Distribution (Fazelabad Area)

These facilities are built under the initiative of the JAO and are managed and controlled by the Village Board/Rural Mayor with the approval of the Water Company, which is responsible for surface water use, and the Cooperative is the owner. Privately built small reservoirs, wells and springs are privately owned and are not regulated by the Water Company.

Well on the Hillside (Gerankooh Area)

Farmer and his Source of Water (Gerankooh Area)

(2) Plains

Irrigation and drainage areas managed by production cooperatives in the plains are often equipped with drainage canals. Irrigation canals and drains are combined in irrigation systems in the plains, with a hierarchy of drains, such as trunk drains and branch drains. While irrigation canals are generally lined canals, many drains are earthen canals. Drainage water collected downstream of the irrigation system is likely to drain outside the area, to some of the adjacent agricultural land and to the Gorgan River.

Lining Irrigation Canals
(Sabz Dash Ghaleha Area)

Drainage Canals in Earthen Canals
(Sabz Dash Ghaleha Area)

5.3.2 Case Studies of Agricultural Wastewater Reuse

(1) Hilly areas

The effluent collected in the above reservoirs is used to irrigate production cooperatives or groups of farmers who have irrigation beneficiaries in the vicinity or downstream of the reservoirs.

Catchment Canals and Reservoirs (FazelAbad Area)

Reservoirs on the Hillside (Ghareh Cheshmeh Area)

(2) Plains

Although constrained by topographical conditions, in some areas drainage water is collected at the end of the field and pumped back into the canal for reuse. However, this type of use was not observed in the Gorgan River Plain.

The discharge of water into the Gorgan River also contributes to the increase in the salinity of the river. The change in salinity should be taken into account when reusing water from the river in the downstream plains. Depending on the topographical location, drainage water from the district may be used to irrigate adjacent downstream agricultural land.

5.4 Consideration of Water Saving Measures

5.4.1 Irrigation Water Allocation

The abstraction and allocation of irrigation water from the reservoirs in the hilly areas is done under the management and operation of the Cooperative and farmers' groups. On the other hand, in the plains where the Gorgan River is the source of water, water is withdrawn under the permission of the Water Company, which manages the Gorgan River. Water abstraction takes place during the months when there is water in the river and also during periods of high-water abundance when river flows are high. There are no clear water rights as in other countries, but the beneficiary farmers pay water fees to the Water Company or the cooperative according to the area of crop cultivation.

The seasonal river flow in the Gorgan River fluctuates significantly because of the increase in river flow due to the melting of snow (Figure 5.1.3). On the other hand, in the case of PAYVAND area, the available months for pumping water are from January to March. It is not clear whether the period during which water can be withdrawn is determined by seasonal variations or whether there are area-specific agreements on the amount of water that can be withdrawn.

5.4.2 Case Studies of Water-Saving Irrigation

The most common irrigation method in the plains and hills is the traditional furrow irrigation by gravity. This method has low irrigation efficiency due to water conveyance losses, and water abstraction is prioritised in fields adjacent to the canal, resulting in inequitable water allocation between the canal and the field and between fields upstream and downstream.

In recent years, water conservation in agriculture has become an important issue and irrigation methods have started to be introduced to save water. For example, in PAYVAND area, an irrigation hose reel has been introduced with the support of JAO. In Vahdat & Resalat areas, a centre pipod irrigation system is planned to be introduced.

Irrigation Hose Reel (Payvand Area)

Centre Pivot Irrigation
(Vahdat & Resalat Area Training)

In the hilly areas, there are some examples of drip irrigation areas using piped water from constructed reservoirs and drip irrigation from hoses connected to tanks. Water-saving irrigation combined with soil conservation in mountainous areas is also being piloted. Some profitable cultivated crops can benefit from such water-saving irrigation.

Drip irrigation (Shahkooh Area)

Irrigation Combined with Soil Conservation (Chaharbagh Area)

5.5 Organizational Structure for Water Management in Case of Natural Disasters and Other Emergencies

5.5.1 Flood and Drought Risk

(1) Agricultural damage caused by the 2019 floods [21]

The floods were caused by intensive rainfall across the Gorgan River basin in March-April 2019. The total rainfall was 2,211 MCM and the flood volume was calculated to be 327 MCM, which is 2.7 times the storage capacity of the basin dams. The area affected was 31,998 ha in the plain of the Gorgan River based on satellite images (29 March 2019).

Factors contributing to the occurrence of floods include widespread heavy rainfall, rapid runoff from steep mountainous and hilly terrain, and low water-holding land cover and soils. Riverine infrastructure was affected by breaches of river embankments and weirs, deposition of sediment in reservoirs and pumping facilities.

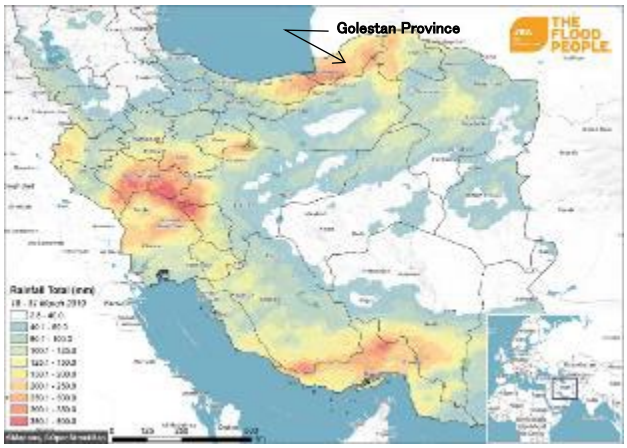


Figure 5.5.1 Cumulative Rainfall for 18-31 March 2019

Source: JBA Risk Management Limited

Figure 5.5.1 shows the cumulative rainfall in different parts of Iran for the period 18-31 March 2019 [22]. Typically, the average annual rainfall in the plains of Golestan Province is around 300mm. Therefore, it can be seen that during the 2019 floods, there was significant rainfall, almost as much as the annual rainfall, in less than about two weeks in March.

Damage to agriculture totalled USD[23] 250 million (1090 billion tomans), comprising mainly cereal production; USD 181 million (760 billion tomans), water and soil infrastructure; USD 36 million (150 billion tomans), horticulture; USD 29 million (120 billion tomans), and livestock and poultry; USD 14

[21] Summary of the Flood report of 1038 (2019), Golestan Regional Water Company
[22] https://www.jbarisk.com/flood-services/event-response/deadly-flash-flooding-hits-many-provinces-of-iran/
[23] Ril/USD ; 42,037

million (60 billion tomans). In this flood, more than 90% of cereals and horticultural crops were damaged (around 100,000 ha) and in total 250,000 ha of agricultural lands were affected. Affected crops were mainly wheat, barley and oilseed rape. Table 5.5.1 shows the pumping stations affected by the 2019 floods.

Table 5.5.1 Flood-affected Pumping Stations in 2019

No	City	Cooperative company
1	Agh Ghala	Payvand Rural Production Cooperative Company
2	Agh Ghala	Shadi Mehr Rural Production Cooperative Company
3	Gomishan	Sabzdasht Rural Production Cooperative Company
4	Gomishan	Arakh Rural Production Cooperative Company
5	Gomishan	Gomishan Kesht Rural Production Cooperative Company (2 pumping stations)
6	Kordkooy	Royan Yasaki Rural Production Cooperative Company
7	Gonbad	Bibi Shirvan Rural Production Cooperative Company
8	Gonbad	Sari Bakhsh Rural Production Cooperative Company
9	Gonbad	Omid Rural Production Cooperative Company
10	Gonbad	Yasi Tappeh Rural Production Cooperative Company
11	Gonbad	Peyman Rural Production Cooperative Company
12	Kalaleh	Tamran Rural Production Cooperative Company
13	Marave Tappeh	Aq Taqeh Rural Production Cooperative Company

Source: Golestan JAO

(2) Rehabilitation plan for irrigation areas

In the irrigation areas in the plains, six damaged pumps and the retaining wall of the pumping station in Payvand area will be rehabilitated by the Japanese grant aid GGP (Grass-Roots in the Payvand area, six pumps and the retaining wall of the pumping station are to be restored by the Japanese grant aid GGP (Grass-Roots Project). In other irrigation areas (Hermmat, Sabz Dasht e Ghale ha, Bonavor and Vahdat Resalat), pumping stations, irrigation canals and bridges were damaged but the details of rehabilitation are not available.

5.5.2 Damage Caused by the 2019 Floods, Status of Facility Rehabilitation

(1) Water conservation in mountainous and hilly areas for flood risk reduction

1) Preservation of agricultural land in mountainous and hilly areas

Rapid run-off from mountainous and hilly areas occurs from agricultural land with poor water-holding soils and from sloping land where water erosion occurs. Therefore, measures to avoid them as far as possible are necessary to reduce future flood risks. In order to achieve this, it is necessary to identify forest areas and sloping fields in the basin where soil loss and erosion are observed, and to implement water conservation measures aimed at enhancing water retention and reducing soil erosion in these areas.

- Ensuring that the boundary between national forest land and agricultural land is well known
- Reforestation activities in degraded forest areas and thorough water conservation measures in the surrounding farmland
- Water conservation measures on agricultural land (planting of erosion-resistant crops, application of agricultural methods to prevent soil erosion, catch basins and drainage canals for run-off sediment, accumulation and removal of run-off sediment, prevention of erosion of agricultural roads and field slopes, etc.)

- Strengthening the water conservation function of reservoirs (Ab Bandan) and uncultivated land

2) Promotion of soil conservation farming methods to strengthen the water retention capacity of the soil

As part of flood defenses, sloping fields should be converted to alternative crops and existing fields should be subjected to conservation farming practices to reduce soil run-off.

- Engineering measures: staircases, contour cultivation, catch basins, simple run-off bunds, etc.
- Cropping measures; planting of erosion resistant crops, planting cover, intercropping, mulching etc.

These should be applied according to the topographical conditions of the area.

(2) Water management for drought risk reduction

1) Management of pump abstraction between irrigation areas for the drought period of the Gorgan River

There are a number of irrigation areas in the plains which are fed by the Gorgan River. All the irrigation systems are based on pumped water abstraction, but there is no clear allocation of water rights for abstraction. In the absence of clear water rights, the beneficiary farmers pay water fees to the Water Company. According to the list of irrigated areas, there are irrigated areas on the Gorgan River which are under planning for survey. Therefore, it is expected that the total amount of water pumped in the irrigation areas will increase further than at present.

One of the future challenges in this situation is the need to establish rules (water rights) for pumping water for each irrigation area depending on the river flow. If the river flow is sufficient to meet the pumping requirements of all irrigation areas, including those currently under study, this will not be a problem. However, in drought years, irrigation areas located upstream of the river may be expected to take priority in pumping water, resulting in unfairness in pumping water among irrigation areas.

If there are no rules for pump operation in each irrigation area, pump abstraction is likely to be prioritized in upstream areas, and water shortages will be more pronounced in downstream irrigation areas. Disputes over water allocation must be avoided in order to ensure fairness in future water allocation and the continued collection of water user fees. In order to achieve this, the rules for pumping water according to the river flow should be established in advance between the irrigation areas. In addition, efforts should be made to ensure that beneficiary farmers are aware of the established rules and that the limited amount of water is distributed fairly among irrigation areas.

2) Promotion of water-saving irrigation for efficient water use in the plains

In some of the larger irrigation areas along the Gorgan River, such as Resalat/ Vahdat and Payvand areas, sprinkler irrigation (e.g. centre pipod irrigation) is planned and operated. However, in most of the irrigation areas, traditional surface irrigation (Flood Irrigation) is the prevailing method. This method of surface irrigation is not an efficient use of water due to high evaporation and seepage losses of irrigation water.

In addition, there are several irrigation areas along the Gorgan River that are being planned for study. Therefore, it is expected that the amount of water resources available among the irrigation areas will become tighter in the future, and the river may also experience a drought year depending on rainfall conditions. Given these circumstances, it is necessary to shift irrigation methods to water-saving irrigation techniques such as sprinkler irrigation and drip irrigation to promote efficient use.

3) Construction of small-scale reservoirs and promotion of water-saving irrigation in mountainous and hilly areas

In the cultivation of alternative and existing crops, some crops require supplementary irrigation in addition to rainfall. Research has shown that some farmer groups and production cooperatives in some areas have built small reservoirs or installed water storage tanks and introduced gravity drip irrigation to secure water for irrigation. Such supplementary irrigation methods are also possible in other areas, depending on topographical conditions.

Efforts to construct reservoirs (Ab Bandan) in depressions in the natural terrain will also be effective in reducing the risk of future droughts. The water canal to the reservoir will be planned in combination with the installation of a drainage canal to channel the water from the hillside to the reservoir so that the rainfall from the hillside will flow downstream at once and the drainage will not be concentrated.

CHAPTER 6: STUDY AREAS AND TARGET FARMERS

6.1 Selection of the Study Areas

A total of 17 sites (villages or Rural Production Cooperatives (RPCs)) in Golestan Province have been proposed by the Iranian side as potential target areas for this study (Table 6.1.1). Figure 6.1.1 shows the location of the 17 sites on the land use map. The sites can be divided into three categories based on land use: mountainous, hilly and plains. 5 mountainous, 5 hilly and 7 plains sites.

In the survey, the local issues related to farming and water use are expected to differ greatly depending on the land use (regional characteristics), so the study areas will be classified into mountainous, hilly and plain areas for information collection and compilation. By categorizing the local issues in this way, the scope of application of the effective approach to solving the issues to be considered in the future can be broadened rather than being limited to the site.

As a result of discussions with the Iranian side, two sites from the mountainous areas, two sites from the hilly areas and four sites from the plains will be selected as representative sites for the detailed study, including a survey of farm households in each area. However, the sites have been selected for this study only as a sample of the regional characteristics and not as sites for implementation of the project (or demonstration of the approach). The selection of a site should be based on a comprehensive review of the impact of the project on solving the problem and the spillover and demonstration effects on other areas, after collecting and analyzing baseline information on land conditions, social conditions and environmental conditions for agricultural production, which will be required again when the project is starting to be implemented.

Table 6.1.1 17 Candidate Sites for the Study

Area	Township	Village/ Rural Production Cooperative (RPC)
Mountainous	Kordkuy	Chaman Savar
	Gorgan	**Chaharbagh**
	Gorgan	Shahkuh
	Galikesh	**Farsian**
	Kalaleh	Khezr Olya
Hilly	**Aliabad-eKatool**	**Mohammad Abad**
	Gorgan	Gerankuh
	Azadshahr	**Fazel Abad**
	Minudasht	Qareh Cheshmeh
	Maraveh Tappeh	Lohondor
Plain (Irrigation Network)	**Aq Qala**	**Vahdat and Resalat RPCs**
	Aq Qala	**Payvand RPC**
	Aq Qala	Hemmat RPC
	Bandar E Torkaman	Parto Banavar RPC
	Bandar E Torkaman	Sabz Dasht E Ghaleha
	Gonbad	**Korand RPC**

Bold text in the table indicates villages/rural production cooperatives (RPCs) where farm household surveys are carried out.

Source: JICA study team

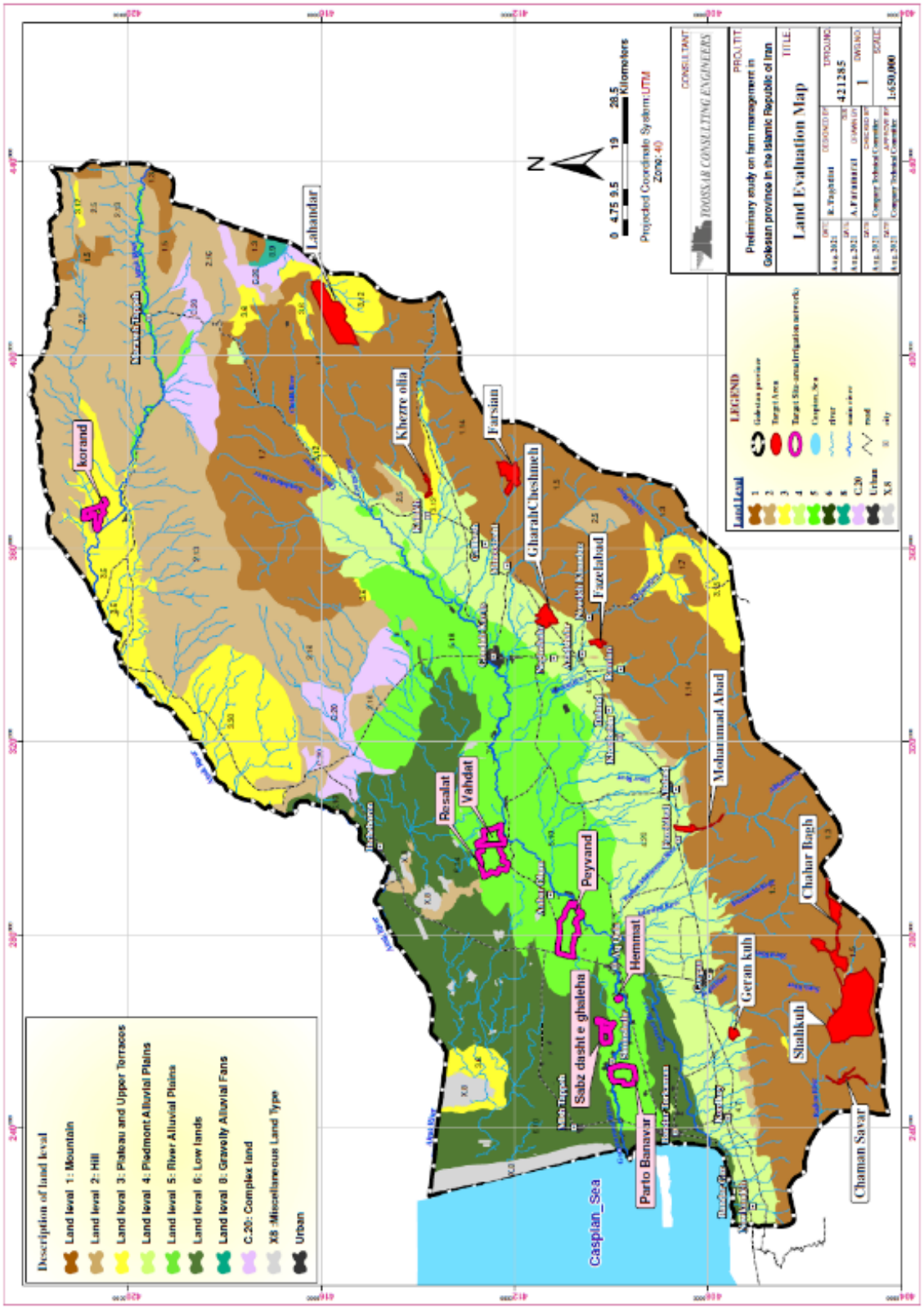


Figure 6.1.1 Location of the 17 Candidate Sites for the Study (Land Use Map)

Source: JICA study team

6.2 Overview of the Study Areas

Basic information on land conditions, social conditions, and crop production environment and water use was collected through field surveys conducted by local partners in the 17 sites covered by the study. In this section, three land use categories are described in detail: mountainous areas, hilly areas and plains (irrigation network).

6.2.1 Land Conditions

Information was collected on land conditions at the study areas, including land use (including agricultural land use), presence and extent of slopes, extent of soil erosion, soil composition and soil salt accumulation, and is summarized below. Mountainous and hilly areas have relatively fertile soils, but are often on slopes, where soil erosion is often a problem. On the other hand, in the plains, there is no soil erosion, but there are problems of sediment inflow due to flooding, salt accumulation and poor drainage. Information on individual villages/RPCs is given in Table 6.2.1.

(1) Mountainous areas

- In addition to agricultural land, there is extensive forest and livestock grazing.
- It is based on rain-fed agriculture, with irrigation only if a water source is available.
- In many cases, the slope is less than 5% on average (12% on average for Khezre Olia)
- Soil erosion is evident on the slopes. There is also wind erosion caused by strong winds.
- Deep with heavy soil, but with partial exposure of rock layers
- No problems with soil salt accumulation (not an issue in the conditions and not captured in the data)

(2) Hilly areas

- In addition to farmland, there are areas of sparse woodland and grassland where livestock grazing is practiced.
- Rain-fed or irrigated agriculture is practiced.
- In many cases, an average slope of less than 3%.
- Soil erosion is evident on the slopes.
- Deep sandy clays or sandy clay loams
- No problems with soil salt accumulation

(3) Plains (irrigation network)

- Extensive farmland or grassland.
- Irrigated agriculture is practiced in those areas where irrigation is provided.
- Flat terrain with 0-8% slopes
- There is no soil erosion caused by the slope. However, there is some damage caused by the inflow of sediment from upstream due to flooding (especially in Parto Bomnavar).
- It is classified as Solonchak (saline soil) and Solonets (alkaline saline soil), and salt damage and poor drainage are problems.

Table 6.2.1 Land Conditions of the 17 Candidate Sites for the Study

No.	Township	Village/ RPC	Environmental Condition					
			Land level	Land Use*1	Slope	Soil erosion	Soil physical & chemical properties	Soil Salinity and Alkalinity
			Level 1 - 8	*Type of land use*	%	*Select the condition whether the soil erosion is Non, Mild, Moderate, or Severe*		
1	Kordkuy	Chaman Savar	Mountain(1.14, 1.1)=437 ha	irrigation farm=286 ha , low forest=151 ha, low rangeland=1 ha	max=6-15 , average=1-3	without soil erosion	The soil cover in these areas is shallow up to deep, uniform and has low heavy texture.Main restrictions of unit land in Golestan Province are including: slope, side erosion.	N.S.(non studied)
2	Gorgan	Chahar Bagh	Mountain(1.14,1.3, 1.5) =2719 ha ,	medium forest=95 ha , irrigation farm (without water restrictions)=500 ha , irrigation farm medium (with water restrictions)=15 ha , high rangeland=2108 ha	max=12-13, average=3-5 (hill=35%)	Due to the cold and strong winds in the region, soil erosion is moderate	The soil cover in these areas is shallow up to deep, uniform and has low heavy texture.Main restrictions of lands are including: steep slope, erosion and limitation of soil depth with rock outcrop.	N.S.(non studied)
3	Gorgan	Shahkuh	Mountain(1.14,1.1, 1.5)=8591 ha , Hill(2)=1289 ha	bare land&without cover= 216 ha , irrigation farm (without water restrictions)=165 ha , irrigation farm medium (with water restrictions)=1372 ha , farm&garden=1494ha , rangeland =6635ha	max=12-20, average=3-7 (hill=48%)		The soil cover in these areas is shallow up to deep, uniform and has low heavy texture.Main restrictions of lands are including: steep slope, erosion and limitation of soil depth with rock outcrop.	N.S.
4	Galikesh	Farsian	Mountain(1.14)=1765 ha	dry farming =689 ha , medium forest=1076 ha	max=8-35 average=2-13	Most lands are sloping and have moderate to high erosion	The soil cover in these areas is shallow up to deep, uniform and has low heavy texture.Main restrictions of unit land in Golestan Province are including: slope, side erosion.	N.A.(Not Available)
5	Kalaleh	Khezre olia	Mountain(1.14)=262 ha , Plateau and Upper Terraces(3.12)= 33 ha	dry farm&irrigated farm=270ha , high forest=25 ha	max=28 , average=12	much erosion	The soil cover in these areas is shallow up to deep, uniform and has low heavy texture.Main restrictions of unit land in Golestan Province are including: slope, side erosion ، soil depth, gravel and flood damage	N.A.(Not Available) ,N.S.(non studied)
6	Aliabad-e-Katul	Mohamadabad	Mountain(1.14)=155 ha , Piedmont Alluvial Plains(4.15)=435 ha	dry farming =3 ha , high forest = 97 ha , irrigation farm (without water restrictions) =488 ha	max=11, average=3	without soil erosion	The soil cover is deep and soil texture is clay and loam clay and in alluvial part includes soils clay, sand, loamy.	S0A0 , N.A.
7	Gorgan	Gerankuh	Piedmont Alluvial Plains(4.15)=392 ha	irrigation farm (without water restrictions)=392 ha	max=2-5, average=1-2 (hill=28%)	without soil erosion	The soil cover is deep and soil texture is clay and loam clay and in alluvial part includes soils clay, sand, loamy.	N.A. , S0A0
8	Azadshahr	Fazelabad	Mountain(1.14, 1.7)=209 ha , Piedmont Alluvial Plains(4.15)=129 ha,Hill(2.17)=20ha	irrigation farm=337 ha , high forest=21 ha	max=11-22, average=2-3	moderate	The soil cover is deep and soil texture is clay and loam clay and in alluvial part includes soils clay, sand, loamy.	N.A. , MIS ,S0A0
9	Minudasht	Ghareh Cheshmeh	Mountain(1.14)=1.4 ha, Piedmont Alluvial lains(4.15)=1346 ha	dry farming =652 ha , high forest =47 ha , irrigation farm (without water restrictions)=455 ha , garden =193 ha	max=8 , average=3	Normally there is not much erosion but in the case of flood they are erosive	The soil cover is deep and soil texture is clay and loam clay and in alluvial part includes soils clay, sand, loamy.	S0A0
10	Maraveh Tappeh	Lohondor	Mountain(1.14)=2430 ha , Plateau and Upper Terraces(3.12)= 2723 ha	dry farming = 1526 ha , medium forest = 1262 ha , high rangeland= 1775 ha , range&farm = 589 ha	max=8-10, average=3-4 (hill=22%)	Most of the land is on slop where there is moderate erosion soil	The soil cover in these shallow to relatively deep areas is gravelly and without profile development.Main restrictions of unit land are including: limitation of soil depth, gravel and flood damage.	N.A.
11	Aq Qala	Vahdat	River Alluvial Plains (5.1)= 1385 ha	low rangeland =1385 ha	0-8%	without soil erosion	Soil cover in these deep areas with moderate to heavy to very heavy texture and moderate to heavy salty. In FAO system is classified as Haplic Solonchaks and Gleyic Solonchaks. Main restrictions of unit land are including: Risk of flooding the land and salty and unsuitable drainage.	S1A1 , S2A2 , S3A3 , MIS
12	Aq Qala	Resalat	River Alluvial Plains (5.1)= 2706 ha	low rangeland=2706 ha	0-8%	Erosion is very low	Soil cover in these deep areas with moderate to heavy to very heavy texture and moderate to heavy salty. In FAO system is classified as Haplic Solonchaks and Gleyic Solonchaks. Main restrictions of unit land are including: Risk of flooding the land and salty and unsuitable drainage.	S0A0 , S1A1, S2A1 , S2A2 , S3A3 , S4A4
13	Aq Qala	Peyvand	River Alluvial Plains (5.1)= 3311 ha	low rangeland=841 ha , dry farming =2451 ha , high rangeland=20 ha	0-8%	without soil erosion	Soil cover in these deep areas with moderate to heavy to very heavy texture and moderate to heavy salty. In FAO system is classified as Haplic Solonchaks and Gleyic Solonchaks. Main restrictions of unit land are including: Risk of flooding the land and salty and unsuitable drainage.	S2A2 ,S3A3 , S4A4
14	Aq Qala	Hemmat	River Alluvial Plains (5.1)= 30 ha	irrigation farm medium (with water restrictions)=17 ha , dry farming =13 ha	0-8%	They are eroded by floods	Soil cover in these deep areas with moderate to heavy to very heavy texture and moderate to heavy salty. In FAO system is classified as Haplic Solonchaks and Gleyic Solonchaks. Main restrictions of unit land are including: Risk of flooding the land and salty and unsuitable drainage.	S2A2 =30ha
15	Gomishan	Parto Bonavar	River Alluvial Plains (5.1)= 1640 ha	irrigation farm medium (with water restrictions)=396 ha, dry farming =1244 ha	0-8%	There is no erosion (the lands of Benavar Cooperative Company did not have any problems in the flood of 1398 because it is higher than the lands of neighboring villages.	Soil cover in these deep areas with moderate to heavy to very heavy texture and moderate to heavy salty. In FAO system is classified as Haplic Solonchaks and Gleyic Solonchaks. Main restrictions of unit land are including: Risk of flooding the land and salty and unsuitable drainage.	S3A3
16	Gomishan	Sabzdasht Ghaleha	River Alluvial Plains (5.1)= 105 ha , Low Lands(6.14) =716 ha	dry farming=178 ha , range&farm=589 ha , low rangeland=54 ha	0-8%	They are eroding along the river	Soil cover in these area is deep with medium areas with light to medium to heavy, strict salty and Ground water is very salty. In FAO system is classified as Gleyic Solonchaks and Mollic Gleysols and Saline Fluvisols. AND Soil cover in these deep areas with moderate to heavy to very heavy texture and moderate to heavy salty. In FAO system is classified as Haplic Solonchaks and Gleyic Solonchaks. Main restrictions of unit land are including: Risk of flooding the land and salty and unsuitable drainage.	S3A3 , S4A4
17	Gonbad	Korand	Plateau and Upper Terraces(3.3)= 939 ha , Hill(2.13)=42 ha	saltland with cover =962 ha , saltland without cover =19 ha	0-8%	Erosion is very low	This land unit includes Eroded and cut plateaus consist of marl and loess materials. The soil cover of these deep soils consists of loess, marl and calcareous materials. General slope varies 2% to 6% and lateral slope 4% to 8% which classified in FAO to Gypsis Regosols.	N.S.(non studied) , Nonsymbol , MIS

Source: JICA study team

Remark- Description of the symbols used on the salinity and alkalinity are as follows:
S0- No salinity limit - with electrical conductivity 0-4 ds/m .
S1- With low salinity limit - with electrical conductivity of 4-8 dS/m
S2- With moderate salinity limit - electrically conductive 8-16 dS/m.
S3- With high salinity limit - with electrical conductivity 16-32 dS/m.
S4 - With very high salinity limit - with electrical conductivity more than 32 dS/m.
A0- No alkalinity-sodium absorption rat (SAR) less than 8 and exchangeable sodium (ESP%) less than 10.
A1- With low alkalinity limit - (SAR) 8-13 and (ESP%) 10-15.
A2 - With moderate alkalinity limit - (SAR) 13-30 and (ESP%) 15-30
A3- With high alkalinity limit - (SAR) 30-70 and (ESP%) 30-50
A4- With very high alkalinity limit - more than 70% (SAR) and 50% (ESP)

6.2.2 Social Conditions

Information was collected on the social conditions of the study areas, including the population of the villages/RPCs, distance and accessibility to main roads, availability of processing facilities in the township, availability of markets, existing examples of agritourism, and the number of ASCs and RPCs in the county where the villages/RPCs are located, and is summarized below. The population of villages in the mountainous areas is small and the working population is declining. On the other hand, infrastructure such as access roads and processing facilities are relatively well developed in all regions. Individual village/RPC information is presented in Table 6.2.2.

(1) Mountainous areas

- Small population per village, 100 to 500 people per village
- With the exception of Chahar Bagh and Shahkuh in Gorgan, it has 2-7 km from the villages to the first asphalt road. Furthermore, access to the motorway is very difficult at each site.
- In the county in which the village is located, there are drying, milling and shipping facilities, mainly for cereals; for Gorgan, there are processing facilities for medicinal plants (canning, distillation, etc.).
- Pick up at local market or by collector
- Gorgan has agritourism sites, potential for eco-agritourism
- 2~5 ASCs in each county

(2) Hilly areas

- Moderate population per village, about 1500-3000 people per village
- It is a relatively short distance to the asphalt road or to the village.
- In the district where the villages are located, there are drying, milling and shipping facilities, mainly for cereals, and in Gorgan, Aliabad-e-Katul and Azadshahr there are processing facilities for medicinal plants.
- Pick up at local market or by collector
- Agritourism sites in Gorgan, Azadshahr (flower gardens) and Minudash (vegetables and herbs)
- 2~5 ASCs in each county

(3) Plains (irrigation network)

- Each RPC has about 5 villages of farmers and more than 3000 members
- In many cases they are bordered by major highways.
- No processing facilities for medicinal plants, scattered drying facilities for cereals
- A depot for the purchase of grain has been set up.
- No existing agritourism sites
- One ASC for each county

Table 6.2.2 Social Conditions of the 17 Candidate Sites for the Study

No.	Township	Village/ RPC	Social Condition						
			Village Population (According to the statistics of 2016)	Distance from Main Road	Existance and type of Processing Facility in the Township	Existance of Wholesale Market in the Township	Potential of Agrotourism	Number of Govemmental ASC in the Township	Number of RPC in the Township
			Number	km				Number	Number
1	Kordkuy	Chaman Savar	83	The distance from the lands to the first asphalt road is 7 km, the distance from Chaman Savar to Kordkoy is 45 km.	In the target area, the shopping center is a cooperative for the production of wheat and barley. In the township: Packaging of seeds and rice, drying of oilseeds preparation of peanut butter - ground seaseme - types of raw sesame meal and oil - vegetable and summer packaging industries, types of pickles and sugar production - packaging of saffron flowers, packages Classification of all kinds of condiments, spices and nuts	they do not have.from Damghan, a buyer comes to the village and buys their products. Or Gorgan market sell their products. .	They do not have it, but it can be created because there is potential in the heights	2	4
2	Gorgan	Chahar Bagh	109	The lands start from the side of the asphalt road and continue up to 2 km of the road, but the distance to the Gorgan-Mashhad highway is 60 km.	Types of paste and canning factories, vegetables freezing and packaging industries, potato and cereal products, nuts, nuts, condiments and spices - malt extract production and fruit syrups and beverages - drying, threshing and packaging industries And oilseeds silage - Rice and grain packaging - Production of pickles and pickles - Canned olives - Types of teas, types of sprouts and cereal bran - rice milling - Rose watering facilities in the target area	Herbal Shop	Tosca Farm Tourism Farm, managed by Mr. Zamani, Mobile: 09124704289, Addressin: front of Kheirat village, uskestan-Shahroud Road, Gorgan	5	8
3	Gorgan	Shahkuh	583	The lands start from the side of the asphalt road and continue up to 2 km of the road, but the distance to the Gorgan-Mashhad highway is 65 km.		Herbal Shop	Tosca Farm Tourism Farm, managed by Mr. Zamani, Mobile: 09124704289, Addressin: front of Kheirat village, uskestan-Shahroud Road, Gorgan	5	8
4	Galikesh	Farsian	500	road side / distance from Galikesh 25 Kilometer	Existence of dryer ,Bojari machine(threshing), paddy, silo -there are in Yengagh village packaging seed and different food seasoning and food spice ,Cereals, grains, rice and nuts	Guaranteed purchase of wheat and canola by the government/ Barley for farmers' own use/ Sunflower (nuts) sold to traders/ And other products sold in local markets and surrounding cities	just ecotourism	3	2
5	Kalaleh	Khezre olia	desolated	13km	Packaging of seeds, nuts, legumes, rice, threshing nuts and oilseeds and legumes, crude vegetable oils and meal, processed nuts and sugar and sugar packaging	In fruit and vegetable stores and markets in the township, as well as for medicinal plants, purchases are made by herbal shop, at the time of harvest, purchases are made by the presence of traders in the area.	In Kuse, Dehneh and Salehabad villags	4	2
6	Aliabad-e-Katul	Mohamadabad	1683	7 Km	Mushroom production units in the form of semi-industrial, rice milling, visit center and handicrafts sales. Freezing and packaging of fruits, vegetables and summer vegetables - factories for preparing pickles and pickles and all kinds of vegetable salads - production and packaging of nuts and dried fruits and packaging of rice and beans and spices and powders and packaging of broken sugar and sugar	They have local markets that sell local bread.	-	3	4
7	Gorgan	Gerankuh	3384	The Kafshgiri and Ospummahale lands start from the side of the road and continue up to 4 km from the road.	Types of paste and canning factories, vegetables freezing and packaging industries, potato and cereal products, nuts, nuts, condiments and spices - malt extract production and fruit syrups and beverages - drying, threshing and packaging industries And oilseeds silage - Rice and grain packaging - Production of pickles and pickles - Canned olives - Types of teas, types of sprouts and cereal bran - Rice	Herbal Shop	Tosca Farm Tourism Farm, managed by Mr. Zamani, Mobile: 09124704289, Addressin: front of Kheirat village, uskestan-Shahroud Road, Gorgan	5	8
8	Azadshahr	Fazelabad	1726	3Kilometers	Drying industries -Drying of oilseeds-Drying and threshing and packaging of grains, cereals and rice-Seed packaging-Packaging of saffron fowers and flowers- Types of paste, jam and canning factories	in local markets	Narcissus flower garden - 15 hectare farm of medicinal plants belonging to Sabzineh Dasht Cooperative Company	3	2
9	Minudasht	Ghareh Cheshmeh	2910	The road is quite close to village	Existence of dryer and packaging industries, **Bojari** (threshing) machine, processing especially for watering, paddy, dairy, oil and canned olives - in Minoodasht city, there is a factory for producing wheat and barley four, packing grains and crops	Sales in stores and local markets and neighboring cities	vegetables ,summer herbs (products in Dozin village (Mr Hadadi 09118747008)	3	2
10	Maraveh Tappeh	Lohondor	709	It is on the side of the road	Flour factory, Oil factory	Sell products to major buyers and traders	-	5	
11	Aq Qala	Vahdat	1750 people and 470 families	It is next to the side road and the distance to the main road is 5 km / distance to Aq Qala 40 km, distance to Gorgan 60 km	There is no in target area	Agricultural products are delivered to Alum depot/ cotton to Aq Qala cotton factory	Existence of Voshmgir dam can affect the potential of Agro tourism - but there is no	1	In Vahdat village, there is 1 production cooperative, but in general, there are 5 production cooperatives in neighboring villages.
12	Aq Qala	Resalat	about 4200 people	Near the road / distance to Alum depot 3 km and to Aq Qala: 35 km	There is no in target area	Agricultural products are delivered to Alum depot/ cotton to Aq Qala cotton factory	-	1	1
13	Aq Qala	Peyvand		4 km distance from the main road and 12 km from Aq Qala	Livestock and poultry	Agricultural products are delivered to Alum depot/ cotton to Aq Qala cotton factory	It does not exist at the moment, but they intend to build a tourist village next to Lagoon	1	1
14	Aq Qala	Hemmat	4050 people	3 km	-	-	-	1	1
15	Gomishan	Parto Bonavar	Siminshahr and 5 villages affiliated to 20,000 people	The land starts from the main road and continues for 7 km	-	-	-	1	1
16	Gomishan	Sabzdasht Ghaleha	5 villages - 3500 people	4.5 km	-	-	-	1	1
17	Gonbad	Korand	5616	2 km / distance to Gonbad Kavous 150 km	Existence of solar-powered dryer facilities (near Inche Broon)	grain depot (for wheat) in Maraveh Tappeh. other products within the province (selling rose - water in gorcery) and neighboring provinces / selling olives in Tarom	-	1	1

Source: JICA study team

6.2.3 Crop Production Environment and Water Use

In order to understand the status of crop production environment and water use in the study areas, information on crops grown (rainfed, irrigated and medicinal plants), climatic conditions, water resources and existing irrigation systems in the villages/RPCs were collected and summarized as follows All the areas have low rainfall and are classified as semi-arid or arid condition. In the mountainous and hilly areas, water is taken from reservoirs (lagoons) and slope overflow irrigation is used for cultivation of wheat, barley, fruit trees and medicinal plants. On the other hand, in the plain irrigation network, wheat, barley, oil crops and cotton are the main crops grown under pressure irrigation (with the intention of introducing medicinal plants that are tolerant to high summer temperatures and salinity). Individual village/RPC information is given in Table 6.2.3.

In order to obtain a more detailed picture of farming conditions and the challenges faced by farmers, the information will be supplemented by a detailed survey, including a farm household survey, covering seven villages/RPCs.

(1) Mountainous areas

- Irrigation with rainwater for wheat, barley, oil crops, pulses and some fruit trees.
- Shallot, damask rose, saffron, borage, etc.
- In addition to water shortages (lack of water facilities) and food damage from livestock grazing, the lack of labor is a serious problem.
- Semi-arid climate of 300~800mm, cool climate of 3~20°C
- Water from springs and river tributaries, reservoirs (lagoons) and private wells
- Traditional canals, overflow irrigation by slope

(2) Hilly areas

- Rainfed or irrigated wheat, barley, oil crops and fruit trees such as olives and citrus.
- Damask rose, saffron, borage, cumin, peppermint, lemon verbena, etc.
- Lack of labor (medicinal plant cultivation is perceived as hard work), no means of processing
- Semi-arid climate of 600~800mm, mild climate of 10~25°C
- Water intake from springs, river tributaries and reservoirs (lagoons)
- Traditional canals, overflow irrigation by slope

(3) Plains (irrigation network)

- Irrigated wheat, barley, oil crops, cotton
- Damask rose, cumin, lemon verbena and others in some cases
- Lack of labor, lack of experience in medicinal plant cultivation, floods/water shortage and salt damage
- 300~500mm dry, mild climate of 10~25°C
- Water abstraction from rivers (Gorgan, Atlak) or dams (Voshmgir dam)
- Lining canals, pressure irrigation, in-field water-saving irrigation (drip irrigation)

Table 6.2.3 Crop Production Environments and Water Use at the 17 Candidate Sites for the Study

No.	Township	Village/ RPC	Crop Production and Water Use					
			Name of Irrigated Crops and Area(ha)	Name of Rainfed crops and Area(ha)	Name of medicinal plants and Area(ha)	Climate Conditions	Main Water Supply Source and Discharge	Current Irrigation System
						Annual Rainfall, Monthly Max-Min Temperature	*Name of dam, river or pond, spring, private well or , Qanat, etc. Q (lit/s)*	*Check whether there are any irrigation system*
1	Kordkuy	Chaman Savar	crops: 167 ha, orchards: 25.5 ha, wheat, squash, beans, chickpeas: 120 ha The predominant crop is wheat.	wheat,squash,peas and beans: 20 ha	shallots : 30m^2	~300 mm , mean - min annual Temp:5.7 mean - max annual Temp: 16.3	15 personal well, springs, from which Lagoon draws water from springs..	Transmission line with a length of 2 km and a diameter of 315 mm and a Lagoon with 10 ha area
2	Gorgan	Chahar Bagh		Wheat: 150 ha, barley: 50 ha, beans: 2 ha	In Shahkooh and Chaharbagh: Damask rose: 20 ha	350 mm, mean - min annual Temp: 3 mean - max annual Temp: 11.9	Springs and rivers, 2 lit/s	Transmission line from springs and rivers: 7km, Lagoon:5-ha
3	Gorgan	Shahkuh		Wheat: 200 ha barley: 25 ha beans: 5 ha		300 mm , mean - min annual Temp: 3 mean - max annual Temp: 11.9	Springs and rivers, 2 lit/s	4 km long transmission line from Shaliar spring to agricultural lands
4	Galikesh	Farsian	Paddy about 126 ha	wheat,beans,barely,canola,sunflower :3000 ha	safferan,Borage: 3 ha	800mm-, mean - min annual Temp: 8 mean - max annual Temp: 20.7	river only to cultivate rice	traditional **flood irrigation**
5	Kalaleh	Khezre olia	2525(ha)	16140 (ha)	20 ha (Nigella)	650mm- , mean - min annual Temp: 11.4 mean - max annual Temp: 24.3	There are about 6 springs in the area that are used for agriculture	In the traditional way and the use of tankers to transfer water from springs to lands
6	Aliabad-e-Katul	Mohamadabad	includes: wheat rice,barley,canola,and gardens 422 hectares	includes:wheat,barely,canola, totally 34 hectares	borage .5 ha (third year) Mr hoseinali kamar mobile: 09111707620	700 mm , mean - min annual Temp:11.1 mean - max annual Temp: 23.6	Mohammad Abad River, Q: 30-50 lit/s	They do not have an irrigation system. There are 2 water wells. They have a 6-hectare area for Lagoon. In the name of Mohammadabad Lagoon, they draw water from Mohammadabad river for Lagoon
7	Gorgan	Gerankuh	Kafshgiri:wheat, Canola, Cotton, Soybeans, Paddy, Citrus Orchards, stone fruits and Olives. Area: 299 ha	Kafshgiri: 413 ha	30 ha (Nigella seeds)	600 mm, mean - min annual Temp: 11.9 mean - max annual Temp: 22.4	Kafshgiri: Lagoon, Well : 150lit/s	Kafshgiri Vilage: *The lands on the western side of the lagoon have a well, and three/ four farmers implemented new irrigation systems. *The lands on the north and east sides of the lagoon, are irrigated with Kafshgiri lagoon
8	Azadshahr	Fazelabad	cultivation area 5189 hectars includs rice,canola,wheat	Cultivation area 4981 includes wheat and medicinal plants	About 30 hectares including saffron, borage, Nigella, stevia, peppermint	800 mm , mean - min annual Temp:10.5 mean - max annual Temp: 22.7	Lasho spring Discharge 0.49 liter per second	flood irrigation traditional method
9	Minudasht	Ghareh Cheshmeh	wheat : 3300(ha), canola:600 (ha), sugerbeet: 150(ha) Rice:1800(ha) Peanut:30(ha)	wheat:6700(ha), Canola:1400(ha), Peanut:150(ha), Medicinal plants: 20(ha) the rest is rainfed	Borage, Lemon verbena,Nigalla, Sage and Lavender: 20 ha	800mm-, mean - min annual Temp: 11.4 mean - max annual Temp: 24.3	Lagoon and well lagoon area: 8 hectares with use 500 cubic meters per years (varriable discharge)	pressurized irrigation system (drip and semi-classic movable) traditional **flood irrigation**
10	Maraveh Tappeh	Lohondor		Wheat, barley, canola, peas, watermelon, sunflower, sesame: 14,000 ha	Damask rose: 150 ha , Nigella, saffron, cumin: 20 ha	600-700, mean - min annual Temp: 8.5 mean - max annual Temp: 19.5	Spring, rain	The products are rainfed
11	Aq Qala	Vahdat	Wheat, barley, cotton and very little canola: 850 ha	600 ha rainfed. dryland farmers are not members of the cooperative	-	320 mm, mean - min annual Temp:12.1 mean - max annual Temp: 24.3	Voshmgir Dam	Pressure irrigation (sprinkler and drip)
12	Aq Qala	Resalat	Wheat: 1000 ha, barley:300 ha, canola:300 ha, cotton: 500 to 600 ha	Wheat: 400 ha, barley:300 ha	It is not cultivated, but the area is prone to cultivation of medicinal plants whose water requirement is low, resistant to heat and soil salinity, and also has a high economic value.	320 mm , mean - min annual Temp:12.1 mean - max annual Temp: 24.3	Voshmgir Dam, In the past, canals were used to carry water, but now pipes are used	2700 ha: new irrigation systems (sprinkler)
13	Aq Qala	Peyvand	Wheat, barley, canola, cotton: 3500 ha, Pomegranate garden: 12 ha, Olive: 10 ha	Due to the Lagoon, all lands are irrigated	-	380 mm , mean - min annual Temp:12.1 mean - max annual Temp: 24.3	About 150 ha: They have deep wells. 100 ha: They have Abandan that if it has water, 1200 ha can be irrigated with it and the rest of the lands are irrigated from Gorgan River.	600 hectares are irrigated by pressure method and the rest by traditional flooding method
14	Aq Qala	Hemmat	Wheat, barley: 300 ha	Wheat: 300 ha, barley: 1000 ha	-	420 mm , mean - min annual Temp:12.1 mean - max annual Temp: 24.3	Gorganrood River (900 liters per second) and 4 people have private wells	Irrigated in the traditional way (using concrete and soil irrigation canals)
15	Gomishan	Parto Bonavar	There is no irrigated cultivation in the area	Wheat, barley, canola, Sugar beet: 1640 ha	Lemon verbena and aloe vera have been planted as an experiment at 1000 m^2 area	450 mm , mean - min annual Temp:12.1 mean - max annual Temp: 23	Gorganrood (Q: 1000 lit/s)	Irrigation is done in the traditional way (using concrete and soil irrigation canals)
16	Gomishan	Sabzdasht Ghaleha	Wheat and barley:1500 ha	barley:3000 ha	-	420 mm , mean - min annual Temp:12.1 mean - max annual Temp: 24.3	Gorganrood (Q: 1.5 m^3/s) and 4 people have private wells.	Irrigated in the traditional way (using concrete and soil irrigation canals) and pressurized irrigation system is under Construction
17	Gonbad	Korand	Wheat, barley, olives: 7391 ha	Wheat, barley, cumin: 7609 ha	cumin, Damask Rose: 3 ha, harmel, *Alhagi* sp. (wild)	180 mm ,mean - min annual Temp:11.1 mean - max annual Temp: 25.1	Atrak River	Traditional (flood) / drip irrigation of 1000 ha, but it was not put into operation due to the electricity problem

Source: JICA study team

6.3 Farm Household Survey at the Study Areas

The target area for the farm household survey was selected after consultation with the Iranian side. As representatives of each region, 2 sites from mountainous areas, 2 sites from hills, and 4 sites from plains were picked up from 17 candidate sites. This section provides an overview of the study and the local issues and needs related to farming and water management. All the responses obtained from the farm household survey are organized in Appendix-2: Farm Household Survey Report.

6.3.1 Overview

Table 6.3.1 shows the study sites where farm household surveys were conducted, and the number of farm households interviewed. Interviews were conducted using a questionnaire, and a total of 214 households responded. Responses were organized by study site and by area classification (mountain, hill and plain). Since Vahdat, Resalat and Payband RPCs are all in the plains and belong to the same district of Aq Qala, they were treated as one study site for the compilation of responses for convenience.

Table 6.3.1 Sites of Farm Household Survey and Number of Responding Farm Households

	Township	Target Sites	H.H	Area Classification
1	Gorgan	Chaharbagh	32	Mountainous
2	Galikesh	Farsian	30	
3	Aliabad-e-Katool	Mohammad Abad	31	Hilly
4	Azdshahr	Fazel Abad	30	
5	Aq Qala	Vahdat, Resalat and Payvand RPCs	61	Plain
6	Gonbad	Korand RPC	30	

Source: JICA study team

Interviews using questionnaires were conducted by local staff in Golestan, with guidance and cooperation from the county offices of the Golestan JAOs and ASCs in charge of the sites under study. The survey was conducted during the COVID-19 pandemic situation and was conducted in compliance with the Code of Conduct stipulated by the local government as well as thorough infection control measures (see picture).

Thorough infection control measures

Questionnaires were also created using a survey design application (KoBo Toolbox). By inputting the survey results into the app on the tablet in the field, the survey results could be checked remotely and in real time. This made it possible to closely communicate with local staff and smooth implementation of the survey even when Japanese experts were not in the field. Along with the interviews with various agencies, literature review, field visits and interviews conducted so far in this study, the results of the farm household survey will also be used as basic data for considering the support approach that will be the output of this study. In particular, the main objective of the farm household survey was to identify issues at the farm household level in the surveyed areas and to identify real local needs.

Interviews with farmers

6.3.2 Issues and Needs

This section outlines the local issues and needs identified in the farm household survey. It should be noted that all the sites surveyed are rural areas where the households consist of farmers whose livelihoods are based on agriculture and the majority of their income is derived from agriculture. Table 6.3.2 shows the key challenges that each site has. The common challenge identified in each region is water scarcity. Droughts, such as those associated with recent climate change, have affected agricultural production activities and hence farmers' livelihoods in all regions. Challenges regarding distribution infrastructure are also commonly cited, with high transport costs being an issue.

Table 6.3.2 Key Issues at Farm Household Survey Sites

No	Area Classification	Target Sites	Item
1	Mountainous	Chahar Bagh	Water shortage, Lack of support from the Agricultural Service Center for fertilizer and pesticides, Expensive cultivation and transportation costs
2	Mountainous	Farsian	The income of the villagers is only through agriculture and livestock production and there are no job opportunities for working in factories
3	Hilly	Mohammad Abad Katool	The road between the farms is not suitable for transportation. Mohammadabad lagoon is small for store water.
4	Hilly	Fazel Abad	Lack of government facilities such as land.
5	Plain	Vahdat, Resalat and Payvand RPCs	Lack of conversion industries and factories, Water shortage, Because the Gorgan River is seasonal, lands are cultivated only once a year Due to being far from the center of the province, they give up for industrial work. Lack of water, Farmers are not familiar with modern agriculture
6	Plain	Sahraye Sabz e Korand	Lack of rainfall, high cost of agricultural inputs, distance from the market outside the village

Source: JICA study team

The challenges associated with water are not only drought, but also flooding due to heavy rainfall, which is regionally selective for mountainous and hilly areas (Chahar Bagh has a small impact, while Farsian states that all households are affected on livelihoods) and regionally common in plains areas to the livelihoods of farm households. (Figure 6.3.1).

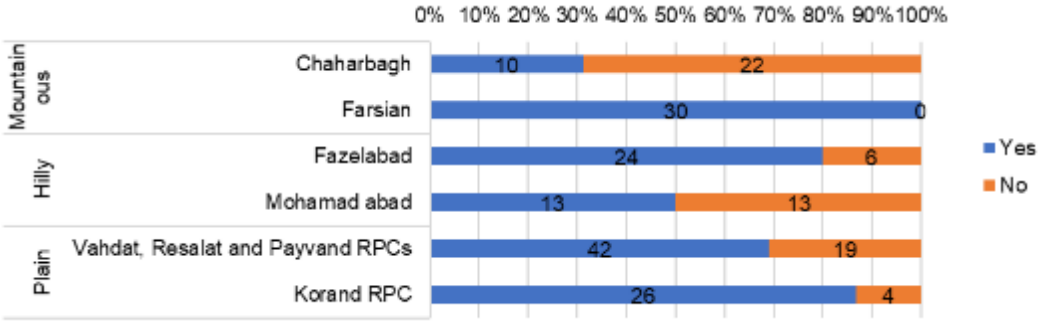


Figure 6.3.1 Flood Damage in 2019 at Survey Sites

Source: JICA study team

In addition, soil erosion in agricultural lands, particularly in mountainous and hilly areas, is becoming more apparent in some parts of the country and is beginning to affect agricultural production. On the other hand, many farmers perceive soil erosion to be caused by heavy rainfall and steep slopes, with limited recognition that it is due to vegetation loss and clearing of farmland (Figure 6.3.2). As a result, very few farmers are currently taking steps to prevent soil erosion (Figure 6.3.3). It is important to create awareness of soil erosion among farmers in order to reduce future water risks.

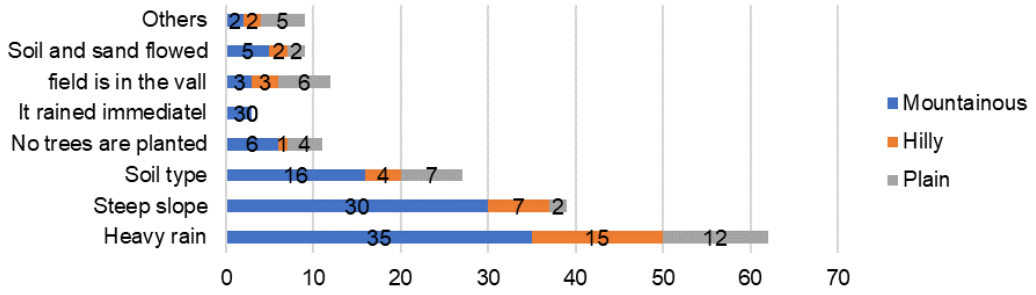


Figure 6.3.2 Awareness of the Causes of Soil Erosion at Survey Sites

Source: JICA study team

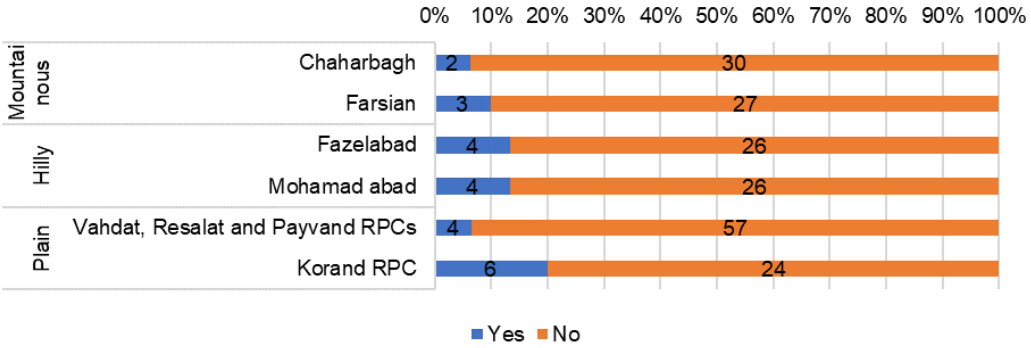


Figure 6.3.3 Soil Conservation Activities at Survey Sites

Source: JICA study team

The survey examines approaches to the introduction and dissemination of conversion crops, including medicinal plants, from the perspective of stabilizing farm household livelihoods and conserving water and soil. In the target sites where farm household surveys were conducted, medicinal plants are used in daily life and are treated as familiar to farmers. On the other hand, the main crops grown in the target sites are cereals such as wheat and barley or oilseed crops such as oilseed rape, and experience in cultivation of medicinal plants are limited (Figure 6.3.4). However, the total number of farmers who have experience in medicinal plant cultivation and those who wish to introduce new medicinal plants in the future account for half of the valid responses, and it can be said that many of the surveyed farmers are highly interested in medicinal plant cultivation. Unlike other sites, many farmers have experience in medicinal plant cultivation at Korand RPC. This is due to the introduction of cumin cultivation because wheat cultivation has become difficult due to water shortages and salt accumulation in recent years.

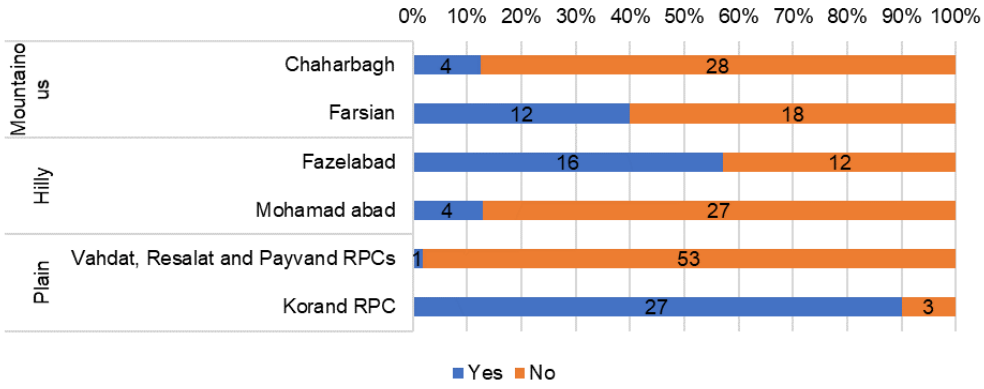


Figure 6.3.4 Experience in Cultivation of Medicinal Plants at Survey Sites

Source: JICA study team

The needs of farmers when introducing conversion crops in the surveyed sites are summarised in Figure 6.3.5. In all regions and target sites, many requests for financial support and support for agricultural equipment and materials such as seeds and fertilizers were mentioned. Currently, administrative support for equipment and financial access is focused on strategic crops and is limited to some medicinal plants. In order to promote the introduction of conversion crops in the future, it is essential to consider the introduction of these administrative support schemes. In addition to cultivation management technology for newly introduced crops that are in high demand from farmers, it is desirable to provide training related to the enlightenment of water and soil conservation and acquisition of conservation measures technology, which became clear in the farm household survey.

Based on the local issues and needs identified in the farm household survey, a support approach that meets the farm needs is proposed as the output of this study (See Chapter 8 for details of the support approach)

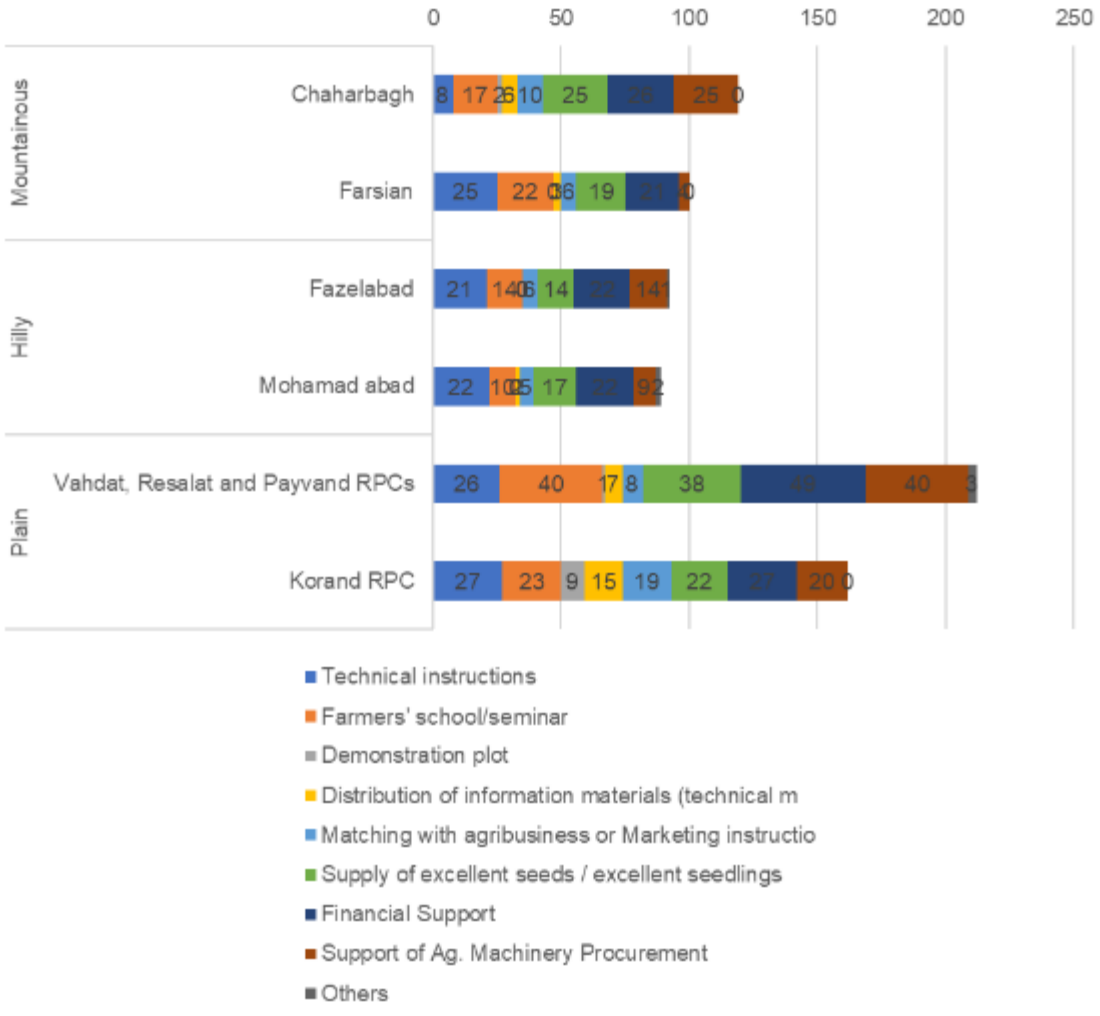


Figure 6.3.5 Needs for the Introduction of Conversion Crops at Survey Sites

Source: JICA study team

CHAPTER 7: ORGANIZING WORKSHOP

7.1 Overview

A workshop introducing Japanese good practices was organized for practitioners involved in farming and water management in MOJA and Golestan JAO in a hybrid format both at a venue in Gorgan, Golestan Province and online. The workshop was conducted a total of three days under the agenda shown in Table 7.1.1.

Table 7.1.1 Workshop Agenda

Date and time	24 Jan (Mon) - 26 Jan (Wed), 2022.
Venue	Botanic Palace Hotel, Gorgan
Day 1 (Session 1).	theme 'Strengthening market competitiveness through value chain development' Overview of the medicinal plant value chain in Japan. 1. Positioning and definition of medicinal plants in Japan. 2. Quality requirements for medicinal plants as raw materials for pharmaceutical use. 3. Collaboration between pharmaceutical companies and farmers. 4. Examples of mechanization in medicinal plant cultivation. Agricultural value chain development initiatives in Japan - direct marketing projects. 5. Examples of direct sales outlets (roadside stations run by farmers). 6. Farmers' efforts to cultivate functional vegetables Participants: 29 MOJA staff, Golestan JAO farming and horticulture-related practitioners and others at the venue, 173 online.
Day 2 (Session 2).	theme 'Strengthening agricultural and rural resilience for sustainable agricultural development' 1. Agricultural policy and land improvement projects in Japan 2. Multifunctional functions, agricultural disaster prevention and agricultural modernization. 1) Maintenance of the multifunctional role of agriculture and administrative support. 2) Disaster prevention of reservoirs and soil run-off control technology. 3) Agricultural modernization (pipelines, water-saving agriculture, agricultural ICT) 3. Irrigation technology (drought water management, asset management) 4. Agricultural disaster prevention technology (reservoir management and hazard mapping). Participants: 34 MOJA staff, Golestan JAO soil and water management practitioners and others at the venue, 172 online.
Day 3 (Session 3).	discussion 'How to utilize Japanese technology and know-how be used to address local challenges in Golestan' Participants: about 45 MOJA officials, Golestan JAO county office executives and others.

Source: JICA study team

Organizing workshop

Introduction of good practices in Japan

7.2 Results of the Questionnaire

The workshop was conducted as a hybrid of on-site and online (MS Teams) and generally ran smoothly, although there were a few problems with the online connection on the first day. The workshop was followed by an active Q&A session, showing a high interest in the Japanese case studies. An online questionnaire (MS Forms) was conducted after the workshop and 120 out of 229 participants responded to the questionnaire.

Figure 7.1.1 shows the items of interest at the workshop. In Session 1, the topics of particular interest were 'Cultivation management of medicinal plants', 'Market-oriented Agriculture', 'Diversification of agriculture (Crop diversification)' and 'Mechanization and processing technology of medicinal plants', and in Session 2, 'Water use adjustment during drought in agriculture'. A high level of interest has been expressed. In fact, many questions were raised about these items during the workshop, indicating that they are highly relevant to local issues.

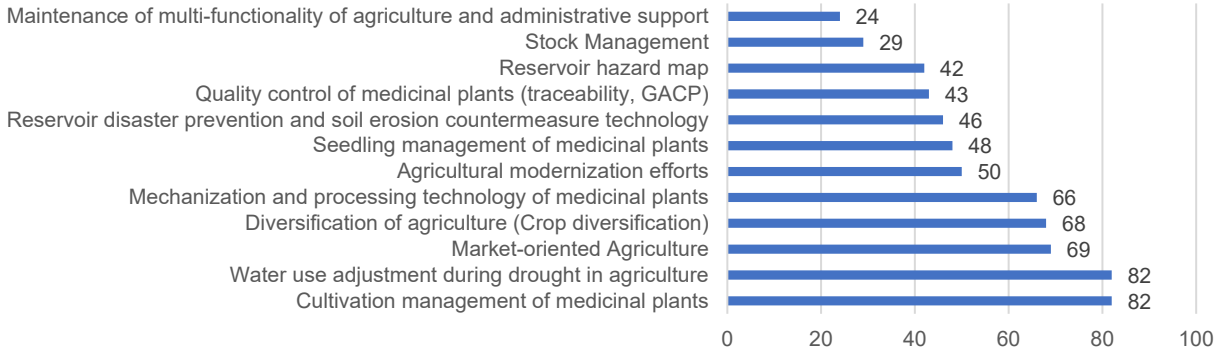


Figure 7.1.1 Items of Interest

Source: JICA study team

Figure 7.1.2 shows the results of responses to requests for future participation in the workshop. Almost all survey respondents said they would like to attend the workshop again. It can be said that there is a high level of interest in Japanese technology, know-how, and governmental efforts, and that this workshop was able to be carried out effectively and appropriately.

Using the questionnaire, participants were asked about the items they would like to learn if there was such a workshop in the future. Based on these results, training opportunities are proposed for items that are of high interest in the field and related to local issues in the support approach to be summarized as the output of this study. In that case, it will be bearded in mind the utilization of training schemes (in addition to online training, training in Japan, site visit of advanced sites, etc.).

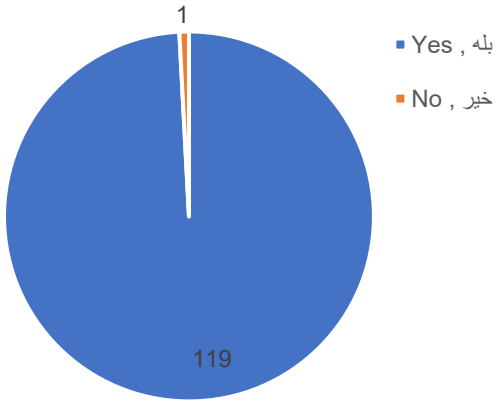


Figure 7.1.2 Willingness to Participate in Workshops

Source: JICA study team

CHAPTER 8: PROPOSED APPROACHES

8.1 Concept of the Approaches

The study aims to propose measures based on the series of information collection surveys in the Golestan Province. The JICA study team examines approaches considering the basic concepts mentioned below and proposes 12 approaches as shown in Table 8.1.1. It should be noted that this proposal is presented as a result of the study conducted by the JICA study team and is not directly linked to the adoption and implementation of technical cooperation projects implemented by JICA.

Basic Concepts

- The goal is set to stabilize **farmers' livelihoods**, and effective approaches for the achievement of the goal are to be selected.
- The approaches focus on **"agricultural and rural development"** and **"water resources management (resilience enhancement)"** to improve the livelihoods of farm households.
- The approaches using **technologies, know-how, and other advantages of Japan** are to be selected**.**

Table 8.1.1 Proposed Approaches against Identified Issues in Golestan Province

Instructions in special specifications	Item	No.	Approach
● Demonstration and dissemination of medicinal plant cultivation ● Proposition of farm management approach	**Agricultural and rural development**		
	Farm income improvement and crop diversification	1	Demonstration for the introduction of conversion crops
		2	Extension for the promotion of conversion crops
		3	Information collection study on value-added agricultural products
		4	Training for livelihood improvement model in the rural community
	Water and soil conservation and sustainable agriculture	5	Approach for soil and water conservation measures in the farmland
		6	Development of locally applicable agricultural technologies
● Proposition of water resources management approach	**Water resources management (resilience enhancement)**		
	Reduction of flood risk	7	Study on Gorgan River flood control plan development
		8	Participatory farmland disaster prevention in hilly areas
	Reduction of drought risk	9	Capacity development for irrigation water resources management
		10	Promotion of irrigation modernization policy
		11	Asset management training to extend the service life of irrigation facilities
● Examination of proper schemes and approaches	**Management**		
	Promotion of project formation	12	Capacity development for project planning, operation, and management

Source: JICA study team

8.2 Farm Management Approach and Demonstration & Extension Approach for Medicinal Plant Cultivation

This section examines the approaches for agricultural and rural development, which contribute to the

stabilization of farmers' livelihoods.

8.2.1 Approaches for Increasing Farm Income and Crop Diversification

(1) Challenges, constraints, and countermeasures

The floods in March 2019 in Golestan Province damaged approximately 250,000 ha of farmland including irrigated farmland, and 50% of farm households are still affected according to the farm household survey (JICA study team, 2021). Under the condition, the Government of Iran has requested a project aiming at the demonstration and dissemination of crops to be converted, including medicinal plants, to restore the livelihoods of flood-affected farmers and reduce flood and other water risks.

The main crops in Golestan Region are oil crops, wheat, rice, and barley. However, water risks such as floods and droughts associated with recent climate change have made it difficult to cultivate crops. Therefore, the farmers are interested in the cultivation of fruit trees and medicinal plants more than before, which can be cultivated on a small-scale basis with rain-fed water and can get value-added through processing. In addition, perennial crops are to be introduced as conversion crops in terms of water and soil conservation, since they have deep and extensive roots. In addition, since medicinal crops can be cultivated in a relatively small area and are subject to processing, they are easy to handle regardless of whether they are men or women, and it is known that to provide effective income generation opportunities for rural households.

The farm household survey (JICA study team, 2021) reveals that farmers are interested in the cultivation of medicinal plants but have very little experience in cultivation management. Moreover, research and development have been started by some government agencies, guidelines, and manuals on the cultivation of medicinal plants for field-level demonstration and farmer dissemination are still under development, though. In addition, since linkages between local farmers and processors/distributors (markets) are limited, it is needed to establish a medicinal plant value chain to increase farmers' profit.

Table 8.2.1 Challenges and Countermeasures for the Introduction of Conversion Crops

Challenge		Countermeasures
Mountainous areas, hilly areas, and plains	− Damage to rural livelihoods and income due to the flood − Reduction of productivity of major crops due to water risk − Insufficient management techniques for medicinal plants cultivation − Inadequate dissemination system − Developing medicinal plant value chain (including processing and distribution)	− Evaluation of profitability of crops to be converted − Examination of the suitability of different agricultural production environments for the introduction of crops to be converted (seed access, fertilizer management, harvesting methods, etc.) − Consideration of cultivation and processing technologies by the needs (market) of the sellers − Preparation of guidelines for the cultivation of medicinal plants and extension materials (manuals) for dissemination − Value chain development through more sophisticated and efficient processing and distribution − Site visits and training on government and business initiatives to improve rural livelihoods and revitalize communities

Source: JICA study team.

Although farmers have strong demands for financial support and subsidization for agricultural equipment and materials such as seeds and fertilizers when new crops are introduced, administrative support for equipment and financial access is limited in the case of medicinal plants. Such a situation can be a constraint for the farmers to start new crops. When new crops are introduced, following

approaches are necessary against the challenges in the table above.

(2) Outline of the proposed approach

No. 1 Demonstration for the introduction of conversion crops

- Necessity

The floods in March 2019 caused severe flooding damage in Golestan Province, affecting approximately 250,000 ha of farmland, including irrigated farmland, and 50% of farm households are still affected as mentioned before. In addition, water risks (floods and droughts) associated with recent climate change have made it difficult to cultivate major crops in the region.

In such a situation, the necessity to introduce conversion crops is increased, and medicinal plants, which have drought tolerance, salt tolerance, cold tolerance, and erosion prevention capacity have been identified as candidates. However, farmers have very little experience in the cultivation of those crops, and it is necessary to prepare any guidelines and manuals for the demonstration of the cultivation of medicinal plants at the field level to disseminate the techniques to the farmers by government agencies.

The proposed approach will focus on the demonstration of medicinal plant cultivation. The feasibility of the newly introduced crops is examined through the establishment of cultivation management systems suitable for the natural environments and the assessment of farmers' profitability. It is noted that records of project activities will be compiled as guidelines and technical manuals to facilitate smooth dissemination to farmers in the future.

Agricultural production in Golestan Province depends on the amount of rainfall, and farming is vulnerable to environmental changes. Further, around 250,000 ha of farmland was affected by the floods in March 2019, and thus, it is needed to shift crops, from conventional ones to such as medicinal plants, to improve the incomes of the affected farmers and to conserve water and soil in the region.

A wide variety of medicinal plant species grow wild or are cultivated in Iran historically in accordance with the diverse climate conditions for traditional use, especially in rural areas. In addition, saffron and damask rose are important crops as export commodities in Iran, and the promotion of such medical plants is a key component in the current agricultural policy since it can improve farmers' livelihoods and promote the export of agricultural products is essential. In fact, "the Sixth Five-Year Plan for Economic, Social and Cultural Development" also mentions the promotion of medicinal plants and sets out a plan to achieve a planted area of 250,000 ha of medicinal plants within the period. In other words, this approach is in line with Iran's development plan, and its implementation is of great significance.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Examination of implementation system (discussion with related organizations, implementation entity and its implementation capacity, possibility of budget measures, necessity of support (technical transfer), etc.).
- Securing land for demonstration/ exhibition fields and coordinating with related farmers and

cooperatives.

- Summary table

Name:	Demonstration for the introduction of conversion crops		
Objective.	To demonstrate cultivation management and processing technologies through pilot projects for the introduction of conversion crops like medicinal plants, which contribute to the improvement of farmers' livelihoods and water and soil conservation.		
Problem to be solved: (Alignment with higher-level policies)	Agricultural production in Golestan depends on the amount of rainfall, and the farmers are vulnerable. In addition, soil erosion has become serious in recent years as a result of deforestation and clearing in hilly areas, and water and soil conservation are urgent. Furthermore, around 250,000 ha of farmland was damaged by the floods in March 2019, and it is needed to shift crops from current ones to medicinal plants, which will restore the livelihoods of affected farmers and contribute to water and soil conservation in the region. Currently, guidelines and manuals for the cultivation of converted crops such as medicinal plants are only available for crops, and utilization of them in extension services is limited.		
Areas covered	Mountainous area	Hilly area	Plain areas
	○	○	○
Target group	Administrative officers of the Golestan JAO in charge of mountainous, hilly, and plain irrigated areas, and staff of ASC		
Implementing agency:	Ministry of Agriculture-e-Jihad (MOJA) Golestan Jihad-e-Agriculture Organization (JAO) Golestan Agriculture Service Center (ASC) Golestan Centre for Natural Resources Research and Education. Gorgan University of Agriculture and Natural Resources, et al.		
Activities.	1st year (selection of target area, implementation of market and farm management status survey, selection of pilot project site and model farm based on survey results, and implementation of training) − Survey of distribution status and needs of sellers (markets) in the target area − Evaluation of cultivation suitability by target area (Current status survey of seedling access, fertilization management, harvesting method, etc.) − Selection of pilot project site (demonstration / exhibition field to be installed at ASC located in suitable cultivation area) − Selection of model small-scale farms (and members of cooperatives) in the target area and evaluation of profitability − Implementation of farmer training on soil conservation, irrigation water use, farming plans, etc. 2nd year (Implementation of pilot project in the target area and demonstration of introduction of converted crops in model farmers (including cooperatives)) − Examination of cultivation and processing technology that meets the needs (market) of the seller − Implementation of pilot projects (comprehensive demonstration/ exhibition fields such as water utilization, soil conservation, and fertilization management) − Introducing planned conversion crops to model small-scale farmers (and cooperatives) in the target area Note: In the demonstration/ exhibition field, medicinal plants including perennials can be candidates for cultivation tests, but it takes multiple years for the growth to stabilize until the yield is stable. Therefore, the cultivation test will include a cultivation test in which annual crops are cultivated between trees to demonstrate the securing of income until the yield stabilizes. 3rd year (evaluation and preparation of extension materials based on the implementation of demonstration of conversion crop introduction in pilot projects and model farmers (including cooperatives)) − Examination of cultivation and processing technology that meets the needs (market) of the seller (Cont.) − Implementation of pilot projects (comprehensive demonstration/ exhibition fields such as water utilization, soil conservation, and fertilization management) (Cont.) − Systematic introduction of conversion crops to model small-scale farmers (and cooperatives) in the target area (Cont.) − Evaluation and examination of profitability of model small-scale farms in the target area		

	− Preparation of conversion crop introduction manual for soil conservation and profit improvement of small-scale farmers − Preparation of guidelines and training materials (manuals) for extension of converted crops that meet market needs for improving the livelihoods of small-scale farmers

Input	Contents of technical transfer
• Dispatchment of Experts (agricultural planning, irrigation and drainage, medicinal plants, land use and soil conservation, processing and distribution, organization strengthening, operational coordination) and their cost for activities • Materials / equipment / land (irrigation materials / equipment, materials such as seedlings and fertilizers, demonstration / exhibition field site) • Land preparation (field preparation, water use facility maintenance), etc.	• Cultivation adaptability evaluation of medicinal crops • Examination of cultivation and processing techniques • Farm Profitability analysis • Creation of guidelines and training materials (manuals)

Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).
• Establishing a sustainable implementation system and budget on the Iranian side even after the project is implemented • In terms of recovery from the floods in 2019, priority is to be given to areas with severer damage. In addition, attention should be paid to legislation related to forest conservation in the farmlands adjacent to forest areas. It is needed to consider land ownership for drainage channels development and the use of unused land. • In order to encourage the active participation of women, the farms of the demonstration plots should be set up in a place that is easily access, and female agricultural extension staffs and facilitators will be involved. Also, when creating a manual, make sure that the technology can be used by women.

No. 2 Extension for the promotion of conversion crops

Necessity

The floods in March 2019 caused severe flooding damage in Golestan Province, affecting approximately 250,000 ha of farmland, and 50% of farm households are still affected even in 2021 according to the farm household survey. In addition, water risks such as floods and droughts make it difficult to cultivate major crops in the region.

It is needed to convert crops from current ones to medicinal plants have been identified as candidates, since they have drought tolerance, salt tolerance, cold tolerance, and soil conservation capacity. Using the guidelines and technical manuals developed in the “No. 1 Demonstration project for the introduction of conversion crops”, an extension system of the cultivation of newly introduced crops by the staff of Agricultural Service Centers (ASCs) is to be developed. Such an extension system can be utilized in similar areas in Iran in the future.

Agricultural production in Golestan Prrovince depends on the amount of rainfall, and farmers are vulnerable to environmental changes. In addition, approximately 250,000 ha of farmland was inundated by the floods in March 2019, and it is needed to shift crops by new crops including medicinal plants, which are effective for the recovery of livelihood of farmers and water and soil conservation.

A wide variety of medicinal plant species grow wild or are historically cultivated in accordance with diverse climatic conditions in Iran and they are traditionally utilized, especially in rural areas. In addition, medicinal plants, such as saffron and damask rose, are important as export commodities, so they play an important role since the agricultural policy aims not only to improve farmers' livelihoods but also to promote the export of agricultural products. In fact, “the Sixth Five-Year Plan for Economic, Social and Cultural Development” also mentions the promotion of medicinal plants and sets out a plan with specific

figures to achieve a planted area of 250,000 ha of medicinal plants within the period. In other words, this approach is in line with Iran's development plan, and its implementation is of great significance.

Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Examination of implementation system (discussion with related organizations, implementation entity and its implementation capacity, possibility of budget measures, necessity of support (technical transfer), etc.).
- Securing land for demonstration/ exhibition fields and coordinating with related farmers and cooperatives.

Summary table

<table>
<tr><td>Name</td><td colspan="3">Extension for the promotion of converted crops</td></tr>
<tr><td>Objective</td><td colspan="3">Establish an administrative extension service system for cultivation management and agro-processing for the introduction of converted crops, including medicinal plants for improvement of farmers' livelihoods and water and soil conservation.</td></tr>
<tr><td>Issues to be solved: (Alignment with higher-level policies)</td><td colspan="3">Agricultural production in Golestan Region depends on the amount of rainfall, and farmers are vulnerable. In addition, soil erosion has become serious in recent years as a result of deforestation and clearing in hilly areas, making water and soil conservation an urgent issue. Furthermore, approximately 250,000 ha of farmland, including irrigated farmland, was affected by the floods in March 2019, and there is a need to shift crops from current ones to new ones including medicinal plants, for the livelihoods of affected farmers and water and soil conservation. Currently, guidelines and manuals for the introduction of converted crops such as medicinal plants are only available for a part of crops, and their use in extension services is limited.</td></tr>
<tr><td rowspan="2">Areas covered</td><td>Mountainous area</td><td>Hilly area</td><td>Plain irrigated area</td></tr>
<tr><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Target group</td><td colspan="3">JAO and ASC staff and farmers in the targeted areas</td></tr>
<tr><td>Implementing agency</td><td colspan="3">MOJA
Golestan JAO
ASCs in Golestan
Golestan Centre for Natural Resources Research and Education.
Gorgan University of Agriculture and Natural Resources, et al.</td></tr>
<tr><td>Activities</td><td colspan="3">- Farmer training by extension staff at ASC using guidelines and extension manuals for the extension.
- Monitoring of small-scale farmers' livelihoods
- Demonstration of technology by the Golestan JAO
- Recommendations for extension and water and soil conservation policies in Iran</td></tr>
<tr><td colspan="2">Input</td><td colspan="2">Contents of technical transfer</td></tr>
<tr><td colspan="2">• Dispatchment of Experts (farming, extension services, value chain development, medicinal plants, processing and distribution, organization strengthening, water management, operational coordination), and their activity costs
• Materials / equipment / land (irrigation materials / equipment, materials such as seedlings and fertilizers, demonstration / exhibition field site)
• Land maintenance (field maintenance, water use facility maintenance), etc.</td><td colspan="2">• Extension of demonstration projects
• Monitoring method
• Training and capacity building on value chain construction, water management, and soil conservation</td></tr>
<tr><td colspan="4">Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).</td></tr>
</table>

- Establishing a sustainable implementation system and budget on the Iranian side even after the project is implemented
- From the perspective of recovery and restoration from the 2019 floods, priority will be given to areas with severer damages and more conducive to the restoration of livelihoods. In addition, attention should be paid to forest conservation legislation on the periphery of forest lands with farmlands. Consider land ownership when developing drainage channels and utilizing idle and unused land.
- Encourage women to participate in farm training through female extension staffs and female facilitators. In addition, consideration should be given to planning a training schedule in consideration of the time zone when it is easy for women to participate.

No. 3 Information collection study on value-added agricultural products

- Necessity

Efforts to add value to medicinal plants in Golestan Province are not made sufficiently, and the processors and pharmaceutical companies, who were interviewed, said that they need initiatives to ensure stable quality and quantity, and administrative policies and measures to support them.

In addition, medicinal plants made in Iran are mainly exported as raw materials such as spices, coloring, and fragrant materials, and if Iran intends to export high value-added materials such as pharmaceutical raw materials in the future, it is needed to establish a shipping system satisfying the quality standards of imported raw materials in the foreign countries, in accordance with GACP. Also, it is necessary to establish and introduce traceability systems.

For the first time, it is needed to identify existing policies related to quality control of agricultural products, for instance, GACP, food traceability system, and agro-processing system in Iran. Also, it is important to collect data on the demand for processed crops in Iran and neighboring countries to analyze the potential of value-added products, especially medicinal plants. Through this survey, it is possible to clarify the actual situation and technical challenges of agro-processing in Iran and discuss how to strengthen competitiveness in the market.

“The Sixth Five-Year Economic, Social and Cultural Development Plan” aims at food security, food self-sufficiency, and enhancing competitiveness in the international markets for export expansion. In other words, the Plan intends to promote farmers' market competitiveness through value-adding of products. It also mentions specific plans to introduce the standards for food safety and quality control, establish a monitoring system from production to consumption, and develop infrastructures such as processing and packaging equipment.

The processing and trading of all agricultural products including medicinal plants, livestock, and fisheries covering imports and exports have been transferred to the MOJA since 2013. In other words, the scope of the MOJA, which previously covered agricultural production, has been expanded to all stages of agricultural production, processing, and distribution, enabling the MOJA to strengthen the agricultural value chain.

In recent years, with increasing social demands for GACP and traceability in the international markets, it is desirable to implement institutional policies and human resource development in these areas for market competitiveness enhancing agricultural products.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Review of the existence of similar study and study results based on discussions with related organizations
- Confirmation of the necessity of this study based on the development policy of the Iranian government in this field
- Consultation and coordination for conducting study with related organizations

Summary table

<table>
<tr><td>Name</td><td colspan="3">Information collection study on value-added agricultural products</td></tr>
<tr><td>Objective</td><td colspan="3">To identify the current status of value-added agricultural products in Iran, including GAP, traceability, and agro-processing policies and initiatives, especially primary processing by farmers and agro-processing by small and medium enterprises, and to collect information to examine the possibility of Japanese cooperation.</td></tr>
<tr><td>Issues to be solved: (Alignment with higher-level policies)</td><td colspan="3">Iran's “Sixth Five-Year Economic, Social and Cultural Development Plan” states food security and self-sufficiency as well as strengthening competitiveness in international markets to expand export capacity and promotes the strengthening of farmers' market competitiveness through value-added agricultural products. It also has specific plans to introduce standards for food safety and quality control, establish a monitoring system from production to consumption and develop infrastructures such as processing and packaging equipment, to strengthen the market competitiveness of agricultural products further through value addition.</td></tr>
<tr><td rowspan="2">Areas covered</td><td>Mountainous area</td><td>Hilly area</td><td>Plain irrigated area</td></tr>
<tr><td>○</td><td>○</td><td></td></tr>
<tr><td>Target group</td><td colspan="3">MOJA, Golestan JAO, seed dealers, farmers (cooperatives), processors, and distributors.</td></tr>
<tr><td>Implementing agency</td><td colspan="3">MOJA</td></tr>
<tr><td>Activities</td><td colspan="3">Policies on GACP, traceability, and agro-processing by the public administration.
Information collection on the demand for processed agricultural products in Iran and neighboring countries.
R&D status of domestic research institutions.
General understanding of Iran's policy on small and medium agro-processing enterprises.
(1) Human resources development system in the industry
(2) Accessible financial services for small and medium enterprises in Iran
Understanding the actual situation and technical challenges of agro-processing</td></tr>
<tr><td colspan="2">Input</td><td colspan="2">Contents of technical transfer</td></tr>
<tr><td colspan="2">• Dispatchment of Experts (agro-processing, distribution, and trade, value chain development, agricultural economics), and their activity costs.
• Equipment required for the study</td><td colspan="2">• Various data analysis techniques
• Improvement of coordination ability with related organizations</td></tr>
<tr><td colspan="4">Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).</td></tr>
<tr><td colspan="4">• Providing data and information that will be the basis for appropriate analysis
• Understand the current role of women in agricultural processing and promote women's participation.</td></tr>
</table>

No. 4 Training for livelihood improvement model in the rural community

Necessity

Farmers' incomes are low in rural areas within Golestan Province, and the village economy is stagnant. This has led to a widening economic gap between urban and rural areas, as well as an exodus of young people from the cities, making it necessary to take measures to improve livelihoods in rural areas to promote rural development. In a survey of farm households, farmers in mountainous and hilly areas showed a high level of interest in agritourism as a livelihood enhancement measure.

On the other hand, the main crops in Golestan Province are food crops such as wheat and barley, and

oilseed crops such as rapeseed, which have been treated as strategic crops and subject to price guarantees, and farmers have not needed specific marketing and branding initiatives.

In recent years, farmers in Golestan Province have been interested in growing medicinal plants as a conversion crop, but linkages with processors and distributors (markets) have been weak, and it is necessary to promote relationship building and collaboration to increase farmers' competitiveness in the market, and to develop a support system.

"The Sixth Five-Year Economic, Social and Cultural Development Plan" promotes food security and self-sufficiency as well as strengthening competitiveness in international markets to expand export capacity, which will strengthen farmers' market competitiveness through the value addition of agricultural products.

In addition, guidelines and technical standards for agritourism initiatives have been developed by the MCTH in Iran in 2020, and the permit system for agritourism has been begun. Golestan Province promotes agritourism initiatives, and it is the 1st province that has gained an agritourism permit in the country. Agritourism attracts only tourists and can contribute to job creation and income increase of residents. Further development of agritourism is expected in the future.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Allocation of personnel and examination / analysis work (analysis of training results conducted so far, learning related to efforts to improve rural livelihoods in Iran, examination of applicability, selection of trainees).
- Establishment of follow-up system for trainees after the training by Iranian side.

- Summary table

Name	Training for livelihood improvement model in the rural community		
Objective	Value-adding of agricultural products and diversification of income generation in rural areas to stimulate the economy of rural areas		
Issues to be solved: (Alignment with higher-level policies)	Farm incomes are low in rural areas of Golestan Province compared to the urban areas, and the youth tend to go to big cities for work. This has led to a widening economic gap between urban and rural areas, and measures to improve livelihoods in rural areas need to be taken for rural development. Golestan JAO is interested in agritourism and other initiatives to revitalize rural areas. In addition, "the Sixth Five-Year Economic, Social and Cultural Development Plan" has the objective to achieve food security and self-sufficiency as well as strengthening competitiveness in international markets to expand export by strengthening the market competitiveness of farmers through value-added products.		
Areas covered	Mountain district	Hilly area	Plain irrigated areas
	○	○	
Target group	MOJA Golestan JAO (including in charge of rural women and nomads) National Federation of Agricultural Cooperatives (IRCO)		
Implementing agency	MOJA Golestan JAO National Federation of Agricultural Cooperatives (IRCO)		
Activities	To conduct site visits and training on administrative and business initiatives for income improvement and revitalization in the rural areas of Japan under the support of local		

	administrations and agricultural cooperatives − "Sixtiary industrialization", agricultural-commercial cooperation, and green tourism. − Income improvement approaches by JICA (SHEP approach and others). − Green tourism by staying in farm households in the rural area − Development of processed agricultural and medicinal plant products − Developing sales channels through direct sales of agricultural products, etc. − Effective public information campaign on rural development
Input	Contents of technical transfer
• Dispatchment of trainees from MOJA, Golestan JAO and related organizations to Japan	• Site-visit and training of the above activities at advanced farmers, green tourism related companies, and government agencies in Japan
Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).	
• The active involvement of women, youth, and ethnic minorities, known as vulnerable groups, is to be facilitated in the implementation. • Establishment of follow-up system for trainees after the training by Iranian side	

8.2.2 Approaches for Water and Soil Conservation and Sustainable Agriculture

(1) Challenges, constraints, and countermeasures

Golestan Province has been urbanized with the drastic change in land use as well as other regions in Iran. The proportions of farmland in 1984 and 2018 are 29.9% and 33.9%, respectively, making the farmland area the largest proportion of land use, with a decrease in the forest area. The farmland has continuously expanded from plains to hilly and mountainous areas, which accelerated the decrease of vegetation, which leads to soil erosion.

The results of the farm household survey (JICA study team, 2021) revealed that the farmers identify soil erosion as a big issue in the farmlands, particularly in mountainous and hilly areas, which gives damage to farmlands. Many farmers understand that soil erosion is caused by heavy rainfall and steep slopes However, they don't know decrease of vegetation on the soil surface is also one of the causes. Therefore, very few farmers are currently taking measures to prevent soil erosion.

In the plains, limited rainfall and excessive evaporation have accelerated soil salinization, and it is difficult to cultivate wheat and barley, which have relatively low salt tolerance. In Aq Qala Township, which is located in the study area, soil shows high alkalinity or more severe salinity in rainfed farmlands, and it is needed to change the crops to be cultivated, from wheat to other crops. It is reported that drought frequency is increased due to climate change, which may accelerate soil salinity in the future in the area. Following table summarizes the challenges and countermeasures for water and soil conservation.

Table 8.2.2 Challenges and Countermeasures for Water and Soil Conservation

Challenges		Countermeasures
Mountainous area and hilly area	− Reduction of water holding capacity in the farmland − Soil erosion in sloping fields	− Fostering farmers' awareness of water and soil conservation. − Control of soil erosion and water run-off through structural measures (terrace construction, establishment of small footpaths and catch drain according to contour lines, setting retailing wall and drainage channels). − Measures by crop cultivation (planting erosion-resistant crops, mulching, inter-cropping, soil improvement, etc.) to reduce soil erosion and improve soil water holding.
Plain area	− Reduction of agricultural productivity due to salt accumulation − Inefficient irrigation	− Production, introduction demonstration, and dissemination of salt-tolerant crops. − Demonstration and dissemination of efficient irrigation systems

Source: JICA study team

The farmers may be reluctant to make efforts for water and soil conservation in mountainous and hilly areas since such activities don't bring about immediate benefits such as agricultural income for them. Fostering awareness of water and soil conservation is the first step toward disseminating the technology to farmers. Furthermore, agricultural labor is limited even in the plain areas due to urbanization in recent years, and a labor-saving is important to implement the proposed measures.

(2) Summary of the proposed approach

No. 5 Approach for soil and water conservation measures in the farmland

- Necessity

According to the farm household survey (JICA study team, 2021), soil erosion is observed on 44% of the surveyed households' farmlands. The interviewees said that the causes are strong rainfall intensity, steep fields, soil characteristics, and wind erosion in order. Concerning effective countermeasures, a small number of respondents mentioned terrace construction and contour cultivation as well as the cultivation of erosion-resistant crops. Some farmers have applied these measures in their fields, but they are very few, and dissemination of the measures is not well established.

The reason for the situation above seems that the natural resources and watershed management office implements soil conservation works and afforestation for soil conservation by employing contractors, and the contractors are in charge of maintenance and management for three years after the tree plantation. As a result, local people don't participate in such activities actively. Considering the current conditions, measures against soil erosion are to be implemented in a participatory manner, especially when new crop introduction or perennial crop planting are implemented.

- Structural measures: construction of terrace, small soil bank along contour lines and catchment channels, simple run-off sediment ponds at the bottom of the field (from a sustainability perspective, use procurable and low-cost materials such as local stones and soil as far as possible) is proposed.
- Crop-based measures: introduction of crops which are profitable for farmers and effective for soil conservation, study tours to advanced areas in terms of soil conservation is practiced, farmer-led crop selection, planting of erosion-resistant crops, soil management through vegetation cover, intercropping, mulching and so on are to be recommended.
- Capacity building of stakeholders: preparation of manuals, training of extension workers and members of rural production cooperatives, identification of technologies that can be disseminated

from members to other members, strengthening links among extension workers, rural production cooperatives, and farmers, preparation of guidelines summarizing the project implementation process are to be done.

The proposed approach will be implemented in the fields, where soil run-off is observed, and conversion crops are grown. Applicable measures will be selected according to the effectiveness of erosion control. Golestan JAO is requested to compile the project activities to the guidelines and technical manuals and to develop a system for disseminating the measures and the results.

It is very difficult to control soil erosion after it has occurred once, and it is important to take prevention measures on slopes, even though soil erosion has not been observed yet. In Iran, various soil erosion control measures and soil conservation works have been implemented by research institutions and other government agencies, but the activities of the people are limited to the plantation of seeds and saplings of trees. For promotion of participatory soil conservation, it is necessary to improve farmers' livelihoods, such as by introducing more profitable crops, rather than focusing solely on soil conservation measures.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Examination of implementation system (discussion with related organizations, implementation entity and its implementation capacity, possibility of budget measures, necessity of support (technical transfer), etc.).

- Summary table

Name	Approach for soil and water conservation measures in farmlands		
Objective	Examination of measures for soil and water conservation in steep areas and capacity development for implementation for reduction of water risk		
Issues to be solved: (Alignment with higher-level policies)	Land use on hillsides has been changed into farmlands, especially wheat field, which requires frequent plowing since farmers are subsidized for wheat cultivation. As a result, the farmlands are vulnerable to soil erosion by intensive rainfall, which leads to soil deterioration. Furthermore, a decrease in the water holding capacity of farmland is regarded as one of the reasons for water run-off in 2019. In addition, “the Sixth Five-Year Plan for Economic, Social and Cultural Development” states watershed management works, water harvesting, soil and water conservation, and introduces modern water-saving irrigation methods with the objectives of “improvement of water productivity, and promotion of appropriate use of groundwater and surface water'. Therefore, it is judged the proposed project is relevant		
Areas covered	Mountainous area	Hilly area	Plain irrigated area
	○ Steep farmlands where soil erosion is observed, and new crops are planted	○ Steep farmlands where soil erosion is observed, and new crops are planted	
Target group	Farmers and cooperative members engaged in farming in mountainous and hilly areas.		
Implementing agency	MOJA, Golestan JAO, and Natural Resource and Watershed Management Office		
Activities	Following measures are proposed to reduce soil erosion and water run-off to adjacent fields in accordance with the topographical conditions such as slope and field shape: - Implementation of pilot projects by the construction of terrace fields, catch drain, soil retaining, and drainage channels according to contour lines. - Implementation of pilot projects by plantation of erosion-resistant crops, mulching,		

	inter-cropping, soil improvement, vegetation cover, etc. - Implementation of study tours to advanced areas in Iran and support for farmers to select crops by themselves. - Development of guidelines for water and soil conservation at the field level and technical manuals, including the role of JAO and support activities - Identification and display of the results of the measures taken, and enhancement of awareness of water and soil conservation by farmers. - Development of a dissemination system by using the guidelines and technical manuals mentioned above
Input	Contents of technical transfer
• Dispatchment of Experts (soil conservation, farming with soil and water conservation, irrigation farming, drainage planning, farmers' organizations, training supervision/monitoring and evaluation, coordinator) and their activity costs • Materials/ equipment/ facilities (cultivation machinery, drainage channel materials, sediment storage materials, seedlings, etc.)	• Selection of necessary measures • Creating guidelines and manuals • Fostering awareness of water and soil conservation through site-visit of advanced areas • Training and capacity building to improve implementation capacity
Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).	
• Establishing a sustainable implementation system and budget on the Iranian side even after the project is implemented • It is needed to confirm the willingness of the farmers to convert crops. • The results of the farm household survey should be taken into account when selecting the target farmland. The agreement of the farmers should be obtained.	

No. 6 Development of locally applicable agricultural technologies

Necessity

In some areas of plains along the Gorgan River, farming is difficult due to the saline and alkali soil. Salt is accumulated on the soil surface when drained water is stagnant, called waterlogging, in the farmlands. Groundwater reaches the soil surface during the hot and dry season, which give negative impacts on crop cultivation. Such a situation is observed in the field with inefficient irrigation system, especially, at the end of non-lined canals.

It is proposed to flush salt accumulated on the surface into the soil subsoil by leaching, proper drainage, and soil improvement, especially, in case of heavy clay. At the field level, proper drainage and irrigation are necessary, and establishment of drainage and culvert drainage is effective for preventing soil salinization. In the field with medium to high saline soil, salt-tolerant crops can be cultivated as far as they are properly managed.

In the two target irrigation systems downstream of the Gorgan River, namely, Sabz dast e ghaleha and Hemmat soil is classified as high salinity, however, wheat and barley are cultivated by traditional flood irrigation and rainwater. Given this situation, it seems possible to grow crops, considering topographic conditions and the availability of irrigation water. When salt-tolerant crops are introduced, it is necessary to develop agricultural technology in accordance with the characteristics of the farmlands.

Soil and water quality in the Gorgan River basin has been studied by the Soil and Water Department of MOJA and other organizations, and there are many study results. Furthermore, research on salt-tolerant crops is also active in Iran. Modernization of irrigation facilities, such as the use of sprinklers and drip irrigation, is also a trend in Iran. Thus, it is desirable to discuss how to introduce salt-tolerant crops in the saline and alkaline fields with relevant organizations and experts. In addition, the results of the discussions can be applied in similar areas.

The saline soil has long been a long-term issue in Iran, and crop production improvement and breeding research have been conducted extensively in universities and research centers over the past half-century.

However, no strategic plan has been developed to integrate them, and research is often conducted in the laboratory, with limited field surveys to select appropriate crops in terms of salt tolerance and water use efficiency.

Besides, JICA Iran Office, in cooperation with the Arid Land Research Centre, Tottori University, has organized a webinar for the MOJA on the topic of "Research and Development on Agriculture in Arid Land and Drought Control". Moreover, many staff of MOJA have gained degrees from universities in Japan or have participated in joint research with Japanese universities, which established good relationships with Japanese researchers.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Examination of implementation system (discussion with related organizations, implementation entity and its implementation capacity, possibility of budget measures, necessity of support (technical transfer), etc.).

- Summary table

<table>
<tr><td>Name</td><td colspan="3">Development of locally applicable agricultural technologies</td></tr>
<tr><td>Objective</td><td colspan="3">To develop adaptable agricultural technologies and promote crop diversity for sustainable agriculture in saline soil of the plains along the Gorgan River. To apply the results to similar irrigated areas in Iran.</td></tr>
<tr><td>Problem to be solved: (Alignment with higher-level policies)</td><td colspan="3">The Sixth Five-Year Plan for Economic, Social, and Cultural Development aims to increase water and land productivity through appropriate crop selection, watershed management works, water harvesting, soil and water conservation, and introduce modern water-saving irrigation methods covering 600,000 ha/year within the goal of "promotion of increase of water productivity and appropriate use of groundwater and surface water". Given agricultural crop diversification, the promotion of salt-tolerant crop cultivation will improve water and land productivity through appropriate crop selection.</td></tr>
<tr><td rowspan="2">Areas covered</td><td>Mountainous area</td><td>Hilly area</td><td>Plain irrigated area</td></tr>
<tr><td></td><td></td><td>○
Irrigated areas with medium to high salt and alkali values</td></tr>
<tr><td>Target group</td><td colspan="3">Production cooperatives and farmers/farmer groups in the downstream irrigated areas of the Gorgan River.</td></tr>
<tr><td>Implementing agency</td><td colspan="3">MOJA (Water and Soil Department)
Golestan JAO (Water and Soil Department).
Soil and Water Research Institute (SWRI) and other organizations concerned</td></tr>
<tr><td>Activities</td><td colspan="3">Cause analysis of soil salinity in the target areas
Analysis of existing data and discussions with relevant agencies on the cultivation of applicable crops
Study on the development and introduction of adaptable technologies for crop cultivation
Examination of demonstration based on the results of consultations and studies.</td></tr>
<tr><td colspan="2">Input</td><td colspan="2">Contents of technical transfer</td></tr>
<tr><td colspan="2">• Dispatchment of Long-term experts (irrigation) and short-term experts (water-saving techniques, salt-tolerant crops, salt-tolerant crops, soil analysis, water quality analysis) and their activity costs,
• Materials, equipment, land, etc. (simple analytical equipment, maintenance of test fields)</td><td colspan="2">• Development and introduction of water-saving techniques, salt-tolerant crop production techniques, analysis method and other techniques</td></tr>
</table>

Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).
• Establishing a sustainable implementation system and budget on the Iranian side even after the project is implemented • In demonstration trials, existing crop cultivation in irrigated areas is not adversely influenced.

8.3 Water Resource Management Approach

This section examines the approach from the perspective of "water resources management (resilience enhancement)", which contributes to stabilizing farmers' livelihoods.

8.3.1 Approaches for Flood Risk Reduction

(1) Challenges, constraints, and countermeasures

According to the farm household survey (JICA study team, 2021), i) 69% of the households experienced livelihood difficulties due to the flood in 2019, while 50% of farm households are still affected by the floods; ii) 48% of the households experienced a flood in their farmland; iii) 44% of the surveyed households face soil erosion in their farmland; iv) 33% of the interviewed households suffer from poor drainage, possibly due to runoff soil from degraded land. From these results, it is thought that degradation in the watershed caused water run-off, which led to the flood.

Most of the interviewed farmers said that structural measures such as the construction of river embankments, and/or check dams, channel maintenance, and removal of sediment deposits from rivers are effective to prevent soil erosion, they are followed by the introduction of tree crops and conservation farming methods are also important. Based on the survey and analysis of causes of the flood, challenges and countermeasures against flood risk are summarized in the table below.

Table 8.3.1 Challenges and Countermeasures against Flood Risk

Challenge		Countermeasures
Watershed level	− Uncontrolled land-use change, namely, from forest to farmland in mountainous and hilly areas − Reduction of river discharge capacity − Reduction of water holding capacity in farmland	− Conservation of forest land, regulation of land use on forest periphery. − Improvement of river infrastructures such as embankments and sediment weirs − Farmland conservation through afforestation and vegetation cover on the soil surface − Development of flood control and groundwater recharge by using idle land and depressions.
Farmland level	− Soil erosion in the farmland − Discharge of eroded soil into rivers − Insufficient and poor functioning of drainage channels	− Identification of soil eroded sites, such as steep areas, and assessment of the extent of erosion − Introduction of erosion-resistant crops − Soil conservation farming methods, implementation of soil retaining work − Maintenance of sedimentation ponds − Arrangement of catch drain and setting of drainage channels, and expansion of cross-sections of drains − Erosion control of farm roads and slopes in the farmlands − Fostering awareness for farmland conservation among the farmers. − Regular monitoring and repair of soil eroded sites

Source: JICA study team

There are few integrated watershed management plans, which several agencies are working together in some cases. Also, research and study of land use to mitigate floods in the watershed have yet to be sufficiently implemented. In addition, drainage channels in the farmland are not sufficiently developed,

and even where drainage channels exist, maintenance and management activities such as sediment removal activities and repair of structures are not actively implemented very much. It is needed to take following approach for flood risk reduction to formulate, plan and implement measures to address the issues listed in the table above.

(2) Summary of the proposed approaches

No. 7 Study on Gorgan River flood control plan development

- Necessity

The causes of flooding in the Gorgan River in March 2019 are various, including extensive and heavy rainfall, which may have been influenced by recent climate change, deforestation due to the clearing of forest land, farmland development in the hills, and rapid water run-off by the reduced water-holding capacity of farmland. Peak runoff at the Gazagli site and the Vashem Gir Dam gate site in the plains of the Gorgan River were calculated at 750 m^3 /s and 666 m^3/s. Especially, the runoff at the Gazagli site corresponds to an 80-year probability, which shows the magnitude of the flooding[24].

One of the reasons for the floods is the inadequate capacity of river structures as well as the poor water holding capacity of farmland and soil. According to the farm household survey (JICA study team, 2021), soil erosion is observed in some mountainous and hilly slopes in the tributary river, which flows into the Gorgan River. It seemed that soil erosion and the reduction of the water holding capacity of farmlands caused the water and soil run-off. For flood risk reduction in the Gorgan River basin, it is necessary to develop comprehensive measures aiming at strengthening riverbanks and conservation of the entire basin, including farmlands and forests.

It is desirable to conduct a series of studies for the plan formulation, namely, an analysis of the current status of the basin, such as current forests, rivers, and farmland conditions, land use plans in the future, examination of flood mitigation measures based on the plans mentioned, development of management systems, and preparation of financial plans. It is proposed to use satellite images and existing hydrological data. Relevant organizations for basin management are various. The Ministry of Energy (Water Company) is responsible for structural measures in river systems, while MOJA is in charge of farmland management. Moreover, the natural resources and watershed management office is responsible for environmental protection in the forest reserves including fringe farmland. Thus, cooperation among the bodies is needed. The survey will clarify their roles & responsibility.

The causes of the severe damage by the floods in 2019 are recognized as intensive heavy rainfall, reduction of water holding capacity in farmland, and inadequate capacity of river structures. It is important to identify such causes and takes measures against flood risks in collaboration with several agencies, and also necessary to address future climate change. “The Sixth Five-Year Economic, Social and Cultural Development Plan” focuses on watershed management works, water harvesting, soil and water conservation in “Improvement of water productivity and promoting appropriate use of groundwater and surface water”. The formulation of a development plan can contribute to the effective implementation of the national policy in Iran.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

[24] Golestan Province Agriculture-Jihad Organization Technical Report Excerpts

- Review of the existence of similar study and study results based on discussions with related organizations
- Confirmation of the necessity of this study based on the current status of rehabilitation plan and implementation after flood disaster
- Consultation and coordination for conducting study with related organizations

- Summary table

<table>
<tr><td>Name</td><td colspan="3">Study on Gorgan River flood control plan development</td></tr>
<tr><td>Objective</td><td colspan="3">A water and soil conservation plan to reduce flood risk in the Gorgan River basin including farmland and forests are to be developed.</td></tr>
<tr><td>Problem to be solved (Alignment with higher-level policies)</td><td colspan="3">The causes of the severe flood in 2019 are regarded as intensive heavy rainfall, reduction of water holding capacity in farmlands, and insufficient capacity of river structures. This approach for examining the causes and preparing for future flood risks is judged relevant. In addition, the Sixth Five-Year Plan for Economic, Social and Cultural Development states watershed management works, water harvesting, soil and water conservation, and introduces modern water-saving irrigation methods within the objectives of “improving water productivity and promoting appropriate use of groundwater and surface water”. Thus, the formulation of a development plan aiming at water and soil conservation and catchment management at the catchment level is very relevant.</td></tr>
<tr><td rowspan="2">Areas covered.</td><td>mountain district</td><td>hilly area</td><td>Plain irrigated areas</td></tr>
<tr><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Target group.</td><td colspan="3">Administrative bodies involved in watershed management</td></tr>
<tr><td>Implementing agency (co-operating organizations)</td><td colspan="3">MOJA
Golestan JAO
Golestan Water Company
Golestan Natural Resource and Watershed Management Office</td></tr>
<tr><td>Activities.</td><td colspan="3">− Analysis of the current land use status in the watershed of the Gorgan River tributaries using satellite imagery, etc.
− Identification of eroded areas and planning of erosion control measures
− Analysis and assessment of current river structures and capacities based on run-off analysis for each tributary basin, and preparation of river infrastructure development plans based on forecasted floods in the future
− Current status of farmland use (soil, vegetation cover, crops) and development of farmland conservation plans, including measures to prevent soil erosion
− Analysis of the current status of forest conservation (legal regulations, afforestation, and other conservation activities) in state-owned forests and other forests, and formulation of conservation plans</td></tr>
<tr><td colspan="2">Input</td><td colspan="2">Contents of technical transfer</td></tr>
<tr><td colspan="2">• Dispatchment of Experts (watershed conservation, water resources management, land use, GIS/satellite image analysis, meteorological and hydrological analysis, river structures, farmland conservation, forest conservation, economic analysis), and their activity costs
• equipment required for the study (image analysis tools etc.)</td><td colspan="2">• Various data analysis technologies
• Improving planning ability
• Improvement of coordination ability with related organizations</td></tr>
<tr><td colspan="4">Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).</td></tr>
<tr><td colspan="4">• Inter-agency co-ordination (Institutional design for collaboration with other institutions is required)
• Check whether plans approved by the relevant bodies have already been drawn up and are at the stage of budgetary action and implementation.
• Providing data and information that will be the basis for appropriate analysis</td></tr>
</table>

No. 8 Participatory farmland disaster prevention in hilly areas

- Necessity

It is needed to take measures for soil and water conservation by means of the improvement of water holding capacity in the farmland and preventing soil erosion. According to the site survey and the farm household survey, erosion has been observed in some mountainous and hilly areas, although the extents of erosion are various. The latter indicates that the causes of soil erosion are steep farmlands and intensive rainfall. To achieve soil and water conservation in the area, both plantation of erosion-resistant crops and structural measures are to be implemented. Also, it is necessary to design drainage facilities for the removal of eroded sediment, as well as the examination of the temporary storage of soil in existing lagoons, and the use of idle land as flood control basins or groundwater recharge areas.

Factors of soil erosion are land use, topographical characteristics, and soil conditions. Therefore, efficient measures are to be taken considering the conditions of sub-watershed such as lagoons and villages. It is important to involve the people, who are familiar with the situation, to examine the current conditions of erosion and necessary countermeasures. The plan and implementation structure/schedule should be discussed between the people and the Golestan JAO. ASC staff also can provide technical information and examine effective measures together with the people.

If the target watersheds are adjacent to national forests, it is important to discuss the participation of the people in tree planting activities. Such conservation activities for their farmlands and/or neighboring farmlands can create awareness for the improvement of land productivity. It is noted that the activities should be implemented in watersheds with high priority, where erosion is observed, and the results of the activities are to be disseminated to other similar watersheds.

One of the reasons for the floods in 2019 is regarded as a reduction of the water holding capacity of farmland, thereby increase of water run-off. It is important to target eroded watersheds as a part of water conservation measures to reduce further runoff in the future. In addition, the Sixth Five-Year Plan for Economic, Social and Cultural Development states watershed management works, water harvesting, soil, and water conservation in “improvement of water productivity and promoting appropriate use of groundwater and surface water”, and the relevance of promoting the matters is significant.

Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Examination of implementation system (discussion with related organizations, implementation entity and its implementation capacity, possibility of budget measures, necessity of support (technical transfer), etc.).

Summary table

Name	Participatory farmland disaster prevention in hilly areas		
Objective	To promote water conservation on farmland in the Gorgan River basin and to prevent flood run-off into the river, which leads to enhancement of awareness of farmland by farmers		
Problem to be solved (Alignment with higher-level policies)	A decrease in the water holding capacity of farmland was identified as a factor in water run-off. In addition, “the Sixth Five-Year Plan for Economic, Social and Cultural Development” states watershed management works, water harvesting, soil and water conservation, and introduces modern water-saving irrigation methods in 'improving water productivity and promoting appropriate use of groundwater and surface water'. Therefore, the proposed pilot project is regarded as relevant.		
Areas covered.	Mountainous area	Hilly area	Plain irrigated area
	○	○	

	Villages, lagoons, or small river catchments where soil erosion is observed	Villages, lagoons, or small river catchments where soil erosion is observed	
Target group.	Farmers who cultivate in sub-watershed where soil erosion is observed		
Implementing agency (co-operating organizations)	MOJA Golestan JAO		
Activities.	− Villagers, who are familiar with the situation of soil and water run-off, can work with JAO to identify eroded sites on farm roads and slopes and assess the extent of the erosion. − JAO and farmers will discuss water conservation measures (sedimentation pond, catchment drain, and drainage networks) for future flood risk reduction. − Lagoons, existing depressions, and idle land can be used as temporary flood storage basins when sediment retaining ponds and catch drains are constructed. − It is needed to clarify the roles of JAOs and residents for prevention measures according to the extent of erosion. Minor repair activities of eroded areas are carried out by participation of the residents (necessary equipment and materials are provided by the JAO). − Participation of people in tree-planting activities − JAO will compile such activity processes to guidelines for conservation measures so that the guidelines can be used for conservation activities in other basins.		
Input		Contents of technical transfer	
• Dispatchment of Experts (participatory development, farmland conservation, drainage planning, run-off analysis, soil erosion/prevention measure planning, supervision/monitoring, extension/project support staff), and thier activity costs • Necessary materials/ equipment/ facilities (workshop management with resident participation, drainage channel construction and simple earth and sand storage facility materials)		• Improvement of facilitator ability • Creating guidelines for conservation measures • Necessary training and capacity building	
Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).			
• Establishing a sustainable implementation system and budget on the Iranian side even after the project is implemented • Results of the farm household survey should be taken into account for the selection of pilot areas, and consensus of the villagers is to be gained. • The link between converted crop cultivation and soil erosion control is to be paid attention to. • It is necessary to comply with any rules for forest conservation in the farmlands adjacent to forests. • Land ownership is to be confirmed when drainage channels are constructed and/or unused and idle lands are utilized for the activities mentioned above.			

8.3.2 Approaches for Drought Risk Reduction

(1) Challenges, constraints, and countermeasures

According to the farm household survey (JICA study team, 2021), irrigation water sources are diverse in the plains, e.g., river, rainfall, lagoon, reservoir, spring, and wells, while the sources are largely dependent on rainfall and spring mainly in mountainous and hilly areas. Mostly, basin irrigation or furrow irrigation, which are not very effective in terms of water use efficiency, is applied. In the plain, both owner farmers and tenant farmers conduct irrigation farming. On the other hand, there is a tendency that tenant farmers practice irrigation farming while owner farmers depend on rainfall for farming. It is not clear whether it is due to unfavorable irrigation conditions, or insufficient investment in irrigation facilities. However, to cope with these situations and to diversify crops, it is needed to develop irrigation facilities on their farmland. Based on the results of the series of surveys, challenges and countermeasures against drought risks are summarized in the following table.

Table 8.3.2 Challenges and Countermeasures against Drought Risk

Challenge		Problem-solving measures (disincentives)
Plain (e.g., landscape)	− Fair water supply based on water rights and water use rules − Efficient and equitable water allocation against water loss − To develop a long-term plan for maintenance/renewal of irrigation facilities by taking measures against aging − Feasibility study on the cultivation of salt-tolerant crops	− Agreements on water distribution in the pump irrigation area based on the amount of the Gorgan River − Establishment of a communication and monitoring system among the irrigation systems − Modernization of irrigation method to reduce water loss by canal lining, sprinkler irrigation, the shift from an open canal to a pipeline, appropriate operation of irrigation and drainage facilities, and human resource development − Development of facility management plan for the life elongation of facilities. − Research on salt-tolerant crop cultivation in saline and alkaline soil
Hilly and mountainous area	− Development of irrigation facilities for the cultivation of the diverse crop − Development of irrigation facilities to secure irrigation water according to the topographical conditions	− Development of small-scale irrigation systems according to the characteristics of various crops and topographical conditions

Source: JICA study team

As mentioned in the table above, the rule of equitable water distribution based on water rights is not very clear in the irrigated plain area and the administrative capacity for the renovation of existing irrigation facilities is under development. In addition, the planning capacity for the design of irrigation facilities for various crops and topographical conditions in hilly areas is to be improved. For drought risk reduction in the future, following approaches are to be implemented.

(2) Summary of the proposed approaches

No. 9 Capacity development for irrigation water resources management

- Necessity

In downstream of the Golestan Dam, many irrigation systems take water from the Gorgan River by using pumps (see “Chapter 5.2.2 Current status of irrigation systems”). However, the rule on how to distribute water in the command area is not clear. According to the activity report of Participatory Irrigation Management prepared by Payvand Cooperative, water taken by pump from the river is allowed only in the season, when river water is sufficient, and probably, the situation is the same as in other irrigation systems. The irrigation water is temporarily stored in reservoirs in each command area and distributed to the farmlands according to necessity, however, the amount of water is not sufficient.

If the water amount of the Gorgan River is more than that by pump irrigation capacity, water can be distributed without any problems. Still, there is a possibility that annual and periodic river water may be fluctuated in the future, partly due to climate change. When the river is not sufficient, excessive pumping of water upstream of the command area could make it difficult to take water downstream.

A pump irrigation plan from Voshmgir Dam is currently promoted in the Resalat/ Vahdat irrigation area, which has 3,342 ha command area, along the Gorgan River. There are many irrigation systems along the river, including just planning, all of them use/will use pump-irrigation systems. In order to achieve equitable water allocation in the systems along the Gorgan River in the future, it is necessary to

decide the water intake amount for each irrigation system according to the river flow. Thus, it is important to establish rules for pump operation among the stakeholders, e.g., production cooperatives and farmers/farmer groups responsible for pump operation, and to establish a monitoring system, including mutual communication of the amount of water intake.

The Sixth Five-Year Plan for Economic, Social and Cultural Development aims to increase water and land productivity through appropriate crop selection, watershed management works, water harvesting, soil and water conservation, and modern water-saving irrigation covering 600,000 ha/year. Under the limited water resources, equitable water distribution among the beneficiaries is useful to soften expected drought risks in the future and contribute to the stability of local communities.

In particular, through technical cooperation projects on participatory water management, one of the JAO departments inherits such technology, and it is possible to disseminate participatory water management in other areas and proper water distribution in case of drought.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Examination of implementation system (discussion with related organizations, implementation entity and its implementation capacity, possibility of budget measures, necessity of support (technical transfer), etc.).

- Summary table

<table>
<tr><td>Name</td><td colspan="3">Capacity development for irrigation water resources management</td></tr>
<tr><td>Objective</td><td colspan="3">To provide equitable water supply to intake irrigation systems in the downstream of Golestan Dam under limited water resources.</td></tr>
<tr><td>Problem to be solved (Alignment with higher-level policies)</td><td colspan="3">“The Sixth Five-Year Plan for Economic, Social and Cultural Development” aims the improvement of water and land productivity through appropriate crop selection, watershed management works, water harvesting, soil and water conservation, and the introduction of modern water-saving irrigation covering 600,000 ha/year. With limited water resources, equitable irrigation water distribution among the beneficiaries can contribute to community stabilization.</td></tr>
<tr><td rowspan="2">Areas covered.</td><td>Mountainous area</td><td>Hilly area</td><td>Plain irrigated area</td></tr>
<tr><td></td><td></td><td>○
Irrigation command areas in the downstream of the Golestan Dam</td></tr>
<tr><td>Target group.</td><td colspan="3">Irrigation systems, production cooperatives, farmers, and farmer groups, which conduct pump irrigation in the downstream of Golestan Dam</td></tr>
<tr><td>Implementing agency (co-operating organizations)</td><td colspan="3">MOJA
Golestan JAO
Golestan Region Water Company</td></tr>
<tr><td>Activities.</td><td colspan="3">Under the condition that a clear water right has yet to be established, the following activities for even water distribution according to the river flow are proposed.
- To establish a system for discussing operating rules for pump irrigation among irrigation systems in accordance with agreed arrangements with the Water Authority
- Measurement of river flow downstream of Golestan Dam
- Determination of amount of water intake by pump for each irrigation system based on the river flow, especially considering the amount of river flow in drought years
- To share records of pump operation for monitoring of water distribution</td></tr>
<tr><td colspan="2">Input</td><td colspan="2">Contents of technical transfer</td></tr>
</table>

• Dispatchment of Experts (irrigation, pump operator, land use, water users' associations, coordinator), and thier activity costs • Necessary materials and equipment (flow observation equipment, PC for analysis and storage of water management data, etc.)	• Fostering and strengthening water management organizations • Data communication and operation technology related to water management • Improvement of facilitator ability • Training and capacity building related to water management activities
Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).	
• Inter-agency co-ordination (Institutional design for collaboration with other institutions is required) • Establishing a sustainable implementation system and budget on the Iranian side even after the project is implemented • Participation of people who worked under the JICA water management projects is recommended. • Some irrigation systems, which use pumps and have not been registered, are expected to participate in the proposed project.	

No. 10 Promotion of irrigation modernization policy

- Necessity

Spray irrigation by using center-pipod is planned and operated in Resalat/ Vahdat irrigation system and parts of Peyvand irrigation system. Still, such a system is minor, and in general, water is taken from the river by pump and distributed from open concrete or earth canal to the farmlands by furrow irrigation. This irrigation method is not efficient considering water loss due to evaporation and infiltration. It is expected that the available water resource for the irrigation systems will be limited in the future since the irrigation command area is increased.

Under such a situation, it is needed to shift from conventional irrigation methods to more efficient ones, and it is important to promote irrigation modernization including upgrading of facilities and the development of management systems. Only structural renovation of irrigation facilities, such as sprinkler irrigation and pipeline, is not enough to reduce water loss, and improvement of the operation system for proper and sustainable water use is also necessary.

In the process of irrigation modernization, it is needed to promote plural components considering i) sustainable use of water resources, ii) cost-effectiveness of irrigation facilities; iii) existing water management system by production cooperatives, water users associations, and farmers/farmer groups; iv) management skill of personnel responsible for the operation. Development of operation & management systems and human resources for information collection, and monitoring by Information and Communication Technologies (ICT) is necessary. To realize them, it is urgent to develop guidelines to implement each component.

“The Sixth Five-Year Plan for Economic, Social and Cultural Development” states an increase in water and land productivity through appropriate crop selection, watershed management, water catchment, water and soil conservation, and modern water-saving covering 600,000 ha/year. In this context, it is needed to modernize irrigation methods to use limited water resources efficiently and cope with the anticipated drought risks.

Efficient use of water resources is becoming more important since rainfall patterns can be fluctuated due to climate change in the future, and allocation of irrigation water can be more difficult. In addition, appropriate water use will require not only technical irrigation efficiency but also strengthening of administrative capacities, such as coordination skills with multiple agencies for plan formulation.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

− Confirmation of the above necessity and examination of implementation priority

- Examination of system development (starting up a policy-making structure, budget measures, securing personnel for policy-making, the need for experts for policy-making, etc.)

Summary table

<table>
<tr><td>Name</td><td colspan="3">Promotion of irrigation modernization policy</td></tr>
<tr><td>Objective</td><td colspan="3">Promote irrigation modernization and efficient use of water in irrigated areas.</td></tr>
<tr><td>Problem to be solved (Alignment with higher-level policies)</td><td colspan="3">The Sixth Five-Year Plan for Economic, Social and Cultural Development aims to increase water and land productivity through appropriate crop selection, watershed management, water catchment, water and soil conservation, and modern water-saving covering 600,000 ha/year. In this context, irrigation modernization needs to be promoted to use limited water resources efficiently and to cope with the anticipated drought risks.</td></tr>
<tr><td rowspan="2">Areas covered.</td><td>Mountainous area</td><td>Hilly area</td><td>Plain irrigated area</td></tr>
<tr><td>○</td><td>○</td><td>○
Relatively large irrigation systems</td></tr>
<tr><td>Target group.</td><td colspan="3">Staff of Golestan JAO, Irrigation manager, and operation staff in irrigation system</td></tr>
<tr><td>Implementing agency (co-operating organizations)</td><td colspan="3">MOJA
Golestan JAO</td></tr>
<tr><td>Activities.</td><td colspan="3">The advisor will prepare irrigation modernization guidelines, including following matters:
- Securement of available water resources in a sustainable manner
- Development of irrigation facilities for efficient water use and water and soil conservation
- Development of cost-effective irrigation facilities
- Capacity development of operational staff of water users' associations, etc.
- Information and data collection of water distribution using ICT</td></tr>
<tr><td colspan="2">Input</td><td colspan="2">Contents of technical transfer</td></tr>
<tr><td colspan="2">• Dispatchment of Experts (irrigation modernization advisors) and short-term experts dispatched as required (water resources, irrigation infrastructure development, water users' associations), and their activity costs
• Required materials (PC etc.)</td><td colspan="2">• Development of guideline
• Training and capacity building in the technologically advanced countries</td></tr>
<tr><td colspan="4">Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).</td></tr>
<tr><td colspan="4">• Note the consistency with the irrigation modernization policy promoted by the MOJA.</td></tr>
</table>

No. 11 Asset management training to extend the service life of irrigation facilities

Necessity

Water is taken from rivers by pumps in the irrigation systems, pumping equipment is not durable sufficiently. Gorgan River water contains large amounts of suspended sediments, which damages the pump equipment, consequently, causing early degradation. Moreover, the management cost for water intake by pumps is also more expensive than gravity irrigation from weirs. It is, therefore, desirable to maintain pump equipment continuously and to reduce the life cycle cost. It is effective to utilize “the asset management approach” applied in Japan, which takes into account the cost of operation & management and renewal for extension of the service life of irrigation facilities.

The Sixth Five-Year Plan for Economic, Social and Cultural Development states an increase in water and land productivity through appropriate crop selection, watershed management works, water harvesting, soil and water conservation, and modern water-saving irrigation covering 600,000 ha/year. Under the situation, it is important to develop maintenance and renewal plans for irrigation facilities to use water resources efficiently and to operate the facilities in the long term by extension of their lifespan

in terms of sustainable agriculture. The concept of lifespan extension has been introduced as a prevention measure. It is to maintain and repair facilities before the facilities are degraded into unusable. Such preventive maintenance is effective to keep their functions and reduce life cycle costs.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Allocation of personnel and examination / analysis work (rehabilitation/ maintenance of irrigation facilities and cost analysis conducted so far, learning about asset management, examination of applicability, selection of trainees).
- Establishment of follow-up system for trainees after the training by Iranian side.

- Summary table

<table>
<tr><td>Name</td><td colspan="3">Asset management training to extend the service life of irrigation facilities</td></tr>
<tr><td>Objective</td><td colspan="3">To extend the service life of irrigation facilities in plain irrigation systems through proper management and renewal, taking into account the durable period of irrigation facilities</td></tr>
<tr><td>Problem to be solved (Alignment with higher-level policies)</td><td colspan="3">The Sixth Five-Year Plan for Economic, Social and Cultural Development aims to increase water and land productivity through appropriate crop selection, watershed management, water catchment, water and soil conservation, and modern water-saving covering 600,000 ha/year. It is important to prepare maintenance and renewal plans for irrigation facilities to ensure sustainable use of limited water resources and to extend the lifespan of facilities based on the plans mentioned above.</td></tr>
<tr><td rowspan="2">Areas covered.</td><td>Mountainous area</td><td>Hilly area</td><td>Plain irrigated area</td></tr>
<tr><td></td><td></td><td>○
Relatively large-scale Irrigation systems</td></tr>
<tr><td>Target group.</td><td colspan="3">Water resource policy officers under the MOJA, staff of Golestan JAO, and irrigation system managers, and facility operations & maintenance staff</td></tr>
<tr><td>Implementing agency (co-operating organizations)</td><td colspan="3">MOJA
Golestan JAO</td></tr>
<tr><td>Activities.</td><td colspan="3">Through training on asset management of irrigation facilities in Japan focusing following items, the target group can gain knowledge:
- Inspection and repair of facilities in the daily management
- Regular function diagnostic analysis of facilities and evaluation
- Facility classification and assessment of deterioration based on survey results
- Comparison of efficient countermeasures
- Repair and other works
- Organization of collected data
- Information sharing with advanced areas by the site visit</td></tr>
<tr><td colspan="2">Input</td><td colspan="2">Contents of technical transfer</td></tr>
<tr><td colspan="2">• Dispatchment of trainees from MOJA, Golestan JAO and related organizations to Japan</td><td colspan="2">• Training on the above activities in areas where asset management is applied</td></tr>
<tr><td colspan="4">Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).</td></tr>
<tr><td colspan="4">• Noted to pay attention to the MOJA policies on rehabilitation and renewal of facilities in the large irrigation areas
• Establishment of follow-up system for trainees after the training by Iranian side</td></tr>
</table>

8.4 Approach for Promoting Project Formation

Based on the request from MOJA and Golestan JAO, the organization of capacity development

training of the Project Cycle Management (PCM) method is to be implemented. The PCM method is a project management tool, which assists in project planning, management, implementation, and evaluation by using Project Design Matrix (PDM). PCM consists of three stages, analysis, planning and monitoring & evaluation. A Project Design Matrix (PDM), showing flamework of a project, is to be prepared when the project is formulated. Thus, capacity development of project planning, operation, and management for administrative staff is proposed as an "Approach for promoting project formation".

No. 12 Capacity development for project planning, operation, and management

- Necessity

It is recommended to increase the number of staff MOJA and Golestan JAO, who have sufficient experience in project planning, operation, and management. In order to promote project implementation supported by JICA and other donors in the future, training in the PCM method for the official personnel is necessary.

- Activities for embodying the approach

The Iranian side needs to consider the following for the realization of this approach.

- Confirmation of the above necessity and examination of implementation priority based on discussions with related organizations.
- Allocation of personnel and examination/ analysis work (analysis of training results conducted so far, learning related to PCM method, examination of applicability, selection of trainees).

- Summary table

<table>
<tr><td>Name</td><td colspan="3">Capacity development for project planning, operation, and management</td></tr>
<tr><td>Objective</td><td colspan="3">To deepen understanding of the PCM approach, which has been introduced as a general concept in Japan and other donor agencies and emerging donor countries in promoting project formation in the field in Iran as a recipient.</td></tr>
<tr><td>Problem to be solved (Alignment with higher-level policies)</td><td colspan="3">At present, the number of staff of the MOJA and the Golestan JAO, who are familiar with PCM methods is not big. When projects are implemented under the support of Japan and other international donors The recipient organizations are requested to understand the PCM method.</td></tr>
<tr><td rowspan="2">Areas covered.</td><td>Mountainous area</td><td>Hilly area</td><td>Plain irrigated area</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Target group.</td><td colspan="3">MOJA policy officer, staff of the Golestan JAO</td></tr>
<tr><td>Implementing agency (co-operating organizations)</td><td colspan="3">MOJA, Golestan JAO</td></tr>
<tr><td>Activities.</td><td colspan="3">Organization of PCM training through online
− Planning and planning course (1 week)
− Monitoring and evaluation course (1 week)</td></tr>
<tr><td colspan="2">Input</td><td colspan="2">Contents of technical transfer</td></tr>
<tr><td colspan="2">• Dispatchment of Facilitators (PCM method) and their activity costs
• Selection of trainees from MOJA, Golestan JAO and related organizations, attendance at lectures
• Remote communication tools, etc.</td><td colspan="2">• Learning and utilizing the above PCM method</td></tr>
<tr><td colspan="4">Considerations (project risks, environmental and social conditions, cross-cutting issues, gender, etc.).</td></tr>
<tr><td colspan="4">Check telecommunications infrastructure in rural areas (whether online meetings are possible or not).</td></tr>
</table>

8.5 Direction Settings

The proposed approaches were discussed and organized by the JICA study team, Golestan JAO, and the Study Committee established in MOJA in the 3rd survey in Iran.

8.5.1 Organizing Approaches

Setting of Goal

In addition to the initial target, namely, "stabilization of farmers' livelihoods", a new target, "strengthening farmers' competitiveness in the international markets to promote export" is proposed since it is stated in "The Sixth Five-Year Plan for Economic, Social and Cultural Development". However, not only international markets but also a variety of markets are targeted, such as Golestan Province or Tehran. Furthermore, direct sales within the Golestan Province through agritourism are proposed to stabilize farmers' livelihoods based on the market needs.

BOX. Feasibility of value chain development

In recent years, agriculture in many countries has been **shifted from simple crop production to value-adding agriculture considering market needs.** The concept of 'value chain development', which has long been pursued in Japan, is paid attention to in this context. Before agricultural products are served at the table, many stakeholders are involved, including farmers, suppliers of materials such as seeds, fertilizers, and agricultural machinery, processing companies, transport and distribution companies, and retailers. Value chain development is an initiative to add value to products by an increase of the efficiency of production through cooperation among the stakeholders, Specifically, it includes improvement of the quality of agricultural products, development of competitive products, expansion of the sales network, and increase of sales opportunities.

Value chain development is often inter-ministerial activities, as they involve farmers and a diverse range of stakeholders. In Iran, all agro-processing and trading (including import and export) of agricultural products including medicinal plants have been under the control of the MOJA since 2013, enabling integrated supervision of all stages, from production to processing and distribution of agricultural products. The government's support is becoming more systematic, and value chain development initiatives can be embodied in Iran. Also, MOJA has a strong willingness to promote agricultural value chain development in the future.

BOX. Examination of the introduction of the market-oriented agriculture (SHEP) approach

The Market Oriented Farming (SHEP) approach, developed by JICA, is an approach that realizes "Market-Oriented Agriculture" and converts farmers' minds from "grow and sell" to "grow to sell". Also, it aims to increase farm income by helping farmers to **acquire market-oriented farming skills**. The SHEP approach is currently being applied in the Middle East and other countries around the world to improve farmers' livelihoods.

Many farmers in Golestan Province have cultivated wheat and other crops, which are targets of the buy-back program by the government since the government subsidies seeds and fertilizers. They know a certain level of profit is secured by such crop production based on their experience. On the other hand, high inflation rates have caused an increase in input costs and labor costs, and the production environment has been deteriorated by climate change in recent years. Those situations resulted in a profit decrease since the sales price of crops are not increased, therefore, the introduction of medicinal plants as profitable crops is being proposed. In Iran, conversion of farmland to other land uses is not permitted, while the change of crops to be cultivated can be decided by the farmers. In such a case, market-oriented farming skills are important. A market survey by farmers and matching for strengthening linkages among stakeholders by application of SHEP approach can be effective when new crops are introduced as converted crops.

Setting of Strategy

The Head of the Golestan JAO pointed out for handling issues in Golestan Region, that it is important to consider two aspects, namely, "agricultural and rural development" and "water resources management (strengthening resilience)" to achieve the goal, stabilization of farmers' livelihoods and strengthening market competitiveness.

The crop production environment in Golestan Region is harsh, and farming is dependent on the amount of rainfall. Thus, water risks have become endemic due to recent climate change. To stabilize the livelihoods of farmers, who are vulnerable to such water risk, it is necessary to focus on not only "agricultural and rural development" by an increase of profits through crop diversification, but also on "strengthening", including farmland disaster prevention and water management in the region, and should be implemented on both wheels.

Stabilization of farmers' livelihoods and improvement of their competitiveness in markets

Figure 8.5.1 Strategies for Stabilizing Farm Household Livelihoods
Source: JICA study team.

BOX. Needs for the action of water risk reduction

The floods in 2019 gave damage to riverine infrastructure, e.g., riverbank and weir breaches, soil erosion into reservoirs, and pumping facilities. Damage to the infrastructures has affected farming even after the disaster, thus, early rehabilitation is necessary. In March 2022, the rehabilitation of six pumps and revetment for bank protection in the pump station of Peyvand irrigation system was done by Grant Assistance for Grassroots Human Security Projects by Japan, and such **disaster rehabilitation projects are effective for farming activities in a short period.**

Rehabilitation projects cannot be a fundamental countermeasure for future water risks, and it is needed to take measures to avoid water run-off from flooded mountains and hillsides as much as possible. Therefore, it is necessary to identify forests and steep fields in the basin where soil run-off and erosion are observed and to implement effective **water and soil conservation measures in the middle and long-span** in these areas, by means of an increase of water holding capacity of soil and prevention of soil erosion.

Proposed approaches by scheme

The proposed approaches by scheme are organized under the strategy of "Agricultural and Rural Development" and "Water Resources Management (Enhancing Resilience)" as mentioned in Table 8.5.1. They are technical cooperation projects, information collection surveys/preparatory surveys, training in Japan and within Iran, and dispatch of experts from Japan to Iran.

The technical cooperation projects will focus on demonstration (No. 1) and dissemination (No. 2) for the introduction of new/converted crops as requested by the Government of Iran, participatory water and soil conservation (No. 5), and farmland disaster prevention (No. 8) in mountainous and hilly areas, and extensive participatory water management (No. 9) in plain areas.

Regarding the information collection survey and preparatory survey, the feasibility of conversion of the crop in mountainous, hilly, and plain areas should be done with detailed study of agricultural production environment and value chain to be narrowed down the scope of this study. The results shall be used for the agricultural products value-adding approach (No. 3) and flood control approach (No. 7) as basic information.

As for the training in Japan, it consists of approaches No.4 and No.11 based on experience and

knowledge developed in Japan. In No.4, training shall be organized focusing on rural livelihood improvement such as "Sixtiary industrialization[14]", agro-industrial cooperation and the SHEP approach. In addition, training in asset management of irrigation facilities shall be implemented.

Based on the request of the Government of Iran, training for project planning, operation, and management (No. 12) is to be organized by the JICA team member online. Although the agreement on technical cooperation between the Government of Iran and the Government of Japan has yet to be signed as of March 2022, the training is thought to be effective for the official personnel in Iran to receive projects in the future Therefore, it is planned to conduct the training in 2022.

For the purpose of irrigation modernization to use water resources efficiently and cope with the expected drought risk, an irrigation policy advisor shall be dispatched (No. 10). In addition, various experts related to appropriate irrigation methods, salt removal measures, and the introduction of salt-resistant crops to deal with soil salinization in the irrigated plains (No. 6) shall be dispatched.

[14] "Sextiary industrialization" is integrated sector proposed in Japan, consisting of agriculture, fishery and forestry (primary industry) is manufacturing and processing (secondary industry) and distribution, sales and service (tertiary industry) (1+2+3=6)

Table 8.5.1 Summary of the Proposed Project

Scheme	Overview		
Technical cooperation Project	Name	**Project for farmers' livelihood improvement in the Golestan Province**	
	Contents	Demonstrations for the introduction of conversion crops (mountains areas, hilly areas, and plains) Extension for the introduction of conversion crops (mountains, hills, plains) Water and soil conservation measures in farmland (mountains, hills). Participatory farmland disaster prevention (mountains, hills) ... Strengthening irrigation water resources management capacity (plains)	
	Application approach		implementation period
	No. 1, 2, 5, 8, 9		3 years (demonstration phase) 3 years (dissemination phase)
	Input (Iranian side)	Arrangement of counterparts (16 people including project manager and coordinator) from Horticulture Department (4 people) and Water and Soil Department (4 people), MOJA, Horticulture Department (4 people) and Water and Soil Department (4 people) × 6 years (demonstration phase + dissemination phase)), securing counterpart budget, setting up local offices, land securing/ maintenance costs for pilot plots, and other materials and equipment necessary for activities.	
Information collection survey/ Preparatory survey	Name	**Information collection on strengthening agricultural and rural resilience in the Golestan Province**	
	Contents	Feasibility study on the introduction of conversion crops (mountains areas, hilly areas, and plains). Note 1) Collection of information on value-adding of agricultural products (in and outside the region). Information gathering and planning for flood control (mountains, hills, plains)	
	Application approach		implementation period
	No. 3, 7		1-2 years.
	Input (Iranian side)	Arrangement of counterparts (8 people x 1 to 2 years) from the Horticulture Department (4 people) and Water and Soil Department (4 people), MOJA, and securing counterpart budget, collecting and sharing materials necessary for study	
Training in Japan (Dispatch of trainees).	Name	**Training for Agricultural and Rural Resilience Strengthening**	
	Contents	Rural Livelihood Improvement Model Training/Visits Asset management training and inspection visits for irrigation facility longevity	
	Application approach		implementation period
	No. 4, 11		3 months/year
	Input (Iranian side)	(No.4 Rural Livelihood Improvement Model) Arrangement of total of 15 trainees from MOJA Horticulture Department (5 people) and tGolestan JAO (6 horticulture, 2 organizations, 2 extension officers) (No.11 Asset management) Arrangement of total of 15 trainees from MOJA Water and Soil Department (5 people) and Golestan JAO (6 irrigation, 2 machineries, 2 extension officers)	
Training by online	Name	**Training for capacity development for project planning, operation, and management** Note 2)	
	Contents	Conducting PCM training online. Planning and planning courses Monitoring and evaluation courses	
	Application approach		implementation period
	No. 12.		2 weeks
	Input (Iranian side)	Arrangement of total of 15 trainees from MOJA and Golestan JAO	
Dispatch of experts (Policy adviser).	Name	**Advisory services for irrigation modernization**	
	Contents	Preparing guidelines for irrigation modernization.	
	Application approach		implementation period
	No. 10.		2 years
	Input (Iranian side)	Arrangement of counterparts (4 people x 2 years) from Water and Soil Department, MOJA, 3 counterparts in charge of irrigation and coordinator, securing counterpart budget, setting up an office, etc.	
Dispatch of experts	Name	**Development of applicable agricultural technologies**	
	Contents	Study on the development and introduction of locally adapted technologies.	
	Application approach		implementation period
	No. 6.		3 years
	Input (Iranian side)	Arrangement of counterparts (6 people × 3 years) from Water and Soil Department, MOJA, and Water and Soil Department, Golestan JAO in charge of irrigation, water-saving technology, salt-tolerant crops, soil analysis, and water quality analysis , securing counterpart budget, setting up local offices, land securing/ maintenance costs, and other materials and equipment necessary for activities.	

Note 1) MOJA and Golestan JAO expect JICA to conduct a detailed study on farming e.g., seed and nursery production system, cultivation for the introduction of converted crops, and value chain analysis consisting of processing, distribution, and marketing for the selected medicinal plants.
Note 2) The training will be conducted in this Study.
Source: JICA study team.