DEPARTMENT OF IRRIGATION
MINISTRY OF LANDS, AGRICULTURE, FISHERIES, WATER AND RURAL RESETTLEMENT
THE REPUBLIC OF ZIMBABWE

REPUBLIC OF ZIMBABWE
DATA COLLECTION SURVEY
ON
IRRIGATION AND AGRICULTURE DEVELOPMENT

FINAL REPORT

February 2022

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
SANYU CONSULTANTS INC.

Location Map

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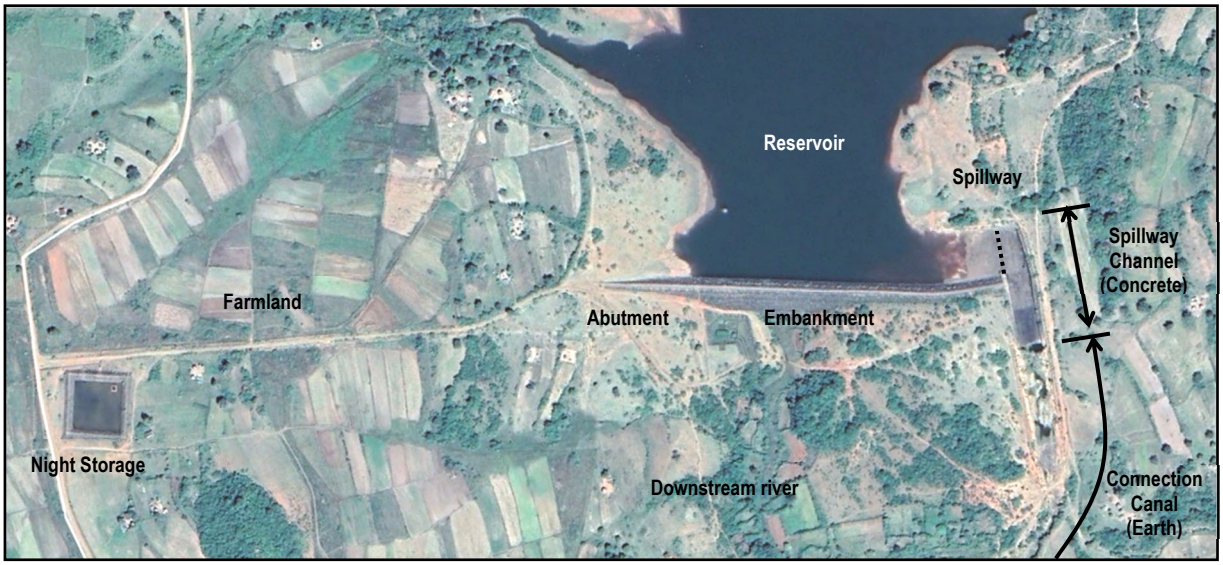
Abbreviations

ADCA	Agricultural Development Consultants Association
AfDB	African Development Ban
AGRITEX	Agricultural Technical & Extension Services Department
AZE	Alliance for Zero Extinction
COVID-19	Coronavirus Disease 2019
DOI	Department of Irrigation
DOM	Department of Mechanization
EIA	Environmental Impact Assessment
EMA	Environmental Management Agency
EMP	Environmental Management Plan
E/N	Exchange of Note
EU	European Union
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistical Databases
FTLRP	Fast Track Land Reform Programme
G/A	Grant Agreement
GCF	Green Climate Fund
GDP	Gross Domestic Product
GIS	Geographical Information System
GoJ	Government of Japan
GoZ	Government of Zimbabwe
GMB	Grain Marketing Board
GNI	Gross National Income
IBAs	Important Bird Areas
IBAT	Integrated Biodiversity Assessment Tool
ICT	Information and Communication Technology
IFAD	International Fund for Agricultural Development
IMC	Irrigation Management Committee
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
KBAs	Key Biodiversity Areas
MSD	Meteorological Service Department
MLAFWRR	Ministry of Land, Agriculture, Fisheries, Water and Rural Resettlement
NAPF	National Agriculture Policy Framework
NDS-1	National Development Strategy 1
NDS-2	National Development Strategy 2
NGO	Non-Governmental Organization
NPO	Non-Profit Organization
PA	Protected Area
PAP	Project Affected Persons
PSIP	Public Secor Investment Programme
RAP	Resettlement Action Plan
RDC	Rural District Counsil
SADC	Southern Africa Development Community
SHEP	Smallholder Horticulture Empowerment and Promotion
SIRP	Smallholder Irrigation Revitalization Programme
TSP	Transitional Stabilisation Programme
UK	United Kingdom
UNDP	United Nations Development Programme
UNOCHA	United Nation Office for Coordination of Humanitarian Affairs
USA	United States of America
USAID	United States Agency for International Development
WB	Word Bank
WFP	Word Food Programme
ZIMPARKS	Zimbabwe Parks and Wildlife Management Authority
ZIM-SHEP	Project for Zimbabwe Smallholder Horticulture Empowerment and Promotion
ZIMSTAT	Zimbabwe National Statistics Agency
ZINWA	Zimbabwe National Water Authority

Exchange Rate (JICA Exchange rate as of July 2021):

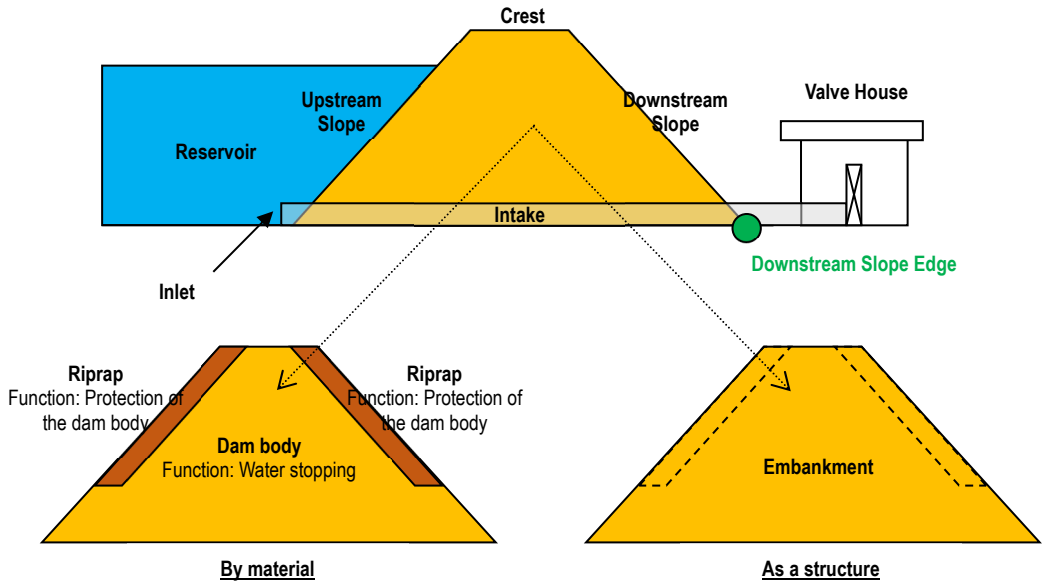
1 ZWL = 1.3148	JPY
1 USD = 110.552	JPY
1 ZWL = 0.01189	USD
1 USD = 84.083	ZWL

Naming of each part of facilities



Plan

Irrigation Area:
A series of facilities from reservoir to the end of the farmlands



Cross Section

CHAPTER 1 BACKGROUND AND OBJECTIVES OF THE SURVEY

1.1 BACKGROUND OF THE SURVEY

In this Survey, (1) survey on six dams constructed under the "Project on Medium Size Dams in Masvingo Province" and (2) survey on new irrigation development are conducted. The background of each survey is shown as below.

(1) Survey on Six Dams Constructed under the "Project on Medium Size Dams in Masvingo Province"

The rainfall in Masvingo Province, the main targeted area of this Survey, varies greatly from month to month, and the rainfall pattern is irregular from year to year, making the area vulnerable to drought and making it one of the poorest areas in Zimbabwe. Therefore, the Government of Zimbabwe (GoZ) requested the Government of Japanese (GoJ) to support the "Project on Medium Size Dams in Masvingo Province" in 1985. In response, the Japan International Cooperation Agency (JICA) dispatched a preliminary survey team in the same year and conducted the feasibility study "The Feasibility Study on Medium Size Dams in Masvingo Province" from 1986 to 1989. Based on the plan formulated in the study, JICA supported the construction of irrigation facilities including six dams (Magudu Dam, Musaverema Dam, Chinyamatumwa Dam, Mashoko Dam, Mabvute Dam, and Munjanganja Dam) through Grant Aid Project.

Since then, these six dams have been operated and maintained (hereinafter referred to as "O&M") by Zimbabwean side, but after Cyclone Idai hit Zimbabwe in March 2019 and caused extensive damage, JICA conducted site surveys on the six dams in May and October 2019. Of the six dams, a large collapse was observed on the side wall of the connection canal at Magudu Dam, and similar slope collapses were found at the boundary of the spillway channel and connection canal at Chinyamatumwa Dam and Mabvute Dam. Even if these damages progressed, they could affect the stability and operation of the dams, and in some cases, affect irrigated agriculture that uses the dams as water sources.

Under these circumstances, this Survey studies the urgency of repairing, and future rehabilitation of the six dams constructed under the "Project on Medium Size Dams in Masvingo Province".

(2) Survey on New Irrigation Development

Zimbabwe is a landlocked country located in the centre of the Southern African region, with high agricultural potential, and was called the 'Bread Basket' of Southern Africa. However, the launch of the Fast Track Land Reform Programme (FTLRP) in August 2000, which are the seizure of large white-owned farms and their distribution to blacks, caused loss of the agricultural technology and farm management know-how that had been cultivated by the white people. It resulted in a sharp decline in agricultural productivity and a food crisis. It affected the share of agriculture, forestry, and fisheries in Gross Domestic Product (GDP), still low at 8.3 % as of 2018. On the other hand, the agriculture sector is positioned as an important industry since about 70 % of the nationals engages themselves in agriculture sector and that supports the livelihood of the people. One of the goals in the current national development strategy "Vision 2030" and the "National Development Strategy 1" (NDS-1) for achieving the Vision 2030 is to create a self-sufficient and food surplus economy that will see the re-emergence of Zimbabwe as the 'Bread Basket' of Southern Africa. The development of irrigation facilities is one of the priority areas for agricultural development in Vision 2030 and NDS-1.

Under the circumstances, this Survey assesses the possibility of new irrigation development projects.

1.2 OBJECTIVES AND TARGET AREA OF THE SURVEY

The objectives and the targeted area of the Survey are shown in Table 1.2.1.

Table 1.2.1 Objectives and Targeted Area of the Survey

	Content	Targeted area
Objective-1	-To grasp the urgency of repairing the six dams constructed under the "Project on Medium Size Dams in Masvingo Province" and formulate the emergency repairing plan -To collect and confirm information for future rehabilitation of six dams and formulate the dam improvement plan	Masvingo Province
Objective-2	-To collect and confirm information as to the possibility of new irrigation development projects to increase farmers' income and formulate the new irrigation development plan	All over Zimbabwe (Finally, three projects are to be selected)

1.3 SURVEY TEAM MEMBERS AND SURVEY SCHEDULE

1.3.1 Survey Team Members

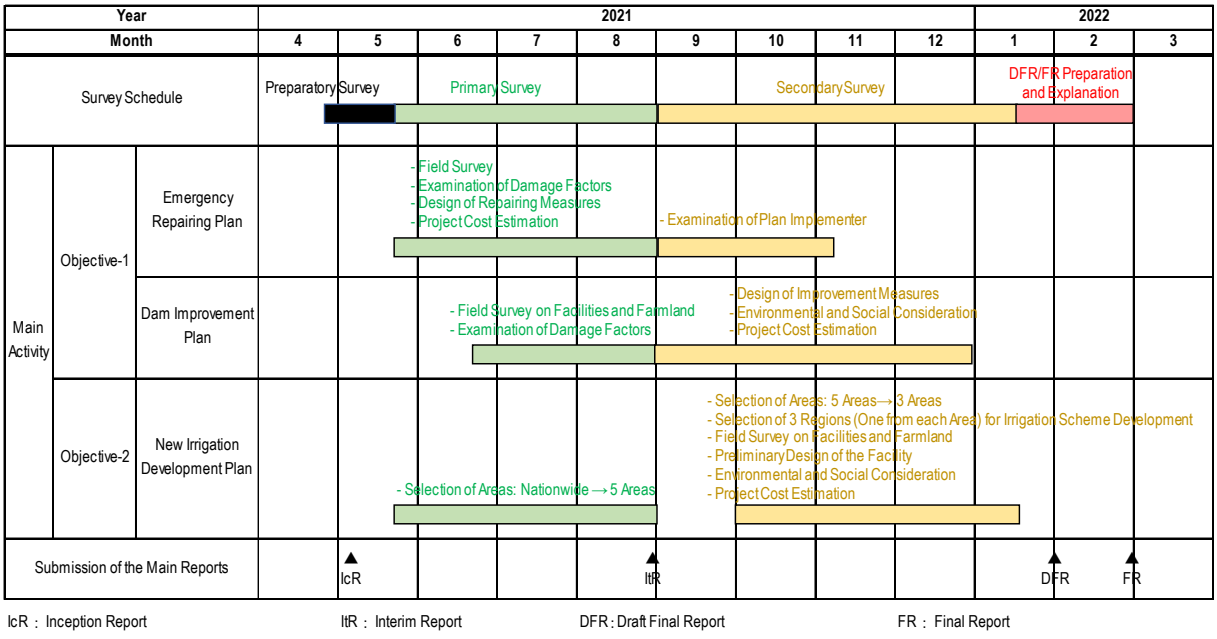
The Survey team members, the assignments, and the affiliations are shown in Table 1.3.1.

Table 1.3.1 Member List of the Survey Team

	Name	Assignment	Affiliation	Remarks
1	Mr. NAKAGAWA Toru	Team Leader/Water Resource Development	Sanyu Consultants Inc.	
2	Mr. ISHIKAWA Hideki	Irrigation Facility Design	Sanyu Consultants Inc.	
3	Mr. AJIOKA Tsuyoshi	Agriculture Development	Sanyu Consultants Inc.	TASK Co., Ltd.
4	Mr. OISHI Takayuki	Environmental and Social Impact Assessment	Sanyu Consultants Inc.	
5	Mr. OIKAWA Taku	Cost Estimation	Sanyu Consultants Inc.	Asia Air Survey Co., Ltd.
6	Mr. SHIMONO Takashi	Satellite Image Analysis	Sanyu Consultants Inc.	

1.3.2 Survey Schedule

The Survey has been conducted through four stages: preparatory survey, primary survey, secondary survey, and Draft Final Report/Final Report formulation and explanation. The main activities and those conducted periods of each stage are shown in Figure 1.3.1.



IcR : Inception Report ItR : Interim Report DFR : Draft Final Report FR : Final Report

Figure 1.3.1 Survey Schedule

1.4 OUTLINE OF THE SURVEY RESULT

1.4.1 Survey on Six Dams Constructed under the "Project on Medium Size Dams in Masvingo Province"

(1) Survey Policy

The procedure of the survey on the target six dams is shown as Figure 1.4.1. Firstly, field survey to identify deteriorations/damages (and those signal) is carried out and examination on the found deteriorations/damages if they already affect the safety/stability/operation of the facilities is conducted. When field survey is conducted, existing farming situation is surveyed as well. Also, examination on the found deteriorations/damages if they expand and affect the safety/stability/operation of the facilities in the future is carried out.

The deteriorations/damages found are evaluated and categorized into three ranks as shown in Table 1.4.1, depending on the timing when the identified deteriorations/damages affect the safety/stability/operation of the facilities. In respect to deteriorations/damages which are already affecting the safety/stability/operation of the facilities or are feared to affect them in the near future (A rank), an "Emergency Repairing Plan" is prepared as an urgent response.

On the other hand, in respect to deteriorations/damages which are not affecting the safety/stability/operation of the facilities at present but may affect them in the long term (B rank), a "Dam Improvement Plan" is prepared as a mid-term and long-term rehabilitation plan. However, the deteriorations/damages which are small and do not require large scale rehabilitation measures are to be rehabilitated through daily/periodical maintenance works by Zimbabwean side and not included in the target for "Dam Improvement Plan". Additionally, change of environment surrounding the six dams in the first 30 years after the construction, especially changes in the social and natural conditions, and challenges in O&M are grasped. Any measures to address these challenges are included in the "Dam Improvement Plan".

After preparation of "Dam Improvement Plan", scoping, a preliminary assessment for environmental and social consideration, is carried out and environmental category is evaluated.

Table 1.4.1 Evaluation Ranks of Deteriorations/Damages Found

Rank	Evaluation Standard
A	Deteriorations and damages that are already affecting the safety/stability/operation of the facilities or are feared to affect them in near future.
B	Deteriorations and damages that are not affecting the safety/stability/operation of the facilities at present but may affect them in the long term.
C	No deteriorations/damages and damage or no signal of them

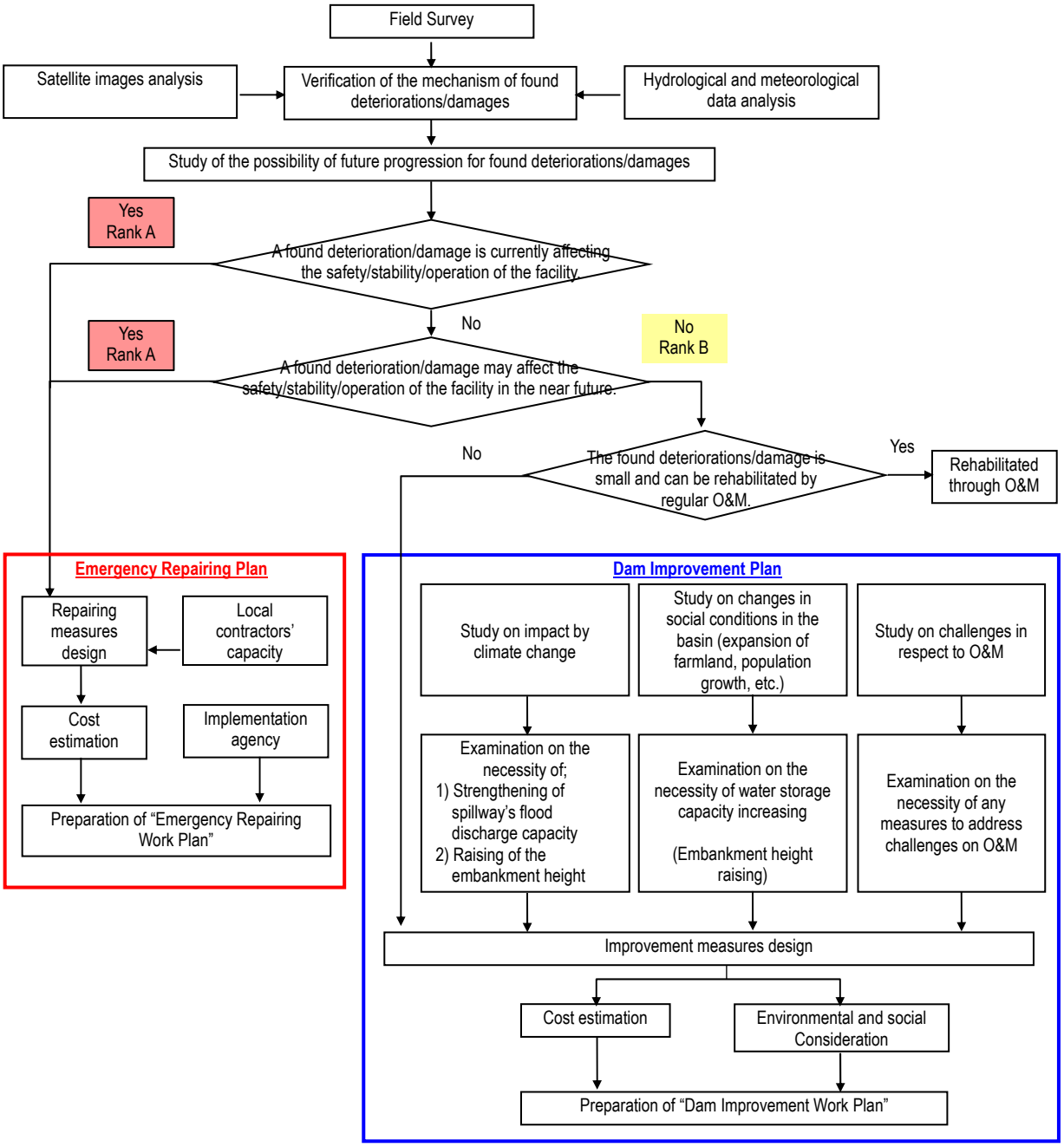


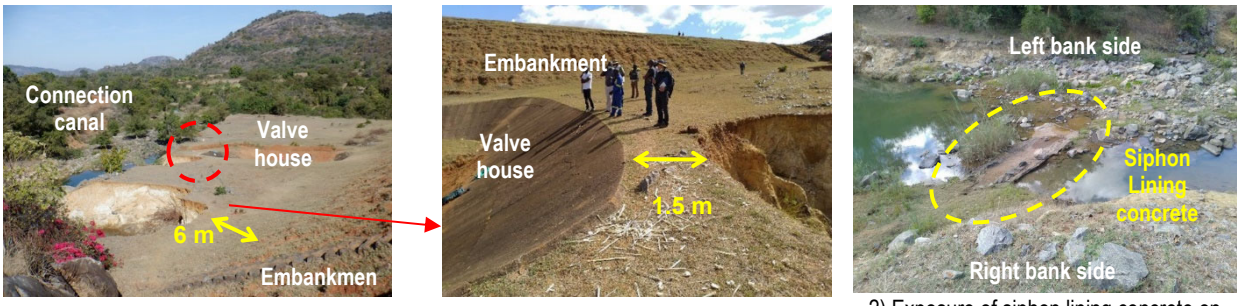
Figure 1.4.1 Procedure of the Survey on Six Dams

(2) Summary of the Survey Results

1) Emergency repairing plan

There are two deteriorations/damages which are evaluated as "A" (urgent measures are required), 1) Two large-scale collapses on the right bank side wall of the connection canal, and 2) Exposure of siphon lining concrete on the connection canal bed (see Figure 1.4.2). In respect to 1), a collapse reaches to the point 6 m from the edge of embankment. It would reach to the edge after seven years and affect the stability of embankment. Also, another one reaches to the point 1.5 m from slope protection works for valve house. It would reach to the slope protection works within two years and affect the operation of valve.

While in respect to 2), since rocks are scattered around and upstream of the siphon lining concrete, erosion is likely to occur when rocks are delivered by floods and impact the lining concrete. As the erosion progresses and siphon pipes are damaged, sufficient irrigation water would not be supplied to farmland and the irrigation scheme may be dysfunctional.



1) Two large-scale collapses on the right bank side wall of the connection canal

2) Exposure of siphon lining concrete on the connection canal bed

Figure 1.4.2 Deteriorations/Damages Evaluated as "A"

Emergency repairing measures for collapses on the right bank side wall of the connection canal are 1) Backfilling the unevenness of canal bed by wet masonry, 2) Construction of retaining wall along the right bank side wall by wet masonry, 3) Backfilling the area from retaining wall to be constructed to the collapse surface with earthen materials and wet masonry. While a measure for exposure of siphon lining concrete at the connection canal bed is covering the exposed siphon lining concrete with wet masonry (see Figure 1.4.3 and Figure 1.4.4).

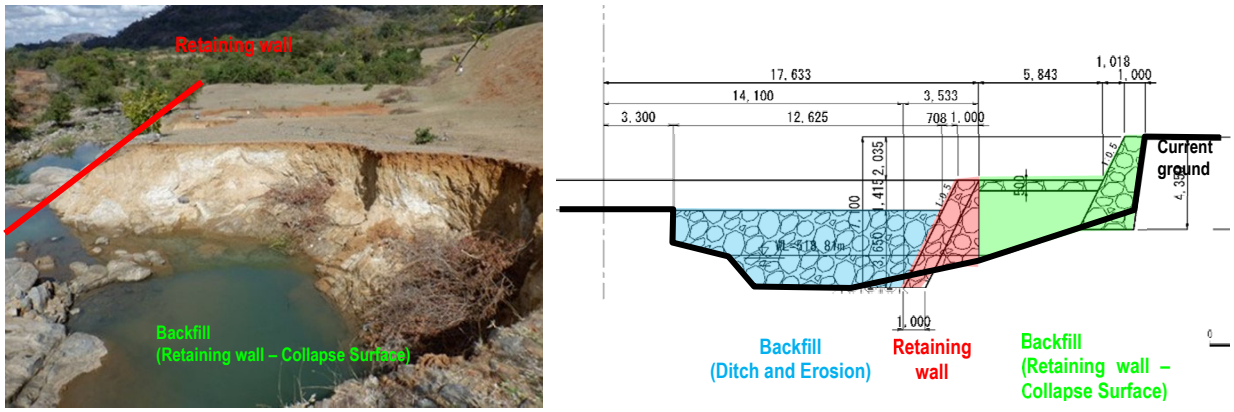


Figure 1.4.3 Emergency Repairing Measures on Right Bank Side Wall of the Connection Canal

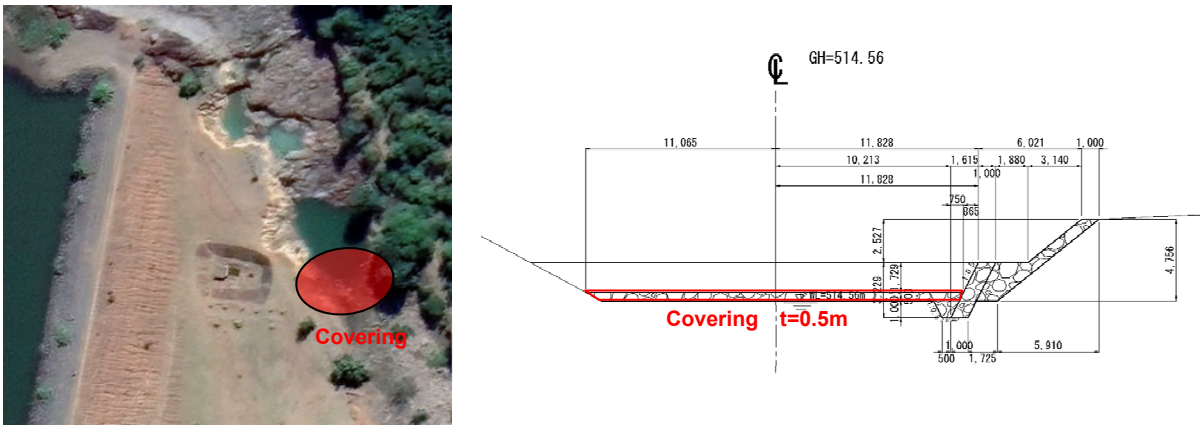
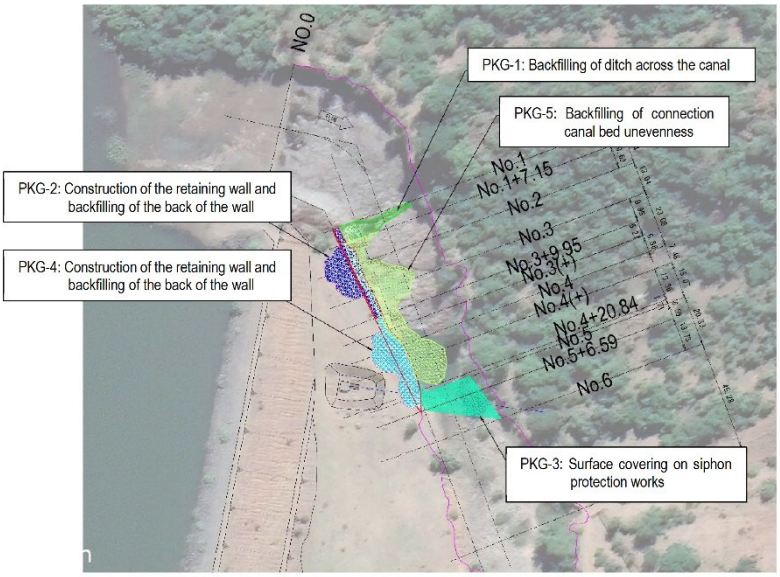


Figure 1.4.4 Emergency Repairing Measure for the Exposure of Siphon Lining Concrete

The emergency repairing measures above are divided into five construction packages (PKGs) according to the implementation priority and project cost of each PKG is calculated



PKG	Target	Project Cost (thousand USD)
PKG-1	Backfilling of ditch	62
PKG-2	Construction of the retaining wall and backfilling of the backside of the wall (upstream side)	271
PKG-3	Covering of siphon protection works	57
PKG-4	Construction of the retaining wall and backfilling of the backside of the wall (downstream side)	314
PKG-5	Backfilling of unevenness of the connection canal bed	375
Total		1,079

Figure 1.4.5 Construction PKGs of the Emergency Repairing Measures

According to the results of a survey to each agency, there is only one agency, ZImbabwe National Water Authority (ZINWA), who may implement the measures but they may target only PKG-1. It is necessary to ensure the reliable implementation of PKG-1 by ZINWA and to find an implementing agency for the other PKG-2 - 5 as soon as possible.

2) Dam improvement plan

The main deteriorations/damages evaluated as "B" are shown in Table 1.4.2. These deteriorations/damages are further classified into two categories 1) to be rehabilitated by Japanese Grant Aid Project and 2) to be rehabilitated by Zimbabwean side, and improvement design and project cost estimation are carried out for deteriorations/damages categorized as 1) above.

Since the target six dams were constructed about 30 years ago, it is considered that the flood volume may have increased since the time of planning due to recent climate change. In such a case, the existing size of the facility would not be able to discharge floodwaters safely. Therefore, the necessity of raising the embankment is also considered by assessing the rainfall and flood volume. As a result, it is concluded that the Chinyamatumwa, Mashoko and Munjanganja Dams need to be raised by 10cm to 30cm.

On the other hand, the possibility of increasing the

Table 1.4.2 Main Deteriorations/Damages Evaluated as "B"

Target Facility	Main Deteriorations/Damages
Embankment	- Disturbance of riprap - Dam body exposure, and erosion - Trees on and around embankment - Seepage and erosion at slope edge
Spillway	- Surface concrete peeling and lack of stones - A slight plant - Leakage from downstream slope - Open and damaged joints on the apron
Spillway Channel	- Cracks at the top of walls - Spilling out of basket mat - Crossing road across the canal (basket mat)
Connection canal	- Collapses on the sidewall - Washed away of a bridge - Crossing road across canal
Intake	- Disappearance of the gate operation facilities - Rusting all over - Insufficient supply volume
On-Farm Facility	- Broken of sluice gate (night storage) - Spilling out of backside soil (canal) - Missing parts (sluice valve) - Water leakage from pipeline (air valve) - Broken of the discharge gate (diversion)

Red: Need rehabilitation by Grant Aid Project

water storage capacity and irrigated area by raising the embankment is also studied. Due to the constraints of the surrounding topography, only the Mashoko Dam has potential to be raised more than 1.0 m, and the height is considered to be about 2 m.

In addition, scoping is carried out as an preliminary environmental and social impact assessment for the Dam Improvement Plan. As a result of the assessment, the plan will fall under Category B.

The total cost of the rehabilitation for all the six dams is calculated to be around 6.4 billion JPY (see Table 1.4.3). Taking into account the cost scale of recent Grand Aid Project, it is difficult to rehabilitate all the six dams by a Grant Aid Project. Therefore, it is necessary to set implementation priorities. On the other hand, the main benefit by the implementation of this plan is to extend the life of the facilities, and only the Mashoko Dam has the potential to increase the irrigated area. Therefore, before setting the priority of the project, it is necessary to carefully examine the benefits and the necessary project cost, and to re-examine the necessity of implementing the plan as a Grant Aid Project.

Table 1.4.3 Rehabilitation Cost of Each Dam

Dam name	Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja
Rehabilitation Cost (billion JPY)	0.848	1.497	0.873	1.004	1.074	1.153

1.4.2 Survey on New Irrigation Development

(1) Survey Policy

The survey on New Irrigation Development targets all the planned irrigation projects in Zimbabwe, assuming to be implemented under Japanese Grant Aid Project. Since dams are the main source of irrigation water in Zimbabwe, the projects to be the target of the survey are 1) dam projects and 2) irrigation scheme projects (see Figure 1.4.7 for the definition of the term).

The survey procedure is shown in Figure 1.4.6. The first step is to select the target projects from the priority projects list provided by ZINWA, Department of Mechanization (DOM) and Department of Irrigation (DOI) under Ministry of Lands, Agriculture, Fisheries, Water and Rural Resettlement (MLAFWRR) according to the cost scale and investment impact. The results show that the development of irrigation schemes alone is superior.

The Region (see Figure 1.4.7 for the definition of the term) which irrigation scheme is to be developed are selected from the high priority Areas for irrigation projects (see Figure 1.4.7 for the definition of the term). Firstly, three Areas are selected from all over Zimbabwe by prioritizing the

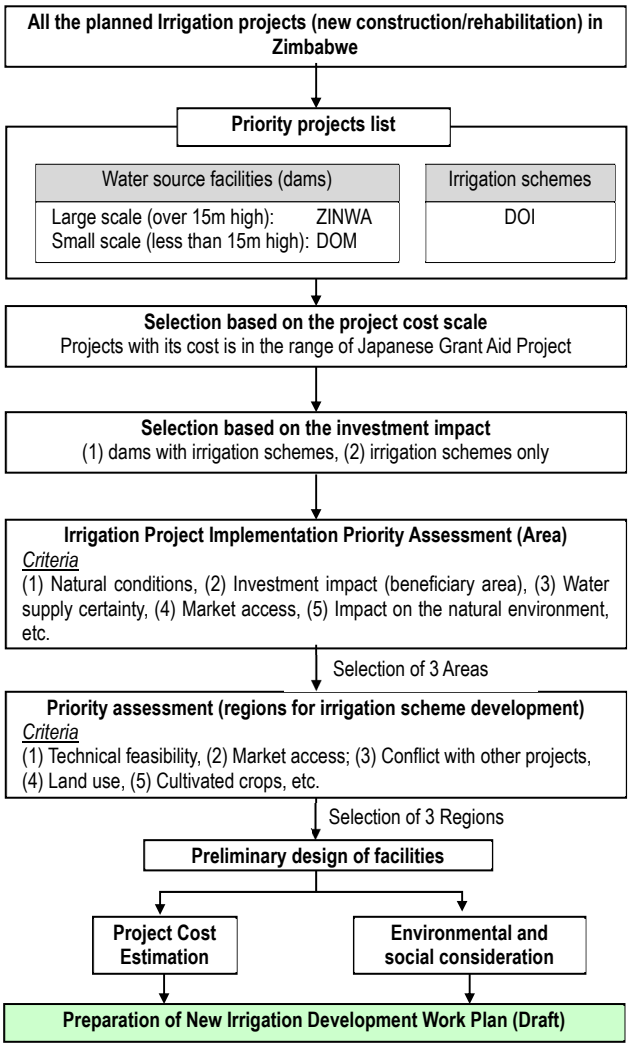
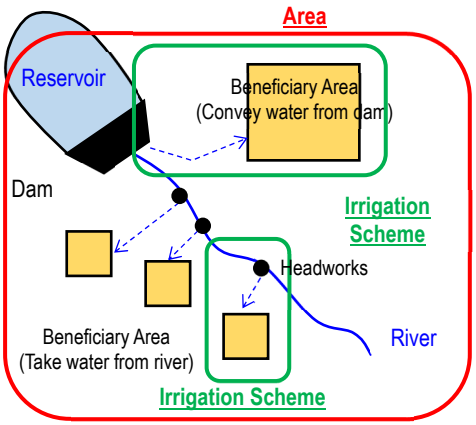


Figure 1.4.6 Procecure of the Survey on New Irrigation Development

Areas from various perspectives. Finally, target Regions for New Irrigation Development (one from each Area) are selected and farming condition survey, preliminary design of the irrigation facilities and project cost estimation are carried out. Additionally, preliminary environmental and social consideration is carried out.



Area: A dam and all beneficiary areas under the dam
Irrigation Schemes: Individual headworks/water conveyance facility and beneficiary areas under that
Region: Target area for irrigation scheme development

Figure 1.4.7 Definition of the Terms

(2) Summary of the Survey Results

1) Selection based on the project cost scale

Six projects (Large dam development: 1, Irrigation scheme development: 5) are selected from priority projects list provided from agencies in charge with a scale of project cost that could be the target of the Grant Aid Project.

2) Selection based on investment impact

It has been identified that there are a number of dams in Zimbabwe that have been constructed and are storing the required amount of water, but the stored water has not been utilized for any purpose since irrigation schemes (including water supply and power generation facilities in some dams) have not been developed (see Figure 1.4.8).

* Stored water has not been utilized since there are no irrigation facilities after a discharge valve.

Figure 1.4.8 A Samplle of Dams which Stored Water has not been Utilized

After examining the investment impact, it is found that it is more advantageous to implement only the irrigation schemes using these existing dams than to implement both the dams and the irrigation schemes at the same time. And therefore, five irrigation scheme development projects (Manyuchi, Muzhwi-Mushandike, Mabwematema, Mundi Mataga and Tuli Manyange projects) are selected. Since the selected irrigation schemes development project target all the beneficiary area in the Area, the project names are read as the name of Areas.

3) Irrigation Project Implementation Priority Assessment (Area)

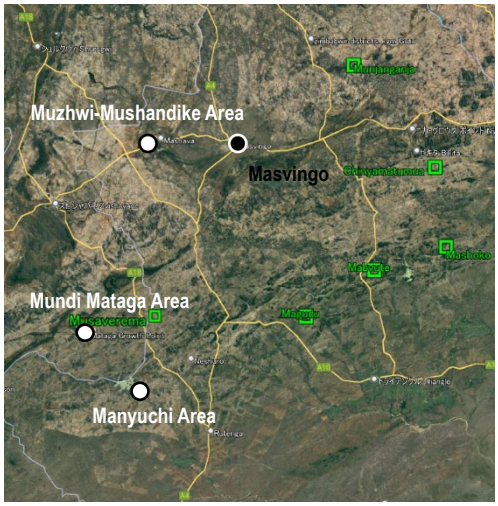


Figure 1.4.9 Selected Areas

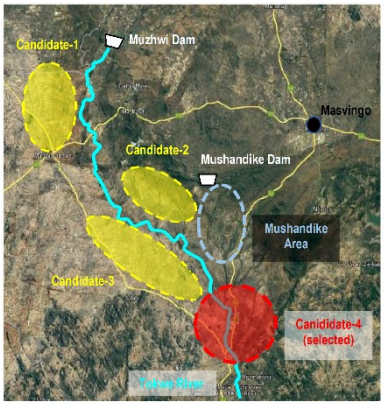
The situation of the selected five projects (= five Areas) is assessed according the criteria i) Natural conditions, ii) Investment impact (beneficiary area), iii) Water supply certainty, iv) Market access, and v) Impact on the natural environment to determine the priority of irrigation project implementation. Finally, three Areas i) Manyuchi, ii) Muzhwi - Mushandike and iii) Mundi Mataga Areas are selected as high priority Areas (see Figure 1.4.9).

4) Priority assessment (regions for irrigation scheme development)

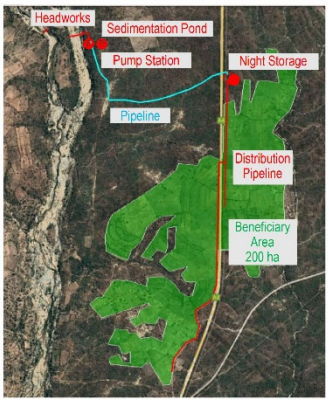
Originally, development of all the irrigation schemes in an Area was planned based on the assumption that all irrigation schemes would be gravity irrigation. However, as there are no suitable Regions under each of Areas for gravity irrigation, it is decided to plan for pump irrigation as a result. Due to the fact that pump irrigation is more expensive than gravity irrigation, it becomes difficult to develop all the irrigation schemes in an Area. Therefore, it is decided to select Regions for irrigation scheme development from each Area and prepare New Irrigation Development Plan.

i) Muzhwi-Mushandike Area

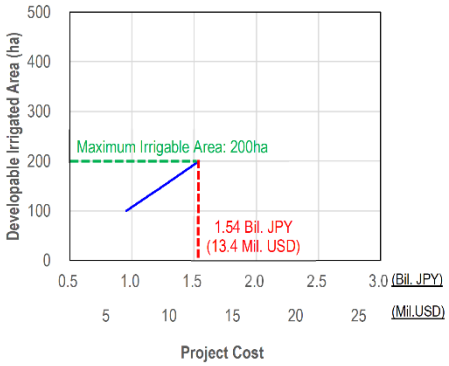
The Region comprising Villages 17C, 18A and 19B of the Mushandike Old Resettlement Area is selected because of its advantages in terms of beneficiary area scale, economical facility scale, market access and conflict with other projects.



Location of the target region



Facility layout plan



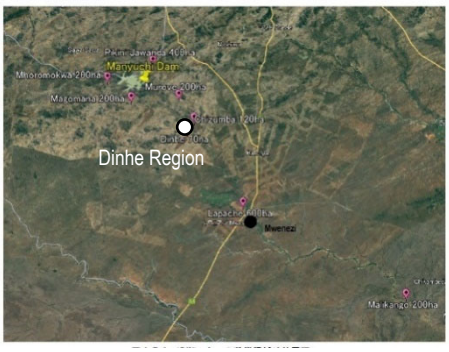
*In case on-farm facilities and land development are implemented by Zimbabwean side

Relation of project cost and irrigable area

Figure 1.4.10 Irrigation Scheme Development Plan (Muzhwi-Mushandike Area)

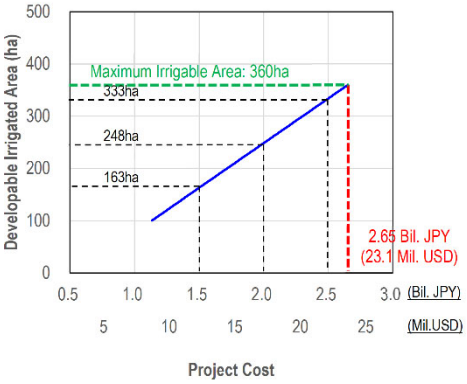
ii) Manyuchi area

The Dinhe Region is selected because of its advantages in terms of technical feasibility, market access, conflict with other projects, target farmers and target crops.



Location of the target region

Facility layout plan



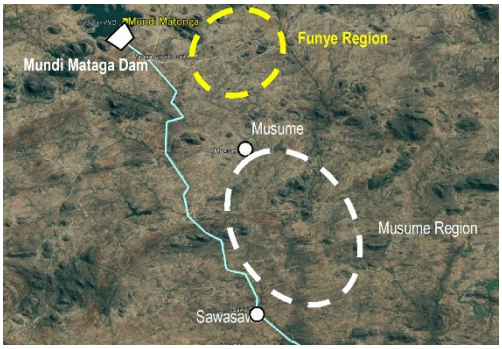
*In case on-farm facilities and land development are implemented by Zimbabwean side

Relation of project cost and irrigable area

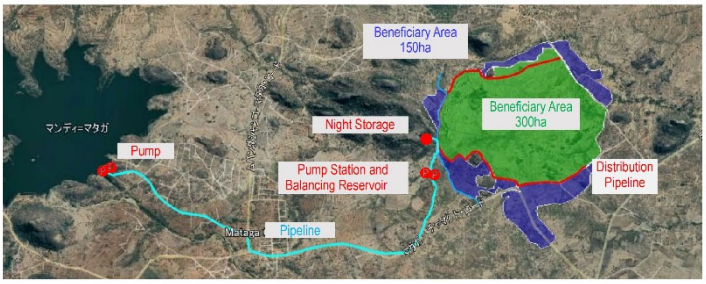
Figure 1.4.11 Irrigation Scheme Development Plan (Manyuchi Area)

iii) Mundi Mataga area

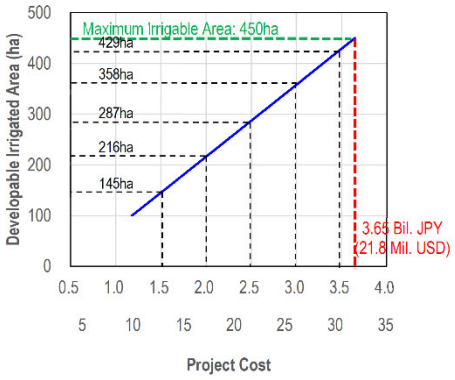
According to the results of comparison between the Musume Region recommended by the DOI and the Funye Region recommended by the Survey team, Funye Region is selected because of its advantages in terms of construction costs and O&M.



Location of the target region



Facility layout plan



*In case on-farm facilities and land development are implemented by Zimbabwean side

Relation of project cost and irrigable area

Figure 1.4.12 Irrigation Scheme Development Plan (Mundi Mataga Area)

iv) Implementation priorities

The above three Regions are prioritised in terms of project cost, investment impact, O&M, market access, and environmental and social conditions. As a result, the Funye Region in the Mundi Mataga Area is selected as the highest priority Region for irrigation scheme development.

5) Environmental and Social Consideration

Scoping is carried out as a preliminary environmental and social impact assessment for each region's development plan. As a result of the assessment, all the three plans will fall under Category B.

6) O&M plan

According to the situation of the existing irrigation schemes observed during the Survey, it may be difficult to achieve sustainable O&M of irrigation schemes without soft program such as i) Training on O&M of water-saving irrigation facilities (including water use and water management), ii) Training on farming under water-saving irrigation, iii) Strategic farmers' income increasing, and iv) Strengthening of O&M institutional structures.

CHAPTER 2 OUTLINE OF THE TARGET AREA

2.1 OUTLINE OF ZIMBABWE

2.1.1 Natural Conditions

(1) Topographical Condition

Zimbabwe is a landlocked country located in the centre of the Southern African region, adjacent to Mozambique, Zambia, Botswana, and South Africa. Most of the country is a highland, a quarter of which is above 1,000 m above sea level (see Figure 2.1.1). The eastern part of is a mountainous region, and the western part is the land following the Kalahari Desert. The lowest point is 162 m above sea level at the confluence of Runde River and Save River (the border with Mozambique), and the highest point is Mt. Inyangari in the east at 2,592 m above sea level.

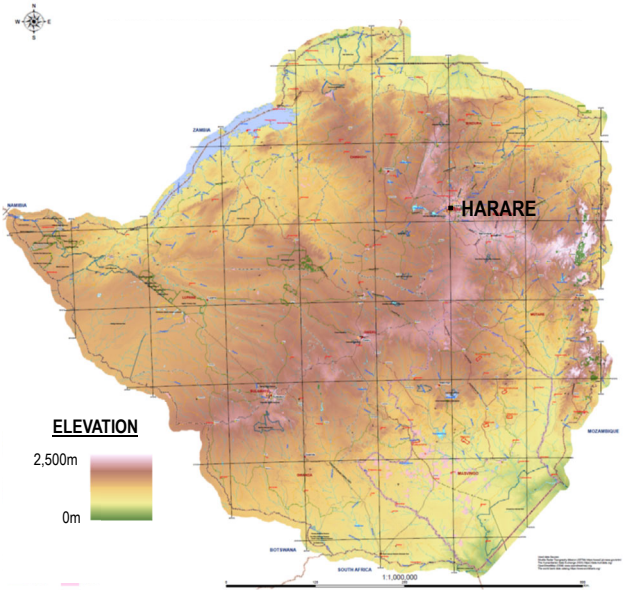


Figure 2.1.1 Topography of Zimbabwe
Source: The Survey team based on satellite data

(2) Meteorological and Hydrological Condition

The south-western part of Zimbabwe has steppe climate and the north-eastern part has warm summer rain climate. Annual precipitation is about 800 mm, most of which is concentrated in the summer from November to April (see Figure 2.1.2 and Figure 2.1.3). As well, the annual precipitation is often calculated from July to June, centered on January, when the rainfall is highest in Zimbabwe.

The hill area crosses the central part of the country from northeast to southwest and national land is divided into the Zambezi River basin (northwest side), the Save River basin and the Rinpopo River basin (southeast side).

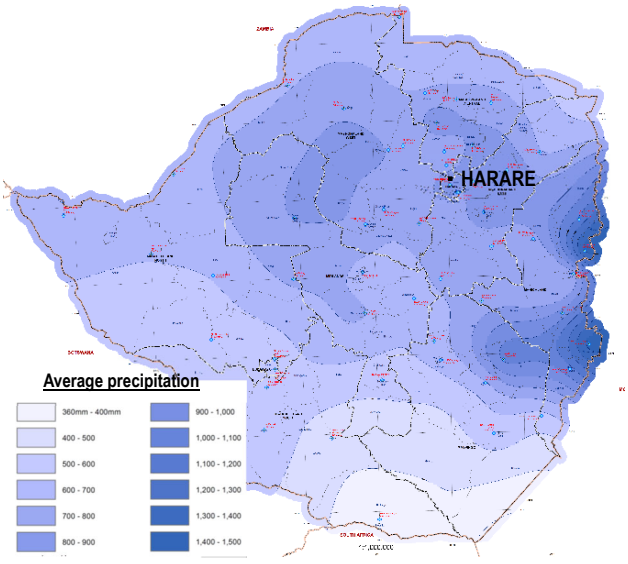


Figure 2.1.2 Contour Map of Average Annual Precipitation
Source: The Survey team based on Meteorological Service Department (MSD) data

Zimbabwe's global surface water resources are estimated to be around 20 km^3/year of which 14 km^3/year are internally produced. The country's dependency ratio on water resource volume flowing into Zimbabwe through transboundary river is around 30 %, which underlines the importance of strong transboundary water management arrangements developed under the auspices of the Revised Protocol of Southern Africa Development Community (SADC) on Shared Watercourses, which provides the basis for the management of international rivers in the SADC region (see 3.4.2 for the detail).

The 90 % probability volume of deposit (1 time of water shortage in every 10-year period) is about

11.26 km^3/year. Of this yield, 8.5 km^3/year is usable. This usable amount can irrigate 1.5 million ha. On the other hand, the frequency and volume of water flow in rivers is variable and water storage facility is critical for sustainable water utilisation. [1]

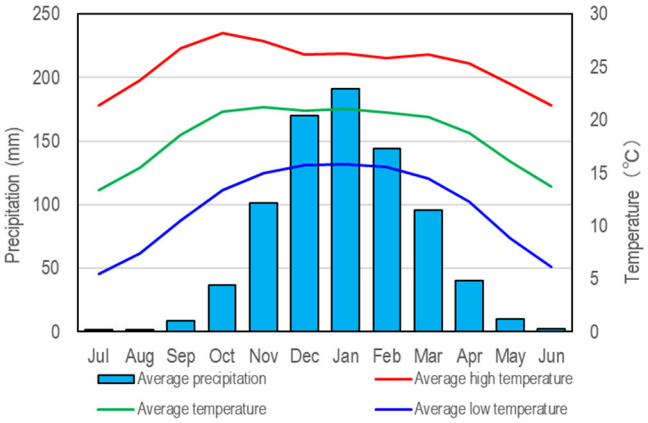


Figure 2.1.3 Meteorology of Harare City

Source: The Survey team based on Climatemps.com

(3) Geological Conditions

The geology of Zimbabwe is such that the Archean stable Zimbabwean craton, which is mainly composed of granite, schist and gneiss, is widely distributed in the central part of the national land. Greenstone belts of mafic, ultramafic, and felsic volcanoes are scattered inside the stable craton. In the center, there is an archean ultramafic intrusive rock called Great Dyke that runs north and south of the country.

The northern part consists of the Precambrian world centered on gneiss formed by orogeny called the Zimbabwe belt, the western part consists of the Precambrian world mainly composed of gneiss and massive granite in the Karahari sedimentary basal, and Jurassic basalt lava. The Karoo Supergroup consists of an upper layer and a lower layer consisting of Precambrian to Precambrian terrestrial layers. (see Figure 2.1.4)

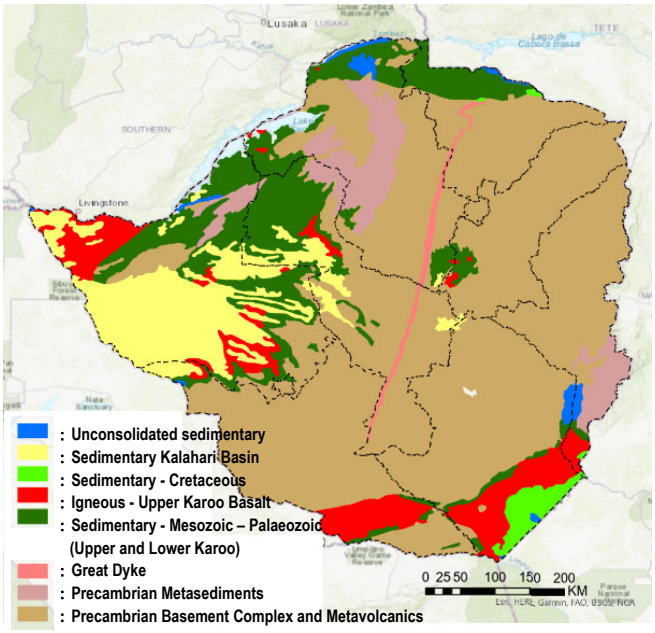


Figure 2.1.4 Geology of Zimbabwe

Source: The Survey team based on Africa Groundwater Atlas

2.1.2 Socioeconomic Conditions

(1) Politics

1) History of the country

Zimbabwe was governed by British South Africa Company in late 19th century, became a part of British colonies after the World War I, and finally stated as South Rhodesia territory of a British colony.

Many African countries became independent after World War II, and year 1960 is called as "African Year" since 17 countries were independent in that year. As same as the other African countries, black people in South Rhodesia deployed independence movements, however, South Rhodesia autonomous government thoroughly oppressed this movement. The United Kingdom (UK), the suzerainty of South Rhodesia, requested the South Rhodesia autonomous government to grant the voting right to the black people in exchange for to grant the white farmland owners' right, since UK considered independence of the African countries was an international movement. However, Ian Douglas Smith, prime minister of

[1] Ministry of Lands, Agriculture, Water and Rural Resettlement, Accelerated Irrigation Rehabilitation and Development Plan (2021-2025), 11th October 2020

South Rhodesia, refused this request and he unilaterally declared independence of the Republic of Rhodesia (hereinafter referred to as "Rhodesia").

The apartheid in Rhodesia might be more extreme rather than in South Africa. The percentage of white people in South Africa, called as white ruled nation, was 13 % at that time whilst 6 % only in Rhodesia. Under this situation, the black people took up armed resistance to the Rhodesian government as anti-apartheid movement. In 1980, the Rhodesian government transferred the rights to the black people, since they considered difficult to maintain white ruled government, and Republic of Zimbabwe was established.

2) Political structure

After the independence in 1980, once Parliamentary Cabinet System was selected, but it was changed to Presidential System in 1987 and Robert Mugabe was inaugurated as the first president. Mugabe administration sent troops to the Republic of Congo in 1999 and start FTLRP from 2000. These events caused domestic economy dislocation and induced the hyper-inflation.

Just before the election season in 2018, Mugabe dismissed vice president Mnangagwa since Mugabe schemed his wife Grace to be the next president. The national defence force strongly supported Mnangagwa and they with Mnangagwa launched de fact coup in November 2017. Consequently, Mugabe lost his position and Mnangagwa became the next president.

At present, pollical structure is republic (multi parties system) and parliament has bicameral system, 1) Lower house: 270 members with 5 years term, and 2) Upper house: 80 members with 5 years term[2].

(2) Ethnic Groups

Main ethnic groups are Shona, Ndebele and other Bantu African, Whites, and Asian. Although official language is English, Shona and Northern Ndebele are also utilized popularly.

Shona covers 2/3 of the Zimbabwean national land. On the other hand, Ndebele is distributed only around Bulawayo (see Figure 2.1.5)

Figure 2.1.5 Ethnic Distribution

(3) Diplomacy[2]

Commonwealth of Nations decided the suspension of Zimbabwe's attendance for its council for a year based on the report from election monitoring group which showed the process of election in March 2002 was injustice, and Zimbabwe withdrew the Commonwealth at the end of 2003. Additionally, due to the political turmoil in the elections in 2000's and continuous political violence, European Union (EU), United States of America (USA), UK, Australia, Canada and Nordic countries executed the ban of GoZ high officials' traveling and freeze of their assets. With this deterioration of relation with the western countries, Zimbabwe had strengthened the relationship with China and Iran, this was called as "Look East".

[2] Website of Ministry of Foreign Affairs of Japan, Basic data of Zimbabwe （https://www.mofa.go.jp/mofaj/area/zimbabwe/data.html）

Whilst, since economic condition in 2008 worthened extremely and food shortage, poor medical/sanitation service, and collapse of education services were found entire the Zimbabwe, some countries expanded humanitarian aid thorough international organizations and/or Non-Governmental Organization (NGO). However, the western countries still continued the sanctions since results of election in July 2013 was seemed injustice, while USA and EU relaxed some sanctions and re-establishment of good relationship with western countries was expected. Also, change in administration and some political reforms in 2017 were expected to be a trigger to improve domestic economy in Zimbabwe. However, due to some turmoil after election in 2018 and delay of political reforms, relation with western countries is yet to be improved.

(4) Economic Trends[3]

The economy experienced sustained recession in 2019 and 2020, with GDP estimated to have contracted by -8,1 % and -8.0 % respectively (see Figure 2.1.6) due to significant output losses in agriculture, mining, manufacturing, tourism, and energy supply sectors. The decline in output was mainly cause by negative effects of prolonged drought episodes, Cyclone Idai experienced in March 2019 and the impact of the Coronavirus Disease 2019 (COVID-19) pandemic.

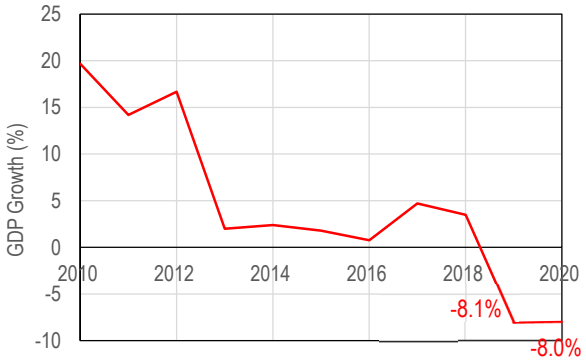


Figure 2.1.6 GDP Growth

Source: The Survey team based on data in the website of World Bank (WB)
https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2020&locations=ZW&start=1961&view=chart

The slowdown in economic activity was also driven by macroeconomic instability characterised by high inflation and exchange rate volatility against the background of excessive monetary expansion. In addition, foreign currency and electricity shortages negatively affected the productive sectors of the economy. Annual headline inflation rose from 10.8 % in 2018, to reach 557.2 % in 2020 (see Figure 2.1.7). Further, the impact of the recent outbreak of COVID-19 has also contributed to structural changes in economic activities, with some sectors such as health services and Information and Communication Technology (ICT), benefiting through increased demand and investments, whilst tourism, education, manufacturing, mining and transport were negatively affected.

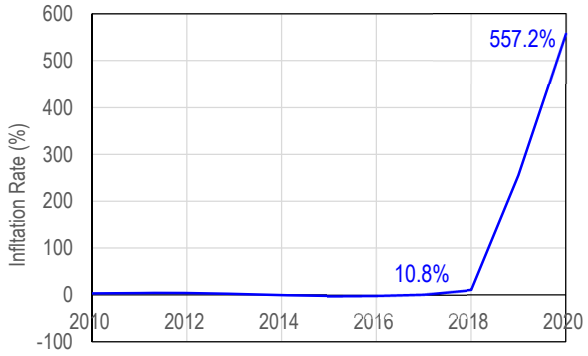


Figure 2.1.7 Inflaton Rate

Source: The Survey team based on data in the website of International Monetary Fund (IMF)
https://www.imf.org/en/Countries/ZWE#countrydata

Exports increased from 20.3 % of GDP in 2017 to a peak of 36.2 % in 2019, before declining to 27.2 % in 2020. However, the increase is largely driven by primary products which include tobacco and gold exports, which are vulnerable to international commodity price fluctuations. Imports contracted sharply in 2019 and 2020 by -32.1 % and -10.5 %, respectively, owing to declining domestic demand and policy interventions. The decline was driven by a fall in consumptive imports.

[3] Republic of Zimbabwe, NDS-1, 16th November 2020

(5) Fiscal Condition[3]

GoZ has managed to restore fiscal stability following periods of high fiscal deficits, which peaked at 12.9 % of GDP in 2017. GoZ introduced a raft of fiscal consolidation measures in 2018, which saw expenditure declining to 13.9 % of GDP in 2019 from 30.8 % in 2107, and fiscal balance closing in a surplus in 2019. On the other hand, revenue collections have gradually declined from an average of 18 % of GDP in 2015 to 14.2 % by 2019. This is due to levying of government fees below cost recovery and leakages manifesting through smuggling; underreporting of revenue particularly on US dollar transactions and corruption.

Zimbabwe's total debt as of at end of 2019 was estimated at 143 billion ZWL (80.8 % of GDP). Total Public and publicly guaranteed external debt position stood at 8.09 billion USD and about 74 % (5.97 billion USD) are arrears.

(6) Demographic[4]

The estimated number of people living in private households in 2017 was 13,572,560. The average rate of natural increase for the whole country was 2 %. The proportion of male and female population was 47.9 % and 52.1 % respectively. The population was relatively young with 50.1 % of the population being below 20 years and its proportion of male and female was 50.1 % and 49.9 % respectively (see Figure 2.1.8). In 2017, life expectancy at birth for both sexes were 60 years, with females recording a higher rate 61 years as compared to their male counterparts 58 years.

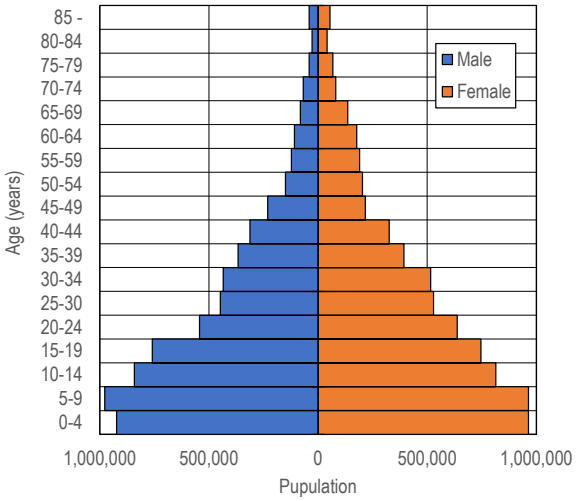


Figure 2.1.8 Population Demograph
Source: Inter-Censal Demographic Survey 2017

The infant mortality rate was estimated at 52 deaths per 1,000 live births. The rate is generally higher in rural areas (56) as compared to urban areas (43). The maternal mortality ratio from maternal causes was 525 deaths per 100,000 live births.

(7) Unemployment Rate[3]

Out of the 2.9 million people employed in 2019, about 552,000 (19 %) were in precarious employment and the majority were in the age group of 20 to 40 years. This reflects the growing risk of missing the demographic dividend. The employment situation has been severely impacted by the outbreak of the COVID-19 pandemic. Measures meant to alleviate the spread have resulted in unemployment or underemployment, with 92 % of firms having decreased the total number of hours worked per week relative to the period before the outbreak, while 22 % have decreased the total number of permanent workers.

(8) Poverty[3]

Poverty and vulnerability have been deteriorating in the past decades mainly due to droughts, cyclones and floods which exposed a number of citizens to food insecurity, hunger and starvation. The number of people under the food poverty line have increased from 3 million people in 2011 to about 6 million

[4] ZIMbabwe national STATistics Agency (ZIMSTAT), Inter-Censal Demographic Survey 2017, November 2017

in 2019 and is expected to reach between 7.6 to 8 million in 2020. Inflationary pressures, contraction in economic activity and the outbreak of the COVID-19 pandemic have exposed livelihoods of many Zimbabweans. In relative terms extreme poverty rose mostly in urban areas while in absolute terms, rural extreme poverty remains much higher than urban.

The social protection system which once ranked impressively in coverage and other measures, recent crises and structural challenges have eroded its quality and reach. About half of the food poor receive no benefits from any of the social assistance programmes.

(9) Education[3]

Zimbabwe's basic education achievements to date include above 90 % for gross intake rates and a steady progress on net intake rate, net enrolment rate, completion rates, and gross enrolment rate especially for the early childhood development classes. Despite the policy of automatic promotion that is in force at the basic education level, whereby learners proceed to the next level regardless of their results, about 17.8 % of Grade 7 learners have been failing to enrol for Form 1 mainly due to inability to pay fees.

Dropouts at the primary level are relatively low as compared to secondary level. The major causes for secondary level dropouts include child marriages, adolescent pregnancy and the burden of high fees, with about 30 % of girls dropping out in Forms 3 and 4. Also, it is desired to equip graduates with skills that empower them to become innovative towards societal development through transformative science and technology knowledge application that delivers goods and services. Innovation will bridge the gap between knowledge produced in lecture rooms, laboratory and industry production.

The shortage of infrastructure has led to the introduction of hot-sitting or double shifts in 7.6% of primary schools and 4.1% of secondary schools; an arrangement that affects quality due to limited time for instruction and learning. Additionally, disasters such as cyclones have had a huge toll on education infrastructure with schools having roofs blown off, wash facilities destroyed and weather induced droughts leaving many children vulnerable. In addition, COVID-19 pandemic has resulted in loss of learning time that will be difficult to make up for.

(10) Infrastructure[3]

The past two decades have been marred by economic challenges, which led to difficulties in ensuring the continuous rehabilitation and maintenance of infrastructure including expansion of critical areas. The deterioration of infrastructure had been serious and this resulted in Zimbabwe being ranked number 127 out of 138 countries in the Infrastructure Index under the 2017-2018 World Economic Forum Global Competitiveness Report.

The decline in the infrastructure stemmed from numerous factors, including the followings:

- Inadequate levels of public expenditure for routine and periodic maintenance including maintenance and rehabilitation of the infrastructure networks
- Lack of an integrated approach in infrastructure investment planning compounded by substantial loss of skills
- Lack of progress in building institutional capacities for management and regulation of the basic services
- Low investment in infrastructure by both public and private sectors
- Inadequate funding for capital and operating expenditure
- Low levels of support from Development Partners due to arrears among other challenges

- Capacity constraints in managing the whole project cycle including weak implementation capacity
- Unviable utility charges which make it difficult for institutions to re-invest in infrastructure
- Weak monitoring and evaluation mechanisms
- Limited foreign and domestic investment

(11) Water[3]

Access to improved water supply rose marginally from 76.1 % in 2014 to 77.1 % in 2019, whilst open defecation fell by 10 % from 31.7 % to 21.7 % and households with hand washing facilities with soap and water rose by 15.3 % from 55.8 % to 71.1 % over the same period.

The majority of the sewerage systems have experienced large scale blockages. Water treatment plants are dysfunctional and lack chemicals while many distribution systems that have fallen into disrepair. Additionally, unreliable energy supply has affected efficient operation of the water supply and sewerage systems in urban areas. Erratic water supply has led to decreased industrial production and breakouts of water borne health crises.

(12) Energy Supply[3]

Despite modest interventions in the sector, the country has experienced significant electricity shortages, mainly due to aged infrastructure dating back to 1950s that has lacked sustained maintenance and upgrading. Consequently, the national electricity access rate is around 41 % and a significant urban-rural disparity exists. About 80 % of the rural population lack access to electricity. Overall dependency on hydro power amidst effects of climatic change is exerting more burden on current electricity supply. The reliance on power imports on the backdrop of regional shortages is also not sustainable.

(13) Transportation[3]

Road: Over the past two decades, transport infrastructure has deteriorated as a result of long periods of inadequate O&M, rehabilitation and upgrading. Given the strategic importance of the road network in enhancing accessibility as well as promoting domestic and regional trade as a key transport corridor, the priority is to ensure that the assets are rehabilitated and preserved. Of the total estimated 84,000 km of road network, equivalent to 93 % of the network is in fair or poor condition and in need of rehabilitation or periodic maintenance. The poor condition of a large part of road network has had direct and indirect impacts on the road transport safety.

Railway: The network has experienced challenges associated with aging track infrastructure, including insufficient ballast, rail wear, lack of spare parts, deteriorating earthworks, and obsolete rail signaling and communications equipment. Out of the total rail network of 2,627 km, about 229 km or 9 % is under caution. The deteriorated infrastructure has also led to prevalence of accidents and derailments. Rolling stock also suffers from low availability and utilisation and, as a result, the railway is not able to meet current demand for freight services. Currently, out of a total fleet size of 166 locomotives, only 60 are operational.

(14) Information and Communication Technology (ICT)[3]

Over the past decade, great strides have been achieved in the uptake and use of ICT, as evidenced by the high active mobile penetration rates of 94.2 % and the internet penetration rate, which stood at 59.1 %, as at the first quarter of 2020. Further, the COVID-19 pandemic presented new opportunities for the sector.

Notwithstanding the positive strides, the ICT sector is faced with challenges related to underutilisation of ICT infrastructure as reflected by slow pace in embracing ICTs in service delivery, particularly e-government. In addition, the slow pace in the implementation of ICT infrastructure sharing has negatively affected performance of the sector leading to high access costs. Further, the sector has been adversely affected by lack of access to capital, low investment in both hardware and software ICT components, shortage of critical ICT skills and low investment in research and development. Application of ICTs has also been weighed down by erratic power supply. From the above-mentioned challenges, Zimbabwe in 2017 was ranked 136 out of 176 countries with an ICT Development Index of 2.92.

2.1.3 Agriculture Conditions

(1) Cropping

Zimbabwe has five agro-ecological zones, which are distinguished by annual precipitation, temperature, agricultural productive potential of the soils, and vegetation (see Figure 2.1.9 and Table 2.1.1).

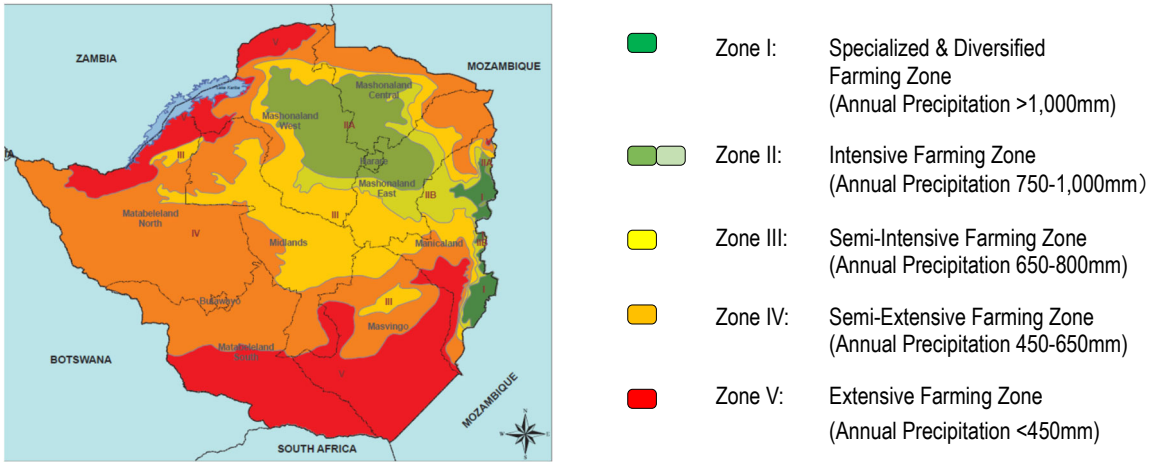


Figure 2.1.9 Agro-Ecological Zones

Source: United Nation Office for Coordination of Humanitarian Affairs (UNOCHA)

Table 2.1.1 Agro-Ecological Zones

Agro-Ecological Zones	Annual Precipitation	Natural Farming Regions	Main Crops /Farming Status	Main Province	Target Area (Percentage of area of the whole country)	Necessity of Irrigation
I	>1,000mm	Specialized & Diversified	Fruits, Tea, Coffee	- Manicaland	7,000 km^2 (1.8 %)	Low necessity of irrigation
II	750 - 1,000mm	Intensive	Maize, Wheat, Soybean, Cotton, Tabaco	- Mashonaland Central, East, West - Manicaland - Harare	58,600 km^2 (15.0 %)	Need of supplementary irrigation
III	650 - 800mm	Semi-Intensive	Sorghum, Maize, Tabaco, Cotton, Pasturage	- Manicaland - Midlands	72,900 km^2 (18.7 %)	Need of irrigation
IV	450 - 650mm	Semi-Extensive	Millet, Sorghum, Sunflower	- Masvingo - Matabeleland South, North - Manicaland - Midlands - Bulawayo	147,800 km^2 (37.8 %)	The most need of irrigation
V	<450mm	Extensive	Pasturing	- Masvingo - Matabeleland South - Manicaland - Bulawayo	104,400 km^2 (26.7 %)	High necessity due to impossible of planting without irrigation

Source: The Survey team based on Agricultural Development Consultants Association (ADCA), The Project Finding Report for the Follow-Up programme of middle scale irrigation in Masvingo province (2013) and other data and reports.

The outline of each agro-ecological zone is as described below

[Zone I] Zone I receives more than 1,000 mm of precipitation per annually. The main agricultural activities include forestry, fruit, tea coffee production and intensive livestock rearing. It covers 7,000 km^2 (1.8 % of total area of Zimbabwe).

[Zone II] Zone II receives between 750-1,000 mm of precipitation per annually. It specializes in crop farming and intensive livestock rearing. Although the need for supplementary irrigation, typical crops cultivated in Zimbabwe, such as maize, wheat, soybeans and tobacco, are produced. It covers 58,600 km^2 (15 % of total area).

[Zone III] Zone III receives between 650-800 mm of precipitation per annually and specializes in livestock rearing, fodder and cash crops. It has marginal production of maize, tobacco, and cotton and covers 72,900 km^2 (19 % of total area).

[Zone IV] Zone IV receives 450-650 mm of precipitation per annually. It specializes in extensive livestock breeding and the cultivation of drought-resistant crops such as millet and sorghum. It covers 147,800 km^2 (38 % of total area).

[Zone V] Zone V receives too low and erratic rains for even drought-resistant crops. For this reason, it is not suitable for cropping with precipitation only. It specializes in extensive cattle and game ranching and covers 104,400 km^2 (27 % of total area).

(2) Agricultural Production

The production, cultivated area and yield of major crops are shown in Table 2.1.2 and the change in the production of maize, wheat and soybean are shown in Figure 2.1.10. Maize is the main staple food crop for the majority of the Zimbabwean people. The average yield (ton/ha) of Maize was about 1.2 ton/ha on average from 1990 to 1995, but decreased to about 0.7 ton/ha on average from 2010 to 2016. It is presumed that the yield has fluctuated greatly depending on the annual weather conditions. Grain Marketing Board (GMB) has the mandate to maintain minimum strategic reserves of 500,000 ton of grain crops in physical stock. However, low productivity and production in the past few years has made it difficult to maintain strategic grain reserves at that level. The strategic grain reserve replenishment has been undertaken through imports by both GoZ and private sector. National demand is 1,800,000 ton.

Wheat is another strategic grain food crop. Consumption requirements are in the range of 350,000 - 450,000 ton/year. The production has fluctuated greatly from year to year, but in recent years it has been around 40,000 to 80,000 ton. Production has been below national requirements about 350,000 - 400,000 ton.[5]

Soybean is one of the important crops for food and nutrition security and for edible oilseed crop, especially in low rainfall areas. However, the total production of soybeans has been from 40,000 to 70,000 ton per year, and it is not meet national annual demand of 240,000 ton.[6]

[5] Ministry of Lands, Agriculture, Water and Rural Resettlement, Maize, Wheat and Soybean Production Recovery Plan, February, 2020. ※Estimated figure

[6] Ministry of Lands, Agriculture, Water and Rural Resettlement, Second Round Crop and Livestock Assessment Report, 2020/2021 Season, April, 2021. ※Estimated figure

Table 2.1.2 The Production, Cultivated Area and Yield of Major Crops

Crop	Item*	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Maize	Production	1,192,399	1,010,473	1,095,954	939,282	974,956	642,793	511,816	1,532,572	1,560,100	777,000
	Cultivated Area	1,362,563	1,538,577	1,385,161	1,260,893	1,048,268	1,107,688	1,161,997	1,099,945	1,155,075	875,909
	Yield	875	657	791	745	930	580	441	1,393	1,351	887
Wheat	Production	18,000	23,000	53,232	50,966	40,000	45,302	42,008	38,715	45,000	80,000
	Cultivated Area	6,478	8,645	21,377	21,753	18,059	22,114	22,094	22,070	27,474	50,342
	Yield	2,779	2,661	2,490	2,343	2,215	2,049	1,901	1,754	1,638	1,589
Soybeans	Production	57,328	53,849	77,124	66,740	71,328	41,768	47,755	36,478	69,688	40,000
	Cultivated Area	42,288	44,672	50,408	50,785	60,616	44,155	39,935	23,515	37,307	30,000
	Yield	1,356	1,205	1,530	1,314	1,177	946	1,196	1,551	1,868	1,333
Sorghum	Production	73,675	50,549	44,346	69,540	103,768	35,303	36,305	54,765	75,324	41,000
	Cultivated Area	272,679	222,988	216,796	226,843	226,127	146,363	190,398	176,213	115,914	107,649
	Yield	270	227	205	307	459	241	191	311	650	381
Sugar Cane	Production	2,692,000	3,058,000	3,929,056	3,960,000	3,856,000	3,348,000	3,483,000	3,101,000	3,582,994	3,562,000
	Cultivated Area	40,663	42,828	53,486	46,605	43,121	43,094	43,500	41,000	45,000	46,000
	Yield	66,203	71,402	73,460	84,969	89,423	77,691	80,069	75,634	79,622	77,435
Sunflower	Production	11,836	8,237	7,349	7,047	6,799	6,398	3,259	5,222	5,907	3,792
	Cultivated Area	28,945	26,164	19,628	18,216	15,399	16,635	8,428	8,269	10,528	8,179
	Yield	409	315	374	387	442	385	387	632	561	464
Ground Nuts	Production	136,719	97,504	72,194	67,855	56,666	52,096	47,209	98,398	102,958	90,000
	Cultivated Area	319,608	329,803	214,266	164,319	137,350	152,290	185,850	199,078	205,296	192,000
	Yield	428	296	337	413	413	342	254	494	502	469
Cotton	Production	149,907	140,267	247,752	141,478	74,693	42,823	32,888	73,260	105,888	107,338
	Cultivated Area	198,824	246,559	358,410	195,072	130,690	112,066	101,660	76,495	129,447	156,640
	Yield	754	569	691	725	572	382	324	958	818	685
Tobacco	Production	109,737	125,056	139,179	147,068	184,003	171,083	168,974	110,816	239,906	257,764
	Cultivated Area	94,175	117,287	92,705	125,717	128,668	132,126	102,537	118,967	136,412	102,795
	Yield	1,165	1,066	1,501	1,170	1,430	1,295	1,648	932	1,759	2,508

* Production : ton, Cultivated Area : ha, Yield : kg/ha
Source : Food and Agriculture Organization STATistical database (FAOSTAT)

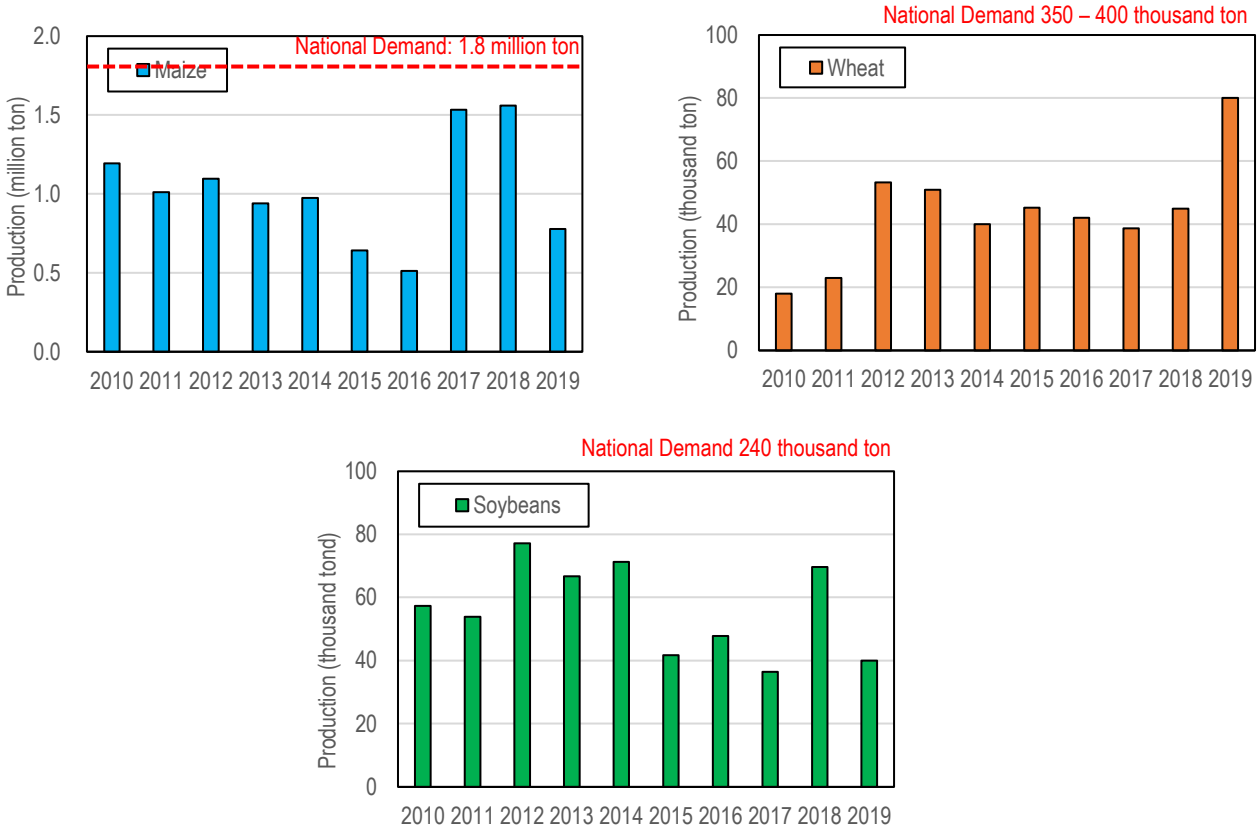


Figure 2.1.10 Changes in Production of Maize, Wheat and Soybeans

Source : FAOSTAT

(3) Import/Export

Production and productivity of grain crops has been on the decline since the early 1990s. From a surplus producer of maize, Zimbabwe has become a net food importer during the past decade. This has been attributed to low producer incentives due to erosion of producer prices by inflation as well as input shortages among other challenges. The import and export status of major products is shown in Table 2.1.3.

Table 2.1.3 Import and Export of Major Crops

Unit: ton

Crop		Maize	Wheat	Soybeans	Sorghum	Sunflower	Ground-Nuts	Cotton	Tobacco
2010	Import	173,824	335,480	20,818	30,065	3	902	15,149	119,184
	Export	103	0	0	0	50	100	12,844	90,196
	Balance	▲ 173,721	▲ 335,480	▲ 20,818	▲ 30,065	47	▲ 802	▲ 2,305	▲ 28,988
2011	Import	459,171	287,766	3,258	23,757	35	241	396	29,585
	Export	989	61	0	0	0	990	12,933	134,466
	Balance	▲ 458,182	▲ 287,705	▲ 3,258	▲ 23,757	▲ 35	749	12,537	104,881
2012	Import	435,375	186,955	460	3,668	15	2,317	307	43,301
	Export	2,450	1,113	100	129	10	38	304	131,853
	Balance	▲ 432,925	▲ 185,842	▲ 360	▲ 3,539	▲ 5	▲ 2,279	▲ 3	88,552
2013	Import	304,532	198,211	5,234	10,406	4	3,753	298	19,180
	Export	1,055	110	314	272	0	0	12,158	147,873
	Balance	▲ 303,477	▲ 198,101	▲ 4,920	▲ 10,134	▲ 4	▲ 3,753	11,860	128,693
2014	Import	287,432	201,010	17,376	6,011	12	5,987	806	15,441
	Export	331	1	841	39	N/A	30	262	141,559
	Balance	▲ 287,101	▲ 201,009	▲ 16,535	▲ 5,972	N/A	▲ 5,957	▲ 544	126,118
2015	Import	571,775	231,293	14,239	11,307	15	7,078	0	1,720
	Export	440	1,510	89	28	N/A	1	1,086	148,268
	Balance	▲ 571,335	▲ 229,783	▲ 14,150	▲ 11,279	N/A	▲ 7,077	1,086	146,548
2016	Import	821,672	268,891	8,451	38,895	57	8,967	92	3,442
	Export	631	0	27	115	N/A	2	4,143	155,191
	Balance	▲ 821,041	▲ 268,891	▲ 8,424	▲ 38,780	N/A	▲ 8,965	4,051	151,749
2017	Import	308,267	205,760	67,197	7,531	16	6,663	191	5,271
	Export	2,324	16,500	377	64	N/A	4	40	157,337
	Balance	▲ 305,943	▲ 189,260	▲ 66,820	▲ 7,467	N/A	▲ 6,659	▲ 151	152,066
2018	Import	92,847	276,776	17,631	7,713	69	8,285	583	7,999
	Export	836	7	176	4,970	N/A	357	593	171,281
	Balance	▲ 92,011	▲ 276,769	▲ 17,455	▲ 2,743	N/A	▲ 7,928	10	163,282
2019	Import	73,601	124,632	12,630	18,318	14	695	765	1,820
	Export	1,154	300	42	6,966	0	52	140	173,559
	Balance	▲ 72,447	▲ 124,332	▲ 12,588	▲ 11,352	▲ 14	▲ 643	▲ 625	171,739

Source : FAOSTAT

(4) Land Use[3,7,8]

1) Land reform and resettlement programme

At independence, Zimbabwe inherited a racially skewed agriculture land ownership pattern where the large scale commercial white farmers, consisting of less than 1 % of the population occupied 45 % of agricultural land. 75 % of this is in the high precipitation areas of Zimbabwe, where the potential for agricultural production is high. Equally significant, 60 % of this large scale commercial land was not merely under utilized but wholly unutilized. Under these circumstances, the GoZ has worked out some land reform and resettlement programmes.

[7] ZIMSTAT, Zimbabwe Smallholder Agricultural Productivity Survey 2017 Report, March 2019
[8] Ministry of Lands, Agriculture and Rural Resettlement, Land Reform and Resettlement Programme Implementation Plan Phase II, March 2001

i) Phase-1 (1980-1998)

The first phase of the land reform and resettlement programme covered the period 1980 - 1998. By 1997 the GoZ had acquired 3,498,444 ha of land through buying from the owner at the market price and resettled 71,000 families. The programme provided crop packs and tillage services for half a hectare to each family in the first year of settlement. Commendable progress was achieved in providing infrastructure for the settlers in the early stage of resettlement.

The majority of settler families experienced real increases in incomes, which exceeded those of their counterparts in Communal Land. Some settler families invested in substantial land improvement, permanent housing and production and transport equipment. Resettlement also created more jobs than large scale land holdings.

ii) Phase-2 (1998 -)

In September 1998, GoZ launched the second phase of the land reform and resettlement programme. The overall objectives of the second phase included redressing the inequities in land resource allocation and providing a more efficient and rational structure for land.

Inception Phase (1998 - 2000)

Phase-2 was meant to commence in October 1998 with two years inception phase where farmlands covering 2.1 million ha were to be acquired for resettlement. Infrastructure and farmer support services were to be provided using GoZ and donor community resources.

However, the white commercial farmers contested acquisition of most of the identified farmlands and the donner community failed to deliver the promised resources. The GoZ, using limited resources, was only able to acquire 168,263 ha and to resettle 4,697 families between October 1998 and June 2000.

Fast Track Resettlement Phase (2000 -)

The fast track approach to resettlement was officially launched on 15th July 2000 to speed up the pace of land acquisition and resettlement. Having lost two years with little activity during in inception phase, GoZ resolved to implement the phase, code named “Fast Track”. However, since lands had been acquired violently from white farmers instead of the original peaceful procedure, buying at market prices, Zimbabwe was subject to sanctions from Western countries.

Although the large scale commercial farmlands were dominated by large scale commercial growers, they committed significant investments in skills development, irrigation infrastructure, handling facilities and export market development. The FTLRP fragmented and dissipated the commercial agriculture sector. Similarly, financial support from investors, banks, private processors, buyers and developed skills dwindled. More significantly, the horticulture cold chain and packaging infrastructure, including overseas markets and logistics were disrupted. Consequently, production fell abruptly and exports declined to 40 million USD from a high of around 143 million USD in the 1990s. This triggered high absorption of imports and further collapse of the sector.

The FTLRP caused not only agriculture sector’s dislocation but also domestic economy dislocation, and became one of the triggers of the hyper-inflation.

2) Farmland

Farmlands in Zimbabwe are mainly classified into six types described as below. The classification and

total area of these three farmland categories, i) Large Scale Commercial Farm to v) A1 Farm and vi) A2, are changing from moment to moment due to the conversion by FTLRP from i) to v) or vi) is on-going.

i) Large Scale Commercial Farm

Large Scale Commercial Farms are those geographically located in the areas occupied by former white commercial farmers. This farming sector is generally well financed, capitalised and produces crops and livestock including horticulture on a large scale. The number and area of Large Scale Commercial Farms has been decreasing due to implementation of FTLRP.

ii) Small Scale Commercial Farm

Small Scale Commercial Farms were formerly called 'Native purchase areas' during the period of minority rule which at the time were areas where African farmers could farm commercially. There are approximately 9,655 Small Scale Commercial Farms in Zimbabwe with an average size of 148 ha and those occupy 4 % of all land. An individual farmer was given a farmland to undertake crop and livestock production. Recently, the number of households under this category has increased since the families are increasing in numbers. Farmers in this sector have title deeds as form of ownership of land. It was a lease with option to purchase- deed of grant.

iii) Old Resettlement Area

These came into existence under the GoZ's early land reform and resettlement programme (Phase-1). From 1980 to 1998, GoZ bought land from Large Scale Commercial Farms on willing buyer willing seller basis and resettled farmers from Communal Land. The farmers were resettled on an individual family basis or as co-operatives.

iv) Communal Land

Communal Land is the area where blacks were forcibly relocated during the Rhodesian era. Farmers live in villages and have areas for cropping and common grazing lands. Agricultural production is mainly for subsistence with the surplus being sold to the market. The population in the Communal Land makes up to about 51 % of Zimbabwe's population. The sector occupies 42 % of total land area.

**Under the FTLRP started in 2000, the acquired lands once belong to GoZ, divided into A1 and A2 Farm, and provided (leased) to the farmers from Communal Land.*

v) A1 Farm（Villagized and self-contained settlement scheme）

A1 Farm has three tiers, a) villagized variant (crop base), b) villagized variant (livestock based), and c) self-contained variant. Land allocated per settler depends on the agro-ecological zones.

a) Villagized variant (crop base)

This is a translocation type of resettlement with a villagized type of settlement. Settlers are allocated individual residential and arable plots, but share common grazing, woodlots and water points. Each household is allocated a minimum 3 ha as arable land with the remainder set aside for communal grazing.

The principal target group for this model are the landless peasants in the Communal Land. They can receive some social services by GoZ, such as a borehole per village of 20 - 25 families, a clinic for 500 families, a primary school class room for every 20 families, and so on.

b) Villagized variant (livestock base)

This model is applicable to drier parts of the country where ranching is the only suitable form of land use in the absence of irrigation development. The land is divided into three tiers, "Compromising a cluster of villages, some arable land and social services", "Near grazing area where each benefiting household keeps five livestock units for day use", and "Grazing area for commercial purpose".

The model is primarily targeted at overcrowded Communal Lands adjacent to acquired farmlands in drier natural regions in which there is insufficient grazing land to sustain a commercial herd. They can receive the same level social services as a) Villagized variant (crop base).

c) Self-contained variant

Each settler is allocated land in one consolidated farmland unit. The principal target group for this model are the landless peasants in the Communal Land who form the majority among the land hungry. They can receive basic social services only.

vi) A2 Farm（Small, medium and large scale farmland settlement scheme）

This model aims at increasing the participation of black indigenous farmers in commercial farming through the provision of easier access to land and infrastructure on full cost recovery basis. All the applicants shall be processed in the province where the applicant wishes to be allocated lands, and finally the Minster of Jurisdiction Ministry approves. The land is leased to an applicant on 99-year lease with option to purchase. Same as A1 Farm, area of land allocated per settler depends on the agro-ecological zones but maximum one may not exceed 50 ha so that as many beneficiaries as possible will also be accommodated.

(5) Food Security[3]

The agriculture sector, which is responsible for feeding the nation and providing livelihoods to 67 % of the country's population in rural areas, is national important sector. Food insecurity, however, has been consistently growing due to natural shocks, low skills and knowledge base of farmers, shortage of inputs, low levels of mechanisation, reliance on rain-fed agriculture, limited access to market information and marketing facilities, limited access to finance and limited security of tenure.

Over the years, average productivity of both food and cash crops across all farmland types has been declining. Maize yields declined from an average of 1.2 ton/ha between the period 1990 to 1995 to an average of 0.749 ton/ha between the period 2010 to 2016. Consequently, the country's capacity to produce sufficient cereal to meet national demand has been constrained and the gap has been consistently met through importing.

The urban population, the vulnerable and food deficit rural households access their food requirements through a private sector dominated food market, whose grain requirements are met by GMB's Strategic Grain Reserve. GMB is the sole buyer of grain, supported by existing grain market regulations, pricing policies and subsidies, which are crowding out the private sector and effectively making millers dependent on the Strategic Grain Reserve against a constrained fiscal space to maintain an adequate stocks. This is being exacerbated by underdeveloped public rural infrastructure and poor rural market linkages, which increase marketing and transaction costs, adversely affecting farmer incomes.

Due to this condition, particularly food in secure from January to March has been serious. During the period 2015 to 2020, the proportion of food-insecure rural population ranged between 30 and 56 % and

59 % was counted in 2019 (see Figure 2.1.11). Further, the proportion of chronically food insecure people in rural and urban communities increased from about 500,000 in 2015 to about 1.7 million people in 2020. Additionally, urban vulnerability was also on the rise reaching 30 % or 2.2 million by 2020.

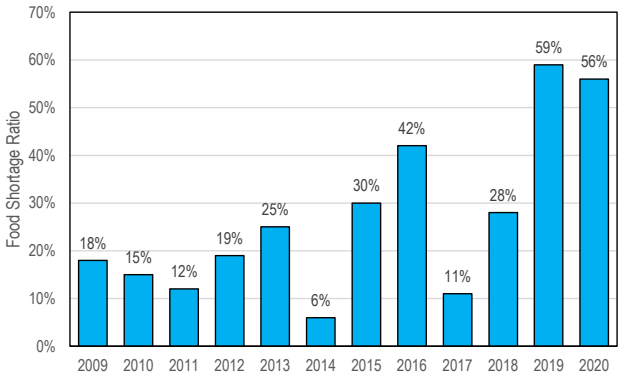


Figure 2.1.11 Food Insecure Rate (January – March)

Source: NDS-1

(6) Nutrition Security[3]

Zimbabwe has demonstrated commitment to addressing nutrition insecurity as reflected by the development and implementation of several national policies and strategies. This has seen significant positive strides being recorded despite high numbers of food-insecure people. However, the country is still facing a triple burden of malnutrition with 1) one out of three children suffering from under nutrition, 2) over nutrition and 3) micronutrient deficiency. This is mainly due to gaps in the country's food system.

The majority of households in both urban and rural areas consume mostly cereals, condiments, vegetables, oils, and sugar, which lead to poor dietary diversity and insufficient consumption of essential nutrients. Consequently, stunting at 26 %, micronutrient deficiencies such as iron-deficiency anaemia, and vitamin A deficiency and iodine deficiency disorders and obesity are led. Also, whilst the proportions of children with stunting is less in urban areas than in the rural areas; the trend in urban areas has been increasing.

2.1.4 Irrigation Conditions[9]

(1) Irrigated Area

From 2000, potential irrigation area and functional irrigation area have increased in average of 518 ha/year and 193ha/year respectively. Whilst, functional irrigation area ratio (=Functional irrigation area / Potential irrigation area) has been almost stable, around 40 % (see Figure 2.1.12). As of 2016, total potential irrigation area and functional irrigation area are 28,000 ha and 12,000 ha respectively.

Irrigation areas by agro-ecological zones is shown in Figure 2.1.13. Functional irrigation area ratio of Zone III is significantly low, only 12%.

Figure 2.1.14 illustrates irrigation areas by provinces. Potential irrigation area in Manicaland Province is remarkably huge, 12,700 ha whilst functional irrigation area ration is low, almost 30 %. Irrigation area in Bulawayo and Harare is zero,

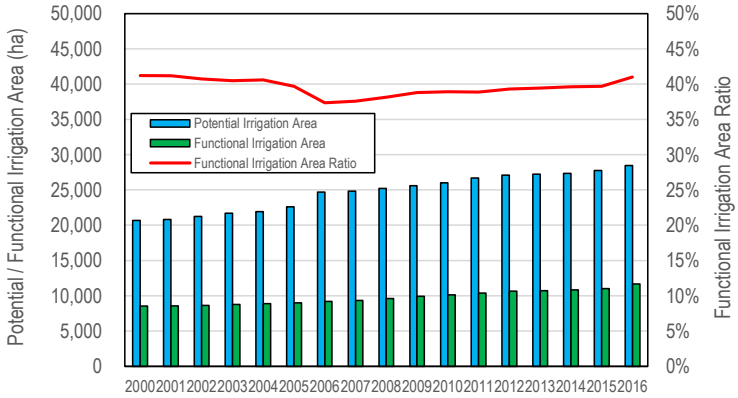


Figure 2.1.12 Change in Irrigation Areas

Source: The Survey team based on Irrigation data base in website of MLAFWRR

[9] Irrigation database in the website of MLAFWRR

this means no irrigation agriculture can be found in these two cities. Functional irrigation area ratio of Matabeleland South and Masvingo Provinces is relatively high, around 70 %, but that of Manicaland, Matabeleland North and Mashonaland West Provinces has low ratio, 20 - 30% only. It can be said functional irrigation area ratio in provinces having relatively small precipitation amount is high.

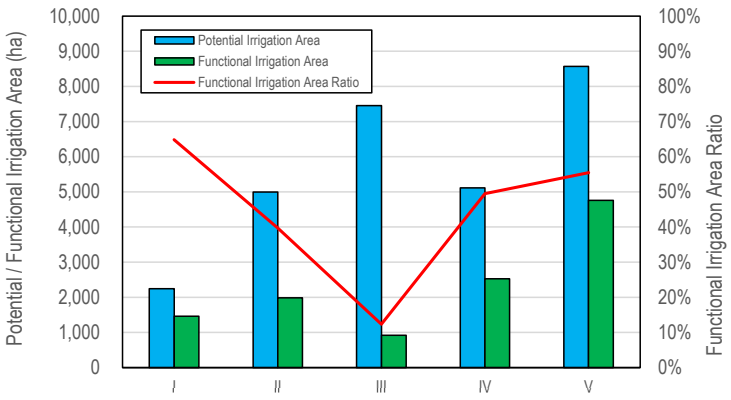


Figure 2.1.13 Irrigation Areas by Agro-Ecological Zones

Source: The Survey team based on Irrigation data base in website of MLAFWRR

(2) Irrigation Scheme

As of 2016, Zimbabwe has total 372 irrigation schemes but this number does not include any private irrigation schemes in Large Scale Commercial Farms.

Number of irrigation schemes by agro-ecological zone is shown in Figure 2.1.15. Total number of Zone III, IV and V where irrigation is required is 236, equivalent 63% of the total number. Also including Zone II where auxiliary irrigation is required, the number becomes 335, equivalent 90 % of the total number.

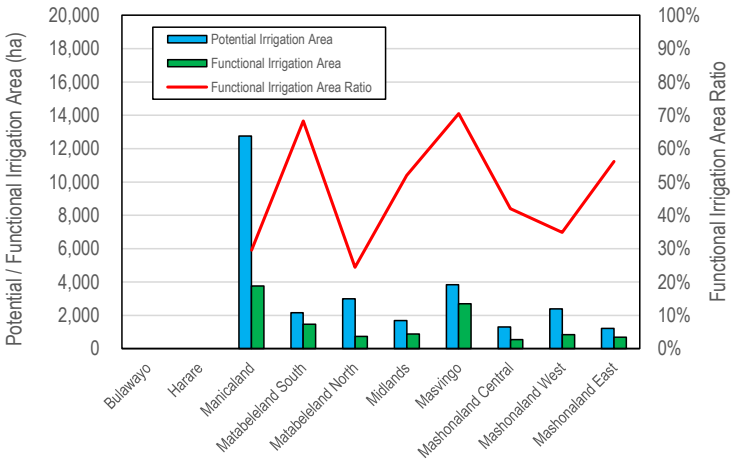


Figure 2.1.14 Irrigation Areas by Provinces

Source: The Survey team based on Irrigation data base in website of MLAFWRR

Number of irrigation schemes by provinces is show in Figure 2.1.16. Manicaland has maximum number, 71 and follow Masvingo 65 and Midlands 56.

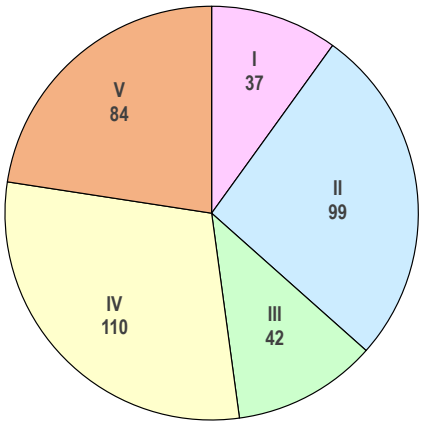


Figure 2.1.15 Number of Irrigation Schemes by Agro-Ecological Zones

Source: The Survey team based on irrigation data base in website of MLAFWRR

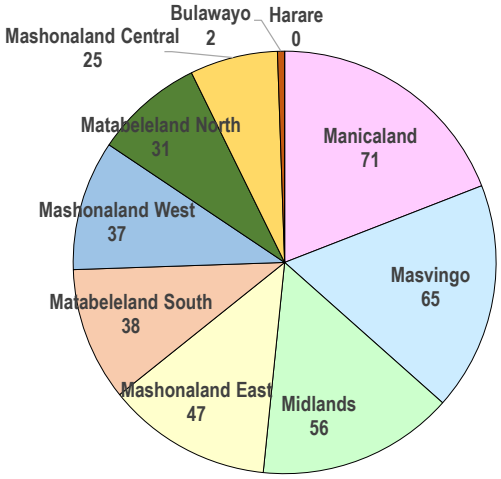


Figure 2.1.16 Number of Irrigation Schemes by Provinces

Source: The Survey team based on irrigation data base in website of MLAFWRR

2.2 OUTLINE OF MASVINGO PROVINCE

2.2.1 Natural Conditions

(1) Topographical Condition

The area of Masvingo Province is 56,566 km^2, which covers about 15 % of national land area. Masvingo Province is the third largest province of Zimbabwe.

The topographical condition of Masvingo Province is gently sloping from north-west to south-east (elevation: from 1,400 m to 162 m). Also, it is roughly divided into the highlands in north and lowlands in south of the Masvingo City. The south-eastern part is the lowest elevation point in Zimbabwe (see Figure 2.2.1).

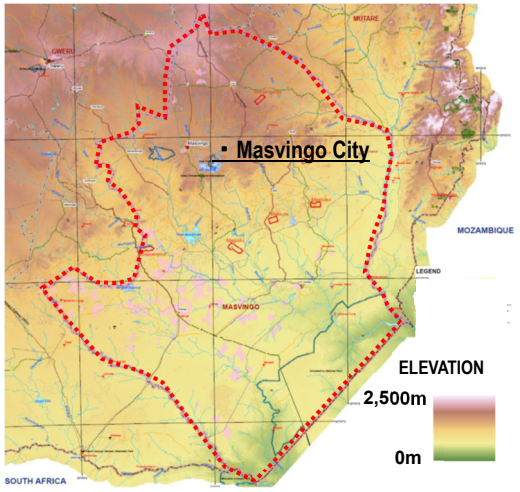


Figure 2.2.1 Topography of Masivngo Province

Source: The Survey team based on satellite data

(2) Meteorological and Hydrological Condition

Masvingo Province is divided into a steppe climate in the south and a temperate summer rain climate in the north. The annual rainfall is about 600 mm, and most of it is concentrated in the summer from November to March.

Most of the river basin is the Save River basin, but the southern part is the Rinpopo River basin.

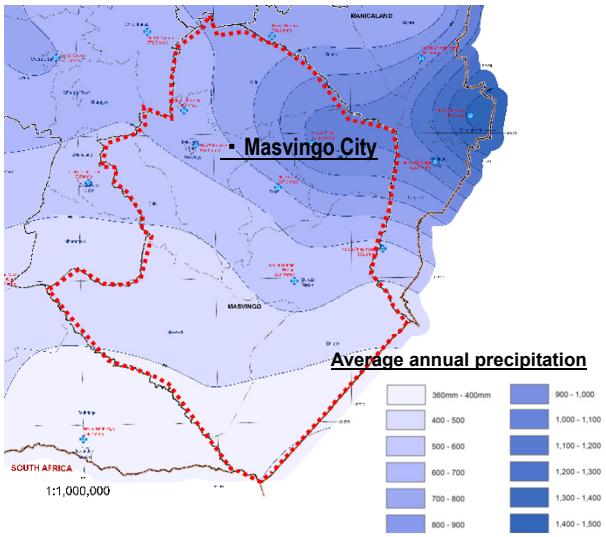


Figure 2.2.2 Contour Map of Average Precipitation of Masvingo Province

Source: The Survey team based on MSD data

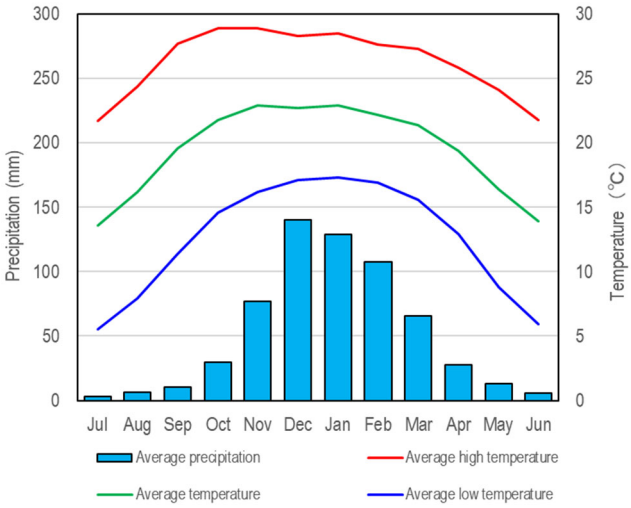


Figure 2.2.3 Meteorology of Masvingo City

Source: The Survey team based on Climatemps.com

(3) Geological Condition

The geology of Masvingo Province is predominantly younger stage granite type and old stage gneisses type, with intrusive rocks of various ages and the Quaternary deposits in between. The geology of the site of the six dams whch was constructed under the "Project on Medium Size Dams in Masivingo Province" are summarized below.

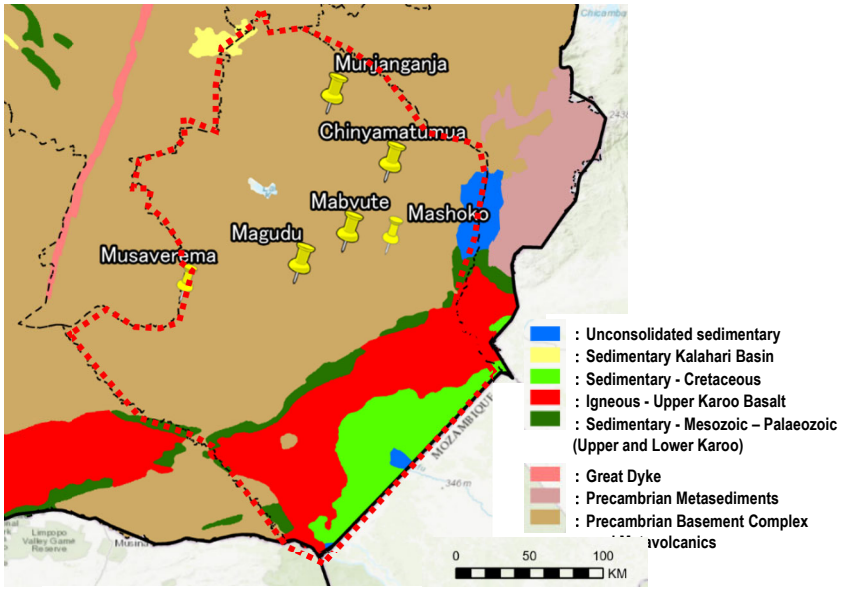


Figure 2.2.4 Geology of Masvingo Province

Source: The Survey team based on Africa Groundwater Atlas

1) Magudu Dam

Magudu Dam site consists of gneiss, coarse-grained basalt and talus. River and terrain conditions and the exposed coarse basalt indicate the presence of dikes around the dam site. As for soil material (dam body material) at the time of dam construction, brown colored sandy silt widely distributed on the left bank side, and brown mottled gray sandy silt presenting on the lower surface connection of both sides were utilized. Further, granite gneiss crushed stone contains racks in the areas of the mound presenting on the right bank side was utiliezed for rock material.

2) Musaverema Dam

Musaverema Dam site consists of gneiss and floodplain sediments. As for soil material (dam body material) at the time of dam construction, silt or fine sand on the right bank side was used. Also, fully exposed crushed stone with granite gneiss mound presenting on the left bank side at upstream portion was utilised for rock material.

3) Chinyamatumwa Dam

Cinhamatsumwa Dam site consists of giant pegmatite, coarse-grained basalt and terrace deposits. The intrusive dikes of coarse-grained basalt into giant granite are parallel to the flow of the river. As for soil material (dam body meterial) at the time of dam construction, dark brown, sticky silty clay on the upper right bank, light brown or light gray, less sticky, silty-gravel mingled sand strait were used. Further, crushed stone granite which was many cracks presenting on the left bank side was utilized for rock material.

4) Mashoko Dam

Mashoko Dam site consists of gneiss, basic metamorphic rocks and terrace deposits. The geology of the dam site is complicated by the intrusion of basic metamorphic rocks. As for soil material (dam body material) at the time of dam construction, dark red-brown, sticky silty clay, also the gravel mixed in a part on the upstreem right bank, dark gray silty-clay sand were used. It existed at the bottom of both banks. Further, boulders, coarse basalt with many cracks presenting on the upstreem right bank was utlilizeda for rock material.

5) Mabvute Dam

Mabvte Dam site consists of gneiss, mottled granite, coarse-grained basalt and river sediments. As for soil material (dam body material) at the time of dam construction, reddish brown, sticky, less some sticky, sandy silt to silty sand on both sides was used. Further, a crack mound, gneiss crushed stone ground on the left bank side was utilised for rock material.

6) Munjanganja Dam

Munjanganja Dam site consits of huge granite, mottled granite and river sediments. As for soil material (dam body material) at the time of dam construction, light reddish, brown silty sand or sandy silt on the upsterrm left bank, and dark red-brown, sticky and gravel mingled clay on the upstreem left bank was used. Further, huge granite existing on the upstreem right bank, and megalithic coarse basalt on the left bank side were utilized for rock material.

2.2.2 Socioeconomic Conditions[10]

Total provincial population is 1.55 million and share about 11.4 % of national population. The population has increased in average 1.5 %/year. Male occupies 47.2 % and female 52.8 %, the number of female is relatively higher than male's one[4]. Main ethnic groups are Shona in northern part and Venda in southern part (see Figure 2.2.5).

Main industry is agriculture, and tourism is the second one. Main tourism source is Great Zimbabwe, a world heritage.

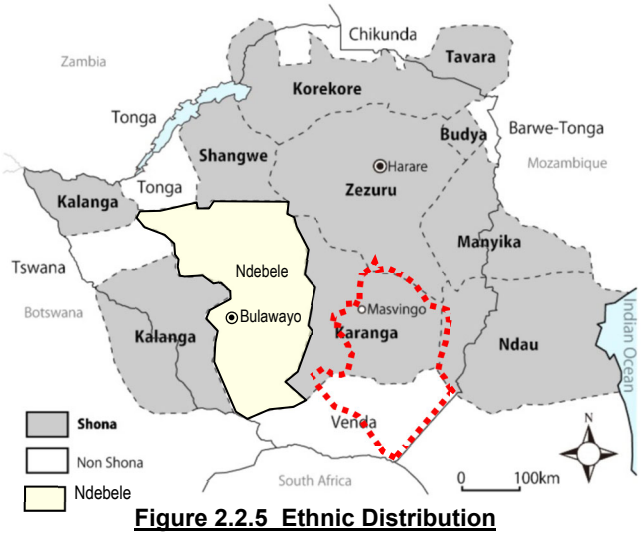


Figure 2.2.5 Ethnic Distribution

Masvingo, capital of the province, is located at the important junction of two roads, 1) North-south road connecting national capital Harare and South Africa, and 2) East-west road starting from border of Mozambique. However, these roads cannot transfer enough properties due to their poor conditions.

Power supply in the province is limited and 14 % (2014) of the households cannot access to the electricity. This ratio is second highest one among all the provinces, the worst one is Manicaland Province. Main communication tool is mobile phone, and it can be utilized in 90 % of the provincial land.

2.2.3 Agriculture Conditions

The major cultivated crops in Masvingo Province are maize, beans and wheat in irrigated areas and finger millet and sweet potatoes in non-irrigated areas. The cultivated area, yield, and production of major crops in Masvingo Province are shown in Table 2.2.1.

[10] United States Agency for International Development (USAID), Zimbabwe Market Study: Masvingo Province Report, January 2020

Table 2.2.1 Cultivated Area, Yield and Production of Major Crops in Masvingo Province

Cultivated year	2019/2020				2020/2021 年			
Crop	Cultivated Area (ha)	Yield (ton/ha)	Production (ton)	Production Ranking in Whole Country *	Cultivated Area (ha)	Yield (ton/ha)	Production (ton)	Production Ranking in Whole Country *
Maize	178,403	0.28	50,458	6	242,908	0.54	131,872	6
Nationwide*	1,582,766	0.57	907,628	-	1,951,848	1.39	2,717,171	-
Sugar Beans	2,214	0.21	459	6	2,609	0.23	596	6
Nationwide*	28,617	0.44	12,650	-	35,322	0.87	30,613	-
Wheat**	403	1.96	788	N/A	718	3.72	2,670	N/A
Nationwide*	50,342	1.59	80,000	-	N/A	N/A	N/A	-
Finger Millet	14,180	0.30	4,211	1	10,051	0.50	5,019	1
Nationwide*	34,082	0.29	9,799	-	24,962	0.53	13,223	-
Sweet Potato	5,392	3.00	16,572	4	13,319	8.35	111,269	1
Nationwide*	19,795	6.00	114,558	-	45,513	9.29	422,613	-

Notes*8 province excluded Harare and Bulawayo

** Planted year of wheat is 2019（Dry season）and 2020（Dry season）

Source: The Survey team based on "2nd round assessment report 2021 draft 26 April 2021" and Nationwide data of wheat from "FAOSTAT "

Maize cultivation is very popular in Masvingo Province since maize is an ingredient of Sadza which is the staple food. The cultivated area of maize is 178,403 ha in 2019/2020 and 242,908 ha in 2020/2021, which is larger than other crops. However, the yield is 0.28 ton/ha (2019/2020) and 0.54 ton/ha (2020/2021), which is only about half of the national average. For this reason, the national ranking of total production is 6th among 8 provinces (excluding Harare and Bulawayo). The total production of sugar beans is also 6th among 8 provinces and the cultivated area of wheat which can be cultivated in winter (dry season) only is 403 ha out of 50,342 ha in nationwide in 2019. On the other hand, cultivation of finger millet and sweet potato in rainy season, which are drought-resistant, are 1st in the national ranking of total production in 2020/2021.

2.2.4 Irrigation Conditions

(1) Irrigated Area

Potential irrigation area and functional irrigation area in the Province as of 2016 is 3,800 ha and 2,700 ha respectively, and functional irrigation area ratio (=Functional irrigation area / Potential irrigation area) is about 71 %.

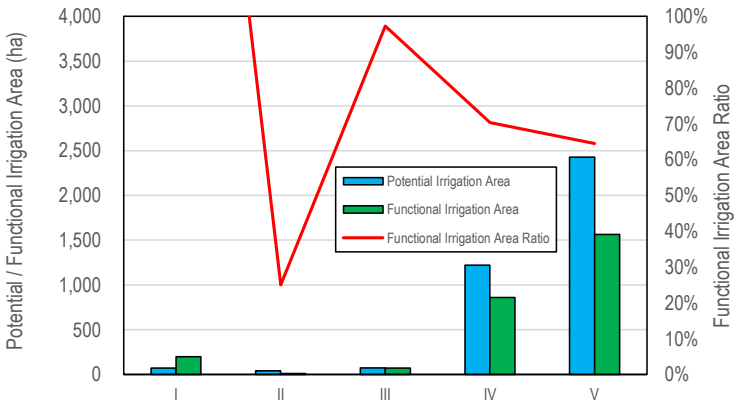


Figure 2.2.6 Irrigation Areas by Agro-Ecological Zones (Masvingo Province)

Source: The Survey team based on Irrigation data base in website of MLAFWRR

Irrigation areas by agro-ecological zones is shown in Figure 2.2.6. Functional irrigation area ratio of main two zones, Zone IV and V is 60 - 70 %. Although functional irrigation ratio of Zone I is more than 100 %, value in the data base might be wrong.

Figure 2.2.7 illustrates irrigation areas by districts in Masvingo Province. Chiredzi District has maximum area among the districts. Also, functional irrigation area ration in Gutu District, Masvingo

District and Masvingo city is almost 100%, though irrigation area is small.

(2) Irrigation Scheme

As of 2016, Masvingo Province has total 65 irrigation schemes but this number does not include any private irrigation schemes in Large Scale Commercial Farms.

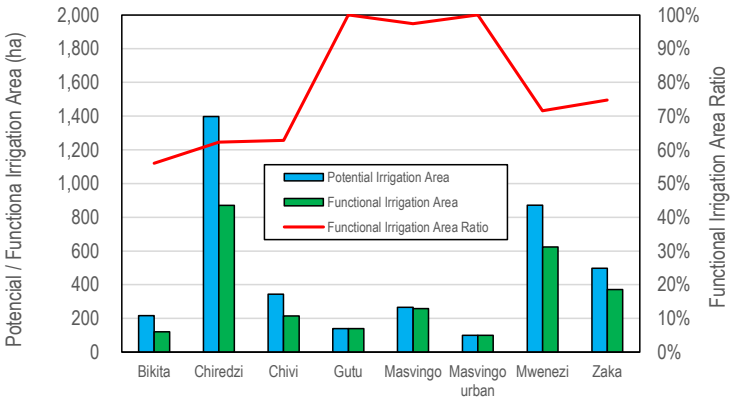


Figure 2.2.7 Irrigation Areas by Districts (Masvingo Province)

Source: The Survey team based on Irrigation data base in website of MLAFWRR

Number of irrigation schemes by agro-ecological zones is show in Figure 2.2.8. Total number in main two zones, Zone IV and V, is 56, equivalent 86 % of the total number. Number of irrigation schemes by districts is show in Figure 2.2.9. Chivi District has 19 schemes, maximum among the districts, and Masvingo and Zaka Districts have 10 schemes, second largest one.

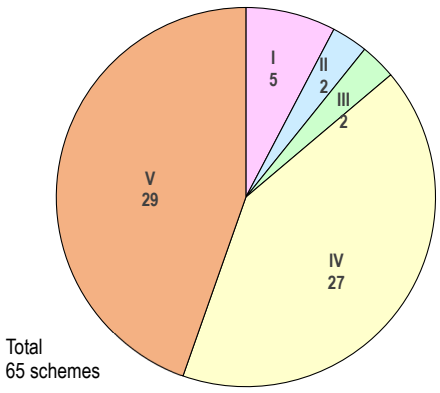


Figure 2.2.8 Number of Irrigation Schemes by Agro-Ecological Zones (Masvingo Province)

Source: The survey team based on Irrigation data base in website of MLAFWRR

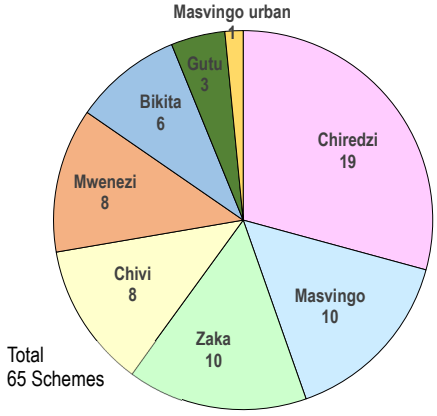


Figure 2.2.9 Number of Irrigation Schemes by Districts (Masvingo Province)

Source: The Survey team based on Irrigation data base in website of MLAFWRR

2.3 SUPPORTING PROJECTS/PROGRAMS BY DEVELOPMENT PARTNERS IN THE IRRIGATION SECTOR

2.3.1 JICA: Nyakomba Irrigation Scheme

This is the Nyakomba Irrigation Scheme developed by the Japanese Grant Aid Project. The Exchange of Note (E/N) and Grant Agreement (G/A) were signed in November 2015 and completion of the construction was in July 2019.

The target area is the left bank of the Gainezi River, which flows along the border between Zimbabwe and Mozambique (see Figure 2.3.1). A total of 580 ha (Block A: 146 ha, Block B: 128 ha, Block C: 115 ha and Block D: 191 ha) were planned to be irrigated by installing and adjusting pumps (see Figure 2.3.2 and Table 2.3.1).

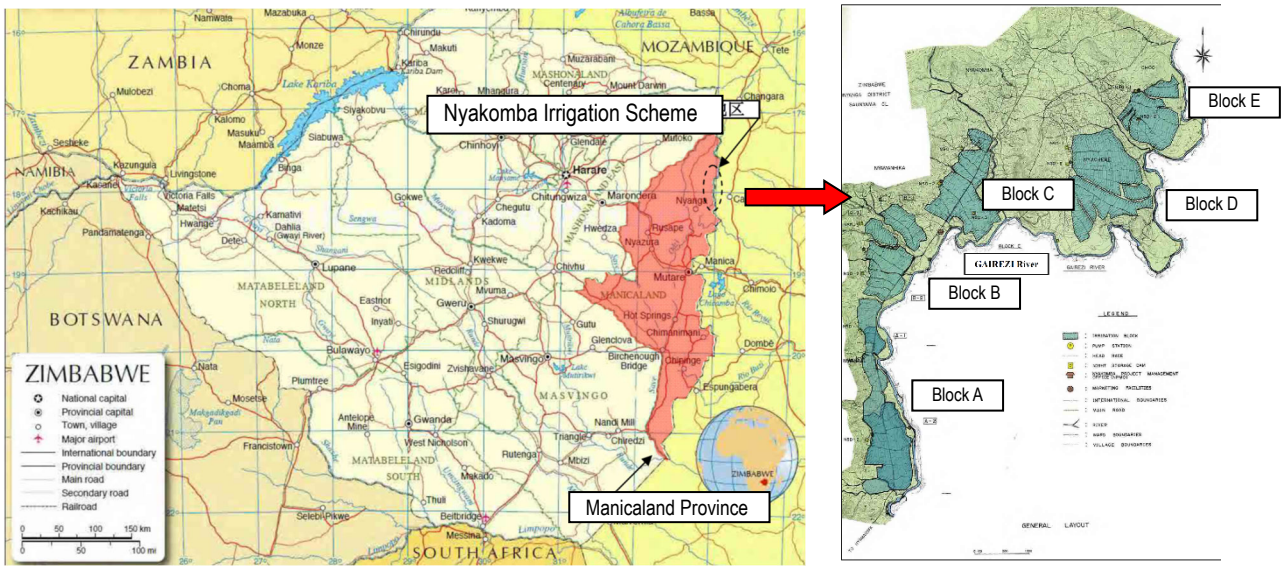


Figure 2.3.1 Location Map of Nyakomba Irrigation Scheme

Source: The Preparatory Survey on the Project for Irrigation Development for Nyakomba Irrigation Scheme in the Republic of Zimbabwe Final Report (2015, JICA)

Pumping station | Canal | Farmland

Figure 2.3.2 Nyakomba Irrigation Scheme Facilities

Source: DOI

Table 2.3.1 Components for the Nyakomba Irrigation Project

Item	Contents
Project Site	Nyakomba Irrigation District, Nyanga District, Manicaland Province
Implementing Agency	Ministry of Agriculture, Mechanisation and Irrigation Development
Overall Goal	Food security and livelihoods of beneficiaries in Blocks A, B, C and D of Nyakomba Irrigation District would be secured.
Project Purpose	In Block A of Nyakomba Irrigation District, irrigated agriculture will improve agricultural productivity and increase the income of beneficiary farmers, while agricultural productivity in Blocks B, C and D will be stabilized.
Outcome	1. Necessary irrigation facilities will be constructed in Block A. 2. Irrigated agriculture in Block A will become possible. 3 Flood disaster prevention will be executed in Block B, C and D.
Activity and Input Plan	**Block A** Construction of irrigation facilities in Block A, Nyakomba Irrigation Area, Saunyama Communal, Nyanga District, Manicaland Province 1. Water source facilities: Pumping facilities (dia. 250 x 90 kW x 3 units) 2. Irrigation facilities: Main pipelines: 0.98 km, Distribution pipelines: 4.4 km, and Irrigation canal (open channel): 10.6 km 3. Roads: 5.0 km of agricultural roads, 3 main road culvert repairs 4. Equipment: 2 tractors (including attachments) and 1 motorbike 5. Soft components: training in the maintenance of facilities, promotion of contract farming **Block B, C** 1. Construction of flood defence retaining walls 2. Pumping equipment: replacement of parts and on-site adjustment of pumping pumps, renewal of electrical equipment **Block D** 1. Water source facilities: Pumping facilities (dia. 300 x 132 kW x 3 units) 2. Irrigation facilities: Conduit: 0.4km

Source: The Preparatory Survey on the Project for Irrigation Development for Nyakomba Irrigation Scheme in the Republic of Zimbabwe Final Report (2015,: JICA)

According to the interview with a project engineer from Manicaland DOI, 1) the main crops grown are chilli, beans, horticultural crops, maize and wheat, 2) the project was completed about four years ago, but sometimes pumps were not able to take water due to significant sedimentation at the intake point, and 3) several beneficiary farmers were unable to pay the O&M costs (50 USD/farmer/ha/year) .

In particular, the reason for 3) was that the beneficiary farmers' income after the irrigation scheme was developed was less than expected. The beneficiary farmers did not carry out market research and selected the crops they wanted to grow, which resulted in a surplus but could not be sold in the market due to less demand. A technical cooperation project under JICA, namely Zimbabwe Smallholder Horticulture Empowerment and Promotion (ZIM-SHEP), is now implementing Smallholder Horticulture Empowerment and Promotion (SHEP) in the beneficiary areas under Nyakomba Irrigation Scheme and as a result beneficiary farmers' income has improved. It is expected that O&M fee payments will be resumed.

2.3.2 IFAD: Small Holder Irrigation Revitalization Programme (SIRP)

This is a programme to rehabilitate the existing irrigation schemes. This is International Fund for Agricultural Development (IFAD) funded programme and its outline is shown in Table 2.3.2.

In this programme, 125 irrigation schemes are selected as the target for the rehabilitation based on the criteria, such as water resources potential, market access and beneficiary area. Feasibility study for all the 125 schemes have been conducted, also some of the rehabilitation works are completed. However, rehabilitation works for some schemes has not been implemented and are not to be implemented due to the budget shortage of IFAD.

Table 2.3.2 Outline of SIRP

Item	Contents
Programme Name	Smallholder Irrigation Revitalization Programme（SIRP）
Programme Period	7 years
Overall Goal	Rural households achieve food and nutrition security and are resilient to climate change effects and economic shocks in the programme districts
Programme Objectives	Rural households sustainably increase their income in SIRP supported scheme and adjacent rainfed area.
Target Area	Manicaland, Masvingo, Matabeleland South and Midland
Target Irrigable Area	5,000ha
Target Land Category	Communal Aera and Old Resettlement Area
Target Persons	1) 12,500 households (62,500 people) with an average of 0.4ha who are currently engaging in irrigation agriculture in the existing irrigation schemes 2) 12,500 households (62,500 people) with no access to irrigation in the greater scheme and sub-catchment areas relying on rainfed agriculture and livestock 3) 2,000 youth 4) 500 extension and technical service provider
Programme Indicator	1) An increase in production and productivity of selected commodities 2) An increase of annual households income 3) Increased market integration 4) A smallholder agriculture production system that is better adapted to climate change
Programme Component	**[Component-1] Sustainable Smallholder Irrigation Development (by DOI)** - Rehabilitation 5,000 ha of existing irrigation scheme - Financing further scheme design sturdies nation wide - Increasing the area of existing smallholder irrigation scheme under effective O&M by irrigators and their Irrigation Management Committee (IMC), through the preparation and implementation of Revitalization Plan at scheme level - Strengthening the capacity of government departments to provide quality service to smallholder irrigators and engaging in a policy dialogue on issues affecting small-scale irrigators. * Sub-component: 1) Scheme selection and rehabilitation, 2) Improved Smallholder Irrigation Management, and 3) Enhanced institutional capacity for irrigation development **[Component-2] Climate-smart Agriculture and Market Access (by AGRIcultural Technical Extension services department (AGRITEX))** - Improving in both rainfed and irrigated conditions productivity and sustainable production of main commodity groups, through improved cropping intensity on selected schemes, and increased adoption of improve varieties, fertilizer, Good Agricultural Practices and Climate Smart Agriculture practices and technologies. - Improving Village Natural Resources Management planning, including soil and water conservation in adjacent rainfed areas - Preparation and implementation of a Greater Scheme Agriculture Plan - Improving farmland profitability and household incomes by increasing market access and linkages between value chain actors for both irrigation and rainfed farmers - Promoting good nutrition practices and gender mainstreaming - Strengthening the capacity of government department to provide quality service to smallholder farmers and engaging in policy dialogue on issues affecting smallholder farmers. * Sub-component: 1) Enhanced agricultural practices and farmer's organization capacity, 2) Market access and rural financial services, and 3) Enhanced institutional capacity for market-led production
Programme Cost	51.28million USD　Component-1: 27.7 million USD Component-2: 20.0 million USD Programme Coordination: 4.5 million USD
Funding Source	IFAD

Source: The Survey team based on documents provided by DOI

2.3.3 UNDP（GCF）: Building Climate Resilience of Vulnerable Agriculture Livelihood in Southern Zimbabwe

This is a programme funded by Green Climate Fund (GCF) of United Nations Development Programme (UNDP) (hereinafter referred to as "GCF Programme"). The outline of the Programme is shown in Table 2.3.3.

Under the output-1 of the Programme, 21 irrigation schemes (rehabilitation:15 and new construction:6) are to be developed and 17 target schemes have selected as of end July 2021. As a concept of the

Programme, these irrigation schemes shall have climate resilience function(s), such as small barrage to protect intake facility from flood.

One of the specifications of GCF funded programme is co-financing. GCF provides 26.6 million USD as grant whilst GoZ provides almost same amount, 20.0 million USD. According to the budget demarcation document of the Programme, GoZ is responsible for the construction cost for all the 21 irrigation schemes. As of end July 2021, this programme is just started and there are no irrigation schemes which development is already completed.

Table 2.3.3 Outline of GCF Programme

Item	Contents
Programme Name	Building Climate Resilience of Vulnerable Agriculture Livelihood in Southern Zimbabwe
Project Period	June 2020 - May 2027
Programme Objectives	Strengthening resilience of agricultural livelihoods of vulnerable communities, particularly women, in southern Zimbabwe in the face of increasing climate risks and impacts
Target Area	137 Wards in 15 Districts in Manicaland, Masvingo and Matabeleland South Province
Target Irrigable Area	1,786 additional ha under climate-proofed irrigation
Outputs and Activities	**[Output-1]** **Increased access to water for agriculture through climate-resilient irrigation systems and water resource management (by DOI and AGRITEX)** **Activity 1-1: Climate proofing irrigation infrastructure for enhanced water security in the face of climate change (by DOI)** Activity 1-1-1: Climate-proofing and revitalizing existing irrigation infrastructure and equipment in 21 irrigation schemes Activity 1-1-2: Training of 21 IMC in climate-adapted O&M and monitoring, and establishment of O&M funds Activity 1-1-3: Field visits and technical advisory support by DOI to IMCs to support climate-resilient O&M and operationalization of the O&M funds based on detailed O&M plans Activity 1-1-4: Learning and knowledge exchange workshops across IMCs to improve coordination and scaling up of climate resilient irrigation systems **Activity 1-2: Field-based training and technology investments for farmers on rain-fed farmlands for climate-resilient water management (by AGRITEX)** Activity 1-2-1: Field-based training of 6,900 lead rain-fed farmers in 230 Farmer Field Schools in rainwater harvesting, soil moisture management techniques and water efficiency practices Activity 1-2-2: Procurement and installation by farmers of technologies to implement climate-resilient water-resource management in rainfed farmlands Activity 1-2-3: Participatory workshops and on-site assistance by lead farmers to facilitate farmer-to-farmer learning to scale up implementation of climate-resilient water resource management **[Output-2]** **Scaled up climate-resilient agricultural production and diversification through increased access to climate-resilient inputs, practices, and markets (by AGRITEX)** **Activity 2-1: Establish transformative multi-stakeholder innovation platforms for diversified climate-resilient agriculture and markets** Activity 2-1-1: Technical assistance, 9 trainings and meetings to establish, operationalize, and coordinate five multi-stakeholder Innovation Platforms across 15 districts and one national-level Platform for upscaling diversified climate resilient production and access to markets Activity 2-1-2: Develop crop-specific production and market strategies for use by all relevant value chain actors for climate-resilient production and market access Activity 2-1-3: Technical assistance to facilitate and formalize public-private partnerships across value-chain actors to upscale climate-resilient agricultural markets Activity 2-1-4: Technical assistance and business planning and management training to smallholder farmers, particularly women and financial intermediaries to enable access to finance for sustained scaling up climate-resilient agriculture **Activity 2-2: Investments in inputs, technologies and field-based training to scale up the implementation of climate-resilient agricultural production in the face of increasing climate hazards (rain-fed and irrigated farms)** Activity 2-2-1: Training of Trainers (155 national, provincial, district and ward level AGRITEX staff), particularly women, to conduct Farmer Field Schools in 15 target Districts of southern Zimbabwe Activity 2-2-2: Organization and activation of 251 Farmer Field Schools for promotion of climate-resilient agriculture in the 15 Districts Activity 2-2-3: Procurement of inputs and technologies (e.g. seeds, tools, fertilizers) to implement CRA packages on 6,900 lead farmer plots Activity 2-2-4: Workshops and on-site assistance by lead farmers to facilitate farmer-to-farmer learning to

Item	Contents
	scale up implementation of climate-resilient agricultural practices and cropping systems **Activity 2-3: Enhance institutional coordination and knowledge management capacities for climate-resilient agricultural production in the face of increasing climate hazards** Activity 2-3-1: Upgrade ICT/Geographic Information System (GIS) data collection/sharing platforms and protocols for knowledge management on climate resilient agricultural systems and livelihoods across knowledge centers in participating agricultural colleges and research centers Activity 2-3-2: Generation, codification and exchange of knowledge across agricultural colleges and research centers for climate-resilient agriculture Activity 2-3-3: Impact evaluation and codification of best practices/lessons for systemic, evidence-based learning to scale-up resilient agricultural livelihoods **[Output-3]** **Improved access to weather, climate and hydrological information for climate-resilient agriculture (MSD, ZINWA and AGRITEX)** **Activity 3-1: Installation and operationalization of weather/climate and hydrological observation networks (by MSD/ZINWA)** Activity 3-1-1: Install 12 automatic weather stations to cover key agricultural zones and 10 automatic low-cost rainfall/weather stations to improve rainfall monitoring in the three catchments Activity 3-1-2: Install 10 water level/gauging stations at strategic points in the three catchments Activity 3-1-3: Upgrade systems and institutional capacities for hydro-meteorological data transmission and processing to enable localized weather, climate and hydrological model forecast generation Activity 3-1-4: Train MSD, ZiNWA, DR&SS/AGRITEX officials, community observers (low-cost stations) in collecting data, O&M equipment **Activity 3-2: Develop, disseminate and build institutional capacities (MSD and AGRITEX) on tailored climate and weather information products (MSD)** Activity 3-2.1: Develop information products to strengthen existing national satellite/observation-based weather, 10-day and seasonal forecasts and advisories targeted to smallholder farmers Activity 3-2-2: Training national level ZINWA staff (partnering with UoZ)) in the use of water resource models (two trainings in WEAP and Pitman models) as well as ingesting input data from weather/climate observations and forecasts Activity 3-2-3: Develop regular hydrological forecasts, incorporating daily updates of hydromet observations and forecasts Activity 3-2-4: Disseminate climate information through mobile phones, community radio, community meetings and local posters and bulletins **Activity 3-3: Capacity building for farmers and local institutional staff on effective use of climate and weather information and products for resilient water management and agricultural planning (by AGRITEX/MSD)** Activity 3-3-1: Training of local level DoI, ZINWA and CC staff in data analysis and production of information products (based on observed and forecast water levels and weather/climate forecasts) for water resource management Activity 3-3-2: Participatory training of farmers and district and local level intermediaries – including Agriculture Extension, MSD and IMC staff - in interpretation and use of climate and weather information products for crop/water management Activity 3-3-3: Set up communication and database systems to facilitate climate information management (equipment and communication materials) at three agricultural training colleges - Masvingo, Makoholi, and Esigodin.
Program Cost	47.8 million USD GCF Grant: 26.6 million USD UNDP TRAC Resources: 1.2 million USD Zimbabwean Government: 20.0 million USD
Funding Source	GCF under UNDP *Co-financing with GoZ

Source: The Survey team based on documents provided by DOI

2.3.4 CESVI: A Resilience Community for Sustainable Development

This is an agricultural support project by the Italian Non-Profit Organization (NPO), namely "Cooperazione E SVIluppo (CESVI)". The Project promotes contract farming in conjunction with the development of irrigation facilities (pumps, canals and on-farm facilities including centre pivots and sprinklers).

CESVI promotes contract farming by organizing matching forums between companies and farmers after the construction of irrigation facilities. Contract farming is on a three yearly basis, with the companies providing agricultural inputs (seed, fertiliser, etc.) and guidance on farming techniques (cultivation, pest control, post-harvest treatment, etc.) to the farmers.

Centre pivots have been installed in the Murove Irrigation Scheme, one of the CESVI project areas, where mainly sugar bean and paprika are grown. From the interviews with the beneficiary farmers, it is confirmed that 1) they have received guidance and manuals from CESVI on O&M of the centre pivot, but 2) they have only received verbal explanation on O&M of the pumps and canals. It is also confirmed that IMC has sold paprika two times but has not set aside any part of the proceeds as O&M expenses. The beneficiaries intend to start setting aside a portion of the proceeds from the next sale.

Project board | Centre Pivot | Crops grown (Paprika)

Figure 2.3.3 Situation of CESVI Project Site (Murove Irrigation Scheme)

Source: Survey team

2.3.5 WB: Zimbabwe Multi Criteria Decision Model Tool

This is a tool being developed by WB to identify and prioritise the rehabilitation of the many dams in Zimbabwe. By inputting information on the condition of each dam's facilities, hydrological and meteorological conditions, etc., the tool will automatically determine the future course of action for the dam: 1) rehabilitation, 2) removal of risk factors, or 3) removal of dam. These results are used for administrative decisions and are expected to lead to effective and efficient dam rehabilitation planning.

Phase I is currently underway and involves 1) clarifying the objectives of dam rehabilitation, 2) establishing selection criteria and indicators, 3) collecting information at model dams, and 4) piloting the tool at model dams. Phase II will be conducted in the future to 1) analyse satellite imagery, 2) trial the tool on a state and basin basis to improve its accuracy, and 3) provide training in its use.

CHAPTER 3 NATIONAL DEVELOPMENT STRATEGY, LEGAL FRAMEWORKS IN AGRICULTURE AND IRRIGATION SECTOR

3.1 NATIONAL DEVELOPMENT STRATEGY

3.1.1 Vision 2030 (September 2018)

(1) Outline

This vision is a national development policy issued by new government inaugurated in 2017. This vision aims to establish "New Zimbabwe" through elimination of political polarisation, prolonged economic meltdown, and a state of general uncertainty the Nation which Zimbabwean nationals have endured over the last two decades.

"To foster inclusive economic growth and address poverty resolutely, thereby transforming Zimbabwe into an industrialising, knowledge based upper middle-income country that provides a high quality of life to all its citizens by 2030" is set as the overall goal. Also, target values are set for some economic and social items as shown in Table 3.1.1. In order to achieve the target values, sustainable double digit economic growth rates of between 7 and 12 % per annum is necessary, and private sectors are set as engines to sustain future growth.

Table 3.1.1 Target Values to be Achieved until 2030

Item	Base Value		Target Value (until 2030)
GNI per Capita	1,440 USD per capita	as of 2018	5,000 USD per capita
Poverty Rate	62.5 %	as of 2012	25 %
Households Accessing Electricity	52.2 %		72 %
(Urban Area)	86.0 %	as of 2017	95 %
(Rural Area)	27.7 %		60 %
Universal Access to Improved Sources of Water	81 %	as of 2017	81 % and more
Average Life Expectancy	60 Years	as of 2017	65 years

Source: The Survey team based on Vison 2030

The Vision sets five fields, 1) Governance, 2) Macro-economic stability and financial re-engagement, 3) Inclusive growth, 4) Infrastructure and utilities, and 5) Social development, as strategic pillars to achieve the target values in Table 3.1.1 and overall goal.

The Vision is to be achieved through three steps, 1) Transitional Stabilisation Programme (TSP) (2018 - 2020), 2) National Development Strategy 1 (NDS-1) (2021 - 2025), and 3) National Development Strategy 2 (NDS-2) (2026 - 2030).

(2) Strategy of Agriculture and Irrigation Sector

Agriculture and irrigation sectors are positioned under a pillar, Inclusive Growth, and "To create a self-sufficient and food surplus economy that will see the re-emergence of Zimbabwe as the 'Bread Basket' of Southern Africa" is set as the goal of the sectors. In order to achieve this goal, completion of the land allocation phase of the FTLRP is required for efficient and sustainable utilisation of allocated land, leading to increased production and investment on the lands. Also, 1) Improvement of farmers' access to agriculture equipment and implement under purchase or leasing and 2) Increasing of accessible water by construction of dams are set as priority targets. The following activities are planned to be implemented in order to achieve the sectors' goal.

- Supporting vulnerable households by the Government and financing to farmers, particularly A2 and A1 farmers, by private sector and commercial bank
- Improving market access through re-establishment of commodity exchange markets
- Expansion of climate change mitigation and adaptation activities to include critical elements such as water management and harvesting measures to mitigate the effects of drought, respect for biodiversity and wetland management issues in conjunction with development partners
- Rehabilitation and establishment of smallholder farmer irrigation facilities covering 200 ha per Administrative District, per year for the next 10 years through implementation of an Irrigation Master Plan
- Facilitation of access to financing by A2 and large scale farmers for the rehabilitation, resuscitation, modernisation and development of end-use irrigation infrastructure
- Resuscitation of horticulture production and exports
- Livestock development, targeting dairy production anchored on small scale dairy farmers, as well as resuscitation of the Cold Storage Company, also targeting resumption of beef exports
- Construction of Kunzvi-Musami Dam, Gwayi-Shangani Dam and Kondo-Chitowe Dam

Additionally, establishment of Special Economic Zones across the provinces is planned. The prioritized fields of each of provinces are shown in Table 3.1.2. Fields related to agricultural value chain is set as the prioritised field in many of provinces.

Table 3.1.2 Prioritized Field of each Province's Special Economic Zone

Province	Prioritized Field
Bulawayo	Heavy industry, Leather, Footwear, Textiles and Engineering
Harare	Information communication technology and Health services
Manicaland	Fruit canning, Diamond cutting and polishing
Mashonaland Central and East	Agro-processing
Mashonaland West	Agro-processing, Chrome, Cotton and Textiles
Masvingo	Sugar cane processing
Matabeleland North	-
Matabeleland South	Gold production and Livestock
Midlands	Iron and steel corridor, Asbestos, Gold, Leather, Footwear and Dairy.

Source: The Survey team based on Vison 2030

3.1.2 Transitional Stabilisation Programme (TSP) (5th October 2018)

(1) Outline

TSP is the first one of planned three steps to realize "Vision 2030" and describes policies, strategies and programmes to be implemented in two years from 2018 to 2020. The objectives of these policies, strategies, and programmes are not only to achieve the target values but also to establish basement of economic growth for next programmes to be implemented from 2021 to 2030.

"To stimulate domestic production, exporting, rebuilding and transforming the economy to an Upper Middle Income status by 2030" is set as the overall goal of TSP. In order to achieve this goal, 1) Stabilising the macro-economy and the financial sector, 2) Introducing necessary policy and institutional reforms to transform to a private sector led economy, and 3) Launching quick-wins to stimulate growth are set as strategic fields. Whilst it is described that painful trade-off, and sacrifice are required to implement these strategic fields.

(2) Targets and Strategies of Agriculture and Irrigation Sector

Agriculture sector is positioned as a sector presenting quick-win investment opportunities for realisation of self-sufficiency and food surpluses that will see the re-emergence of Zimbabwe as a major contributor

to agricultural production and regional food security in Southern Africa. Target productivities by agricultural items are set as shown in Table 3.1.3, and growth in agriculture sector is premised on performance of cash crops such as tobacco, cotton, sugar cane and soya beans. Also, TSP recognises the need for greater involvement and participation of the private sector with regards to financing, contract farming arrangements that also provide skills support and extension for various agricultural commodities.

Table 3.1.3 Target Values by Agricultural Items

Unit: ton

Items	Base Value	Target Value			Production Increase Rate (%) (=2020/2017)
	As of 2017	2018	2019	2020	
Maize	2,155	1,700	1,900	2,400	111
Wheat	160	132	200	250	156
Barley	15	30	35	30	200
Soybeans	**36**	**59**	**100**	**110**	**306**
Sorghum	182	78	180	200	110
Sugarcane	**4,350**	**5,000**	**5,200**	**6,900**	**159**
Horticulture	70	71	72	75	107
Sunflower Seed	10.3	3.7	4.0	5.0	77
Groundnuts	139	127	150	155	112
Paprika	8	8	8	9	113
Coffee	0.5	0.4	0.6	2.0	400
Tea	19	20	20	20	105
Cotton	**75**	**130**	**200**	**250**	**333**
Tobacco (Flue Cured)	**190**	**252**	**255**	**260**	**137**
Dairy (million litters)	83	90	100	120	145
Poultry	131	113	125	140	107
Beef	72	77	90	120	167
Pork	10	11	12	15	150
Sheep and Goat	8.7	11	12	13	149
Ostrich	19	19	19	19	100
Wildlife	32	33	33	35	109

Source: The Survey team based on TSP

(3) Agriculture Sector's Programmes

Table 3.1.4 shows agriculture sector's programmes to achieve the target values shown in Table 3.1.3.

Table 3.1.4 Agriculture Sector's Programmes

Field	Programme	
Financing of Agriculture	- Focus on supporting vulnerable households - Focus on private sector and commercial bank financing to particularly A2 commercial farmers where challenges of access to financing is also linked to rule of law and security of tenure. - Issue the new version of Zimbabwe's 99-year land leases to improve acceptability for borrowing from local banks.	
Special Agriculture Production Initiative	General	- Guarantee adequate and timely availability of agricultural inputs, extension and other support services
	Winter Wheat	- Develop farmlands to raise crop output to 400,000 tons - Improve production yield levels to averages of 6 ton/ha - Support farmers to put over 60,000 ha under with support from the private sector - Input 60 million USD and secure the accessibility to inputs (seed, fertilizers, fuel and chemicals) for 50,000 ha farmlands. - Increase 300,000 ton in 2019 - Install maize driers to realize quick shift from maize to wheat - Rehabilitate and develop irrigation schemes
	Summer Cropping	- Provide financing, input and extension services
	Maize	- Achieve 2.2 million ha of planted area, output of 2.5 million tons, enough to meet the national requirement of 2 million tons - Support with private sector targeting 300,000 ha - Support vulnerable households with Development Partner targeting 1.3 million ha - Promete private contract farming arrangements targeting 600,000 ha

Field	Programme	
Special Agriculture Production Initiative (Cont.)	Maize (Cont.)	- Development of farmlands 300,000 ha (dry land 200,000 ha and 100,000 ha under irrigation) through Special Maize Production Initiative at an estimated total cost of 318.4 million USD - Secure stable annual production 3.5 million ton by mechanization, extension services, research
	Soybean	- Develop 60,000 ha under the 2018/19 season - Product 100,000 tons - Fund from private sector targeting 50,000 ha at an estimated cost of 35.3 million USD - Promote contract farming targeting 10,000ha - Improve the marketing mechanisms in order to encourage intensive production to cover the national requirement of 340,000 tons
	Cotton	- Develop 400,000 ha farmland for 1.3 million households and product 200,000 ton - Improve cotton value chain market
Presidential Vulnerable Households Inputs	- Provide grain inputs targeting over 2 million vulnerable households for maize and small grains (10 kg of grain seed, 50 kg basal fertilizer and 50 kg top dressing) at an estimated cost of 154 million USD. - Support with development partners - Coordinate and facilitate contract farming by private sector	
Plugging Leakages in Supply of Inputs	- Strength control and monitoring systems over agricultural inputs at every stage of the inputs supply and distribution chain to secure transparent market price and avoid utilizing expired inputs - Overcome control challenges over inputs delivered and distributed beyond recommended application window periods, mostly seeds, herbicides and fertilizers - Develop electronic farmer data management system to district level to create a credible database of farmers' obligations and performance	
Inputs Availability	- Prepare seed houses with regards to timely availability of seed for all the targeted crops for the 2018/2019 summer crops. - Capacitate local fertilizers industry	
Farm Mechanization	- Improve farmer access to agricultural equipment and implements under either purchase or leasing arrangements - Strength of local production capacity of rippers, ploughs, harrows, planters, boom-sprayers, trailers and grain dryers - Repairs of tillage and harvesting equipment under the 2018/19 summer cropping season - Fund for the procurement of an additional 20 combine harvesters, 20 driers and 20 threshers at a cost of 10 million USD	
Productivity and Yield	- Develop farmers' capacity by providing extension and technical services to small-holder farmers who, in most cases, lack the expertise to cultivate and market their produce, and research and development mainly targeting tobacco, coffee, sugarcane and horticulture	
Marketing	- Modernize and operationalise the agriculture commodity exchange to close the marketing gap that currently exists - Revive the production of high value crops such as flowers, coffee and tea, among others aiming to increase export value	
De-Racialising Agriculture	- Embracing the former displaced white farmers to form joint venture partnerships with the beneficiary A1 and A2 farmers - Guarantee security of tenure for all farmers, irrespective of race, by issuing 99 year leases - Compensation to all former farmers affected by the FTLRP	
Agricultural Research & Development	- Strength research and development undertakings, coupled with the use of advanced technologies including at the village level	

Source: The Survey team based on TSP

(4) Irrigation Sector's Programmes

Table 3.1.5 shows the irrigation sector's programmes to achieve the target values shown in Table 3.1.3.

Table 3.1.5 Irrigation Sector's Programmes

Field	Programme
Center Pivots	- Start operation of 12 center pivots which are a part of 80 center pivots funded by Spain - Procure an additional 80 centre pivots
Irrigation Scheme	- Add 200 ha per District per year under Accelerated Irrigation Rehabilitation and Development Program. - Prioritized Irrigation Schemes

Scheme/Project Name	Location	Beneficiary Area	Benefitted Households	Project Cost (Million USD)	Funding Source
Nyanje Irrigation Scheme	Gokwe Midlands Prov.	N/A	Over 1,000	N/A	N/A
Nyakomba Irrigation Scheme	Nyanga Manicaland Prov.	570 ha	1,160	15	- JICA

Field	Programme
Irrigation Scheme (Cont.	- Prioritized Irrigation Schemes (Cont.)

Scheme/Project Name	Location	Beneficiary Area	Benefitted Households	Project Cost (Million USD)	Funding Source
Zhove Irrigation Project	Beitbridge Matabeleland South Prov.	2,500 ha	2,600	˚ 37	- Kuwait Fund (Loan)
Small-holder Irrigation Support Programme (more than 125 schemes)	Manicaland Prov. Midlands Prov. Masvingo Prov. Matabeleland South Prov.	Over 6,100 ha	12,200	52	- IFAD - OFID - GoZ
Tugwi Mukosi Irrigation scheme	Chivi and Masvingo Masvingo Prov.	25,000 ha	12,500	150	- GoZ - Development Partners (F/S stage)
Muzwi Irrigation Scheme	Masvingo Masvingo Prov.	800 ha	1,600	5	- GoZ - Development Partners (F/S stage)
Osborne Irrigation Scheme	Mutasa Manicaland Prov.	5,000 ha	5,000	70	- GoZ - Development Partners (F/S stage)
Biri Irrigation Scheme	Chegutu Mashonaland West Prov.	2,000 ha	1,000	8	- GoZ - Development Partners (F/S stage)
Lilstock Irrigation Scheme	Bindura Mashonaland Central	2,000 ha	2,000	12	- GoZ - Development Partners (F/S stage)
DDF small irrigation schemes	Entire Zimbabwe	N/A	N/A	15	- GoZ

Source: The survey team based on TSP

Source: The Survey team based on TSP

3.1.3 National Development Strategy 1 (2021-2025) (NDS-1) (16th November 2020)

(1) Outline

NDS-1 is the successor to the TSP and is the first five-year medium term plan aimed at realising the country's Vision 2030. The first priority of NDS-1 is "Increased economic growth and stability" and the target is to achieve average GDP above 5% per annum and increase Gross National Income (GNI) to 3,200 USD until 2025.

(2) Review of TSP Results

The NDS-1 reviews the results of TSP and analyses good practices to be expanded and challenges to be addressed during NDS-1. Also, the NDS-1 outlines the strategies, policies, legal and institutional reforms and the programmes and projects to realize the expansion of the good practices and addressing the challenges.

Good Practices

Significant progress was made in the implementation of the TSP across various pillars. These include fiscal consolidation, restoration of monetary policy, stabilisation of the exchange rate, the undertaking of governance and institutional reforms, entrenched engagement and re-engagement with the international community, facilitation of investment and infrastructure development.

Under the "Infrastructure and utilities" pillar, a number of roads and other related infrastructure were constructed throughout the country. Besides the road networks, notable achievements were recorded in rail, water and sanitation, ICT, aerospace, energy and power, irrigation, housing and office accommodation infrastructure.

Challenges

Notwithstanding the achievements, the TSP faced a number of challenges during its implementation. These include among others, high inflationary pressures, exchange rate volatility, continued illegal sanctions against the country, and exogenous shocks like droughts, Cyclone Idai and the COVID-19 pandemic. These shocks affected the entire economy with the greatest impact being on agricultural production and electricity generation, with extended effects also felt on other sectors of the economy.

(3) National Priority Fields

Fourteen fields, 1) Economic growth and stability, 2) Food and nutrition security, 3) Governance, 4) Moving the economy up the value chain & structural transformation, 5) Human capital development, 6) Environmental protection, climate resilience and natural resource management, 7) Housing delivery, 8) Digital economy, 9) Health and well-being, 10) Infrastructure & utilities, 11) Image building and international engagement and re-engagement, 12) Social protection, 13) Youth, sport and culture, and 14) Devolution are set as the national priority fields to realize the expansion of the good practices and addressing the challenges confirmed through the review of TSP results.

(4) Strategies, Policies, Programmes and Projects in Agriculture and Irrigation Sectors

Strategies, policies, programmes and projects in agriculture and irrigation sectors are described in four out of fourteen national priority fields, 1) Economic growth and stability, 2) Food and nutrition security, 4) Moving the economy up the value chain & structural transformation, and 10) Infrastructure and utilities.

1) Economic growth and stability

NDS-1 aims to achieve average national GDP above 5 % per annum through sectors' growth, particularly agriculture, mining, manufacturing and tourism sectors. The targets of agriculture and irrigation sector's GDP growth per annum are from 7.6 % to 11.3 % (average 9.54 %) during NDS-1 period (see Table 3.1.6). Also, agriculture and irrigation sectors are positioned as sectors contributing to poverty reduction through its sustainable development.

Table 3.1.6 Sectoral GDP Growth Rates (%) (2019-2025)

Sector	2019	2020	NDS-1 Period				
			2021	2022	2023	2024	2025
National	-6.0	-4.1	7.4	5.5	5.2	5.2	5.0
Agriculture and Forestry	**-17.8**	**-0.2**	**11.3**	**8.9**	**7.6**	**9.5**	**10.4**
Mining and Quarrying	-12.4	-4.7	11.0	7.4	8.8	9.2	8.0
Manufacturing	-8.7	-9.6	6.5	6.5	7.7	6.1	5.9
Electricity and water	-19.2	-7.9	18.8	14.4	5.9	4.5	4.8
Construction	-13.9	-11.4	7.2	5.0	4.0	5.0	4.0
Distribution	-8.2	-6.8	5.7	5.5	5.0	4.5	4.1
Transportation and Communication	12.9	3.4	7.1	4.5	4.3	4.8	4.4
Finance and Insurance	-6.1	-6.5	7.2	3.3	5.2	6.1	5.0
Government Services	1.4	-2.1	6.2	2.9	2.5	2.3	2.0
Other Services	-3.7	-2.0	4.4	2.7	2.6	2.5	2.5

Source: The Survey team based on NDS-1

In order to achieve this sectors' growth and poverty mitigation, the following measures are planned to be implemented during NDS-1 period.

- Security of tenure on the land in order to attract investment
- Creation of conditions for bankability of agricultural projects
- Restructuring of Agribank into a Land Bank
- Expansion of contract farming to other crops and livestock as well as strengthening existing contract farming arrangements
- Irrigation rehabilitation and expansion, promotion and adoption of research that improves productivity of seed and animal varieties, upscaling of climate smart agriculture and capacitation of extension services in order to drought proof agriculture
- Improvement of predictability in the marketing of agricultural produce, operation of the commodity exchange supported by a well-functioning regulated warehouse receipt system.
- Strengthening of agro-processing including soya bean, cotton, leather and fertiliser value chains.
- Widening of the subsidy policy to agriculture, transport and food with a view to cushion vulnerable members of society

2) Food and nutrition security

The NDS-1 seeks to improve food self-sufficiency and to retain the country's regional breadbasket status. The main objective is to increase food self-sufficiency from the current level of 45 % to 100 % and reduce food insecurity from the current peak of 59 % in 2020 to less than 10 % by 2025. The target is also to increase maize production from 0.91 million ton in 2020 to 3.0 million ton by 2025 and beef production from 49,115 ton in 2020 to 110,000 ton by 2025.

Whilst reduction of the national prevalence of under-five stunting from 23.5 % to 17 % by 2025 and reduction of the prevalence of iron deficiency anaemia in women of child-bearing age from 27 % to 13 % by 2025 are set as the target of nutrition security field.

Agriculture and irrigation sectors' strategies and programmes in order to achieve these targets are as shown in Table 3.1.7.

Table 3.1.7 Strategy and Programmes of Agriculture and Irrigation Sectors

Strategy	Contents of Programmes
Promoting Resilience and Sustainable Agriculture	- Upscale and expedite irrigation rehabilitation and expansion utilising existing and new water bodies - Climate Smart Agriculture through adoption of conservation agriculture techniques and principles such as Pfumvudza/Intwasa - Promote water and input use efficient technologies such as Precision Agriculture - Develop stress tolerant, high yielding crop varieties - Promote traditional grains in low potential areas which are climate smart - Implement commercial contract farming that is led by financial services with Government providing guarantees - Implement a Commodity Value Chain Financing Model where private sector players are expected to finance up to 40 % of their raw material requirements - Implement a climate proofed presidential input support scheme that is anchored on the Pfumvudza/Intwasa concept which adopt conservation agriculture techniques or principles such as minimum soil disturbances and mulching - Soil fertility management through soil conditioning management practices including liming and manuring - Diversify food production and consumption moving away from maize to other food crops such as potatoes and cassava - Capacitate extension services delivery - Speeding up of mechanisation facilities for the importation of agriculture mechanization equipment - Introduce private sector led production and marketing initiatives such as the Hub and Spoke Model for smallholder farmers to promote access to finance, inputs and outputs markets
Restructure and Re-Invigorate the Horticulture Sector	- Implementation of Zimbabwe Horticulture Recovery and Growth Plan* * A Plan to reconfigure horticulture industry towards private sector driven, paired with a transformative rural horticulture sub-sector under the Presidential Horticulture Scheme, covering 1.8 million rural households.

Strategy	Contents of Programmes
Restructure and Re-Invigorate the Horticulture Sector (Cont.)	- Improving security of land tenure systems for horticulture producers in order to attract investment - Establishing a legal framework that is specific to the horticultural sector in order to curb side marketing of produce under contract schemes - Improving Ease of Doing Business in the horticulture sector by reviewing and making export documentation less cumbersome and costly - Developing and maintaining a unique competitive brand for Zimbabwe's horticultural products - Promoting the export of value-added horticulture products in order to reduce post-harvest losses and raise export earnings - Diversifying and scaling up production of emerging crops such as blueberries, raspberry, and macadamia nuts, which have high demand on the export market - Formalisation of the domestic horticultural markets, for instance Johannesburg Market Model, in major cities like Harare and Bulawayo
Increasing Access to Affordable Agriculture Financing	- Establishing an agricultural revolving fund with appropriately structured lines of credit - Promoting weather-based agriculture, including the localisation of seasonal weather forecast and weather-based index insurance mechanisms for smallholder farmers - Strengthening the use of Public- Private Partnerships - Implementing of smart subsidies - Reviewing contract farming provisions to become more binding and also include timely payments - Establishing a stop-order system to strengthen and promote contract farming to cover all crops and livestock - Re-structure, re-model and transform Agribank into a Land Bank. - Advancing short, medium and long term capital for agriculture irrigation and infrastructure by the Land Bank
Promotion of Effective Agriculture Knowledge, Technology and Innovation Systems	- Adoption of contemporary ameliorative agricultural practices - Strengthening of coordination and strategic programming of Agricultural Knowledge and Innovation Services through the activities below ➢ Linking farmers, research, extension and agriculture education ➢ Strengthening agricultural research ➢ Training farmers to enhance their effectiveness to support innovations and technology adoption ➢ Continuous capacitation of extension workers ➢ Promoting policies and investment that encourage adoption of digital and modern agriculture production and marketing technologies ➢ Providing contemporary education in theory and practice of science agriculture through existing Agricultural Colleges and other higher institutions of learning in collaboration with Development Partners ➢ Capacitating the existing Agricultural Colleges and extension workers including motorisation and e-extension and advisory services ➢ Developing new crop varieties, planting materials and management technologies ➢ Research on the adoption of Genetically Modified Organisms to inform policy decision ➢ Researching and development for diversification of food consumption focusing on seed multiplication for cassava and sweet potatoes ➢ Research, development and innovation for indigenous fruits and vegetables to improve capacity for seed multiplication and shelf life ➢ Up-scaling technical, extension, advisory and coordination services physically and virtually to suit the newly revised Agro-Ecological Zones ➢ Establishing a comprehensive Agricultural Information Management System including crop and livestock assessment, livestock information management system, lands information management system
Agricultural Engineering and Infrastructure Development	- Intensifying the design construction and rehabilitation of irrigation infrastructure with clearly defined sustainability mechanisms to ensure continuity, further enhance irrigation scheme management and collaborative public service delivery models to irrigation schemes - Upscaling innovation and modernisation of agriculture, including ICT-based advisory services; automation of mechanisation and irrigation, and precision farming such as drip irrigation, fertigation and smart greenhouses and use of satellite technology to provide real time information on area under different crops - Establish irrigable land regulations to ensure maximum benefits are derived from existing water bodies and surrounding irrigable land - Promote local manufacture of farm implements as well as establishment of mechanisation service providers focusing on repair and maintenance of farm equipment
Strengthen Existing Agriculture Markets and Developing New Ones	- Establishing a well-functioning, regulated warehouse receipt system, combined with a commodity exchange system through which Strategic Grain Reserves will be stocked
Facilitating Access to Land and Security of Tenure	- Develop a new land policy that harmonises existing laws (statutory and customary), policies and institutional mandates

Strategy	Contents of Programmes
Facilitating Access to Land and Security of Tenure (Cont.)	- Reform and restructure Agribank into a Land Bank in order to build confidence in the transferability and bankability of tenure systems and enhance the commercial value of the land - Develop adequate legislative and regulatory framework for dispute resolution, compensation, and sharing of infrastructure - Strengthen coordination within Government and across other sectors in enforcing land use planning regulations, orderly resettlements and ensuring that maximum farm sizes are adhered to - Strengthen service delivery capacity and land information management systems - Land Survey and Mapping
Global Compensation Agreement	- Continuous implementation of interim compensation relief payments to the former farm owners, whilst the mobilisation of resources continues for the full settlement of compensation according to the terms of the Global Compensation Deed - Processing of regularising tenure for former farmland owners who are still operating on the land with and without tenure documents through Ministry of Lands, Agriculture, Water and Rural Resettlement - Issuing Offer Letters and 99-Year Leases to former farmland owners as security of tenure to enable them to continue operating and contributing to the revival of the agricultural sector - Restoring title to owners of farms protected under Bilateral Investment Promotion and Protection Agreement and Bilateral Investment Treaties, as well as indigenous persons whose farms were compulsorily acquired, in accordance with the Land Commission (Gazetted Land) (Disposal in Lieu of Compensation) Regulations, 2020 SI 62 of 2020.
Improving Access to Food Markets	- Maintain a diversified Strategic Food Reserves with effective collection and distribution networks - Capitalise the Strategic Food Reserve - Implement measures that minimise postharvest and storage losses - Review the market regulations, floor producer pricing policy and subsidy to millers - Establish Rural Assembly Markets located in production areas to primarily serve as places where farmers and off-takers can meet and trade their products - Pre-season price announcement policy - Review and establish general standards for agricultural commodities to meet local, regional and international market requirements - Institute legal reforms to support fair and transparent pricing mechanisms, establishment of an Agricultural Commodity Exchange and access to funding through a warehouse receipt system - Set up of an agriculture market information system that collects and disseminates information on local, national and regional, markets to enhance local production - Develop policies that promote market linkages and linking farmers to institutions - Amend legislation to remove element of GMB being sole buyer of grain - Revise the Strategic Grain Reserve policy to address thresholds
Enhancing Institutional Restructuring and Coordination	- Transformation of public institutions and institutional re-orientation to fully undertake mandates - Privatisation of some commercial and productive activities which are currently being worked on by Government - Strengthening collaboration between the public sector and agro-oriented civil societies to establish a framework for dialogue to enhance the agricultural profession - Setting up national and sub-national structures for coordination including strengthening of existing food security committees
Food Security Programmes and Projects	- Agriculture education - Crop and livestock research and technology development - Crop and livestock production, extension and advisory services - Agricultural engineering and farm infrastructure development - Animal health and production - Agriculture financing, economics and markets - Lands, resettlement and security of tenure
Irrigation Development and Water Harvesting	- Expansion of 350,000 ha farmland, particularly implementation of Tokwe – Mukosi, Gwayi-Shangaan; Marovanyati, Osborne and Zhove project - Reviving of the Irrigation Development Fund direct resources towards irrigation development and Irrigation infrastructure rehabilitation - Drilling of 35,000 boreholes for rural community water supply
Nutrition Security	- Prioritization on the implementation of public health measures that safeguard proper absorption and utilisation of essential nutrients to prevent nutrient imbalances affecting the Nation - Promotion of consumption of safe, toxin free, nutritious foods appropriate to dietary needs of gender, age, activity and sociocultural preferences - Strengthening of food and nutrition awareness on diet diversification with a variety of grains, fruits and colourful vegetables like greens and carrots - Prioritization on the implementation of public health measures that safeguard proper absorption and utilisation of essential nutrients to prevent nutrient imbalances affecting the Nation
	- Promotion of consumption of safe, toxin free, nutritious foods appropriate to dietary needs of gender, age, activity and sociocultural preferences - Strengthening of food and nutrition awareness on diet diversification with a variety of grains, fruits and colourful vegetables like greens and carrots

Strategy	Contents of Programmes
Nutrition Security (Cont.)	- Promotion of exclusive breastfeeding and commercial production of nutrient-rich foods - Up-scaling food fortification to supplement with nutrients, and bio fortification targeting rural areas with restricted market access to fortified or diverse foods - Strengthening of the Food and Nutrition Security Committees at National and Sub National levels to support and coordinate nutrition specific and nutrition sensitive interventions - Home nutrition and schools gardening, including traditional vegetables - Maternal micronutrient supplementation - Nutrition sensitive social assistance and protection - Good manufacturing practice (from Farm to Fork) - Adapt and adopt the complementary feeding framework for improving young children's diets - Implementation of National Food Based Dietary Guidelines in various sectors – agriculture, health, education - Production and consumption of bio-fortification of foods

Source: The Survey team based on NDS-1

3) Moving the economy up the value chain & structural transformation

The broad objective of this field is "To rebalance the economy and reverse the structural regression" through realization of the contribution of the secondary sector to GDP from 10.6 % in 2020 to 15 % by 2025, and the contribution of value added exports to total exports from 727.47 million USD in 2020 to about 1,337 million USD in 2025.

In order to achieve these goals, 1) Developing and strengthening of already existing value chains, 2) Beneficiation of minerals, 3) Promoting linkage of small and medium enterprises with large corporates, and 4) Decentralisation of industrialisation initiatives in line with the policy thrust of devolution and decentralisation (especially special economic zones) are set as priority targets. Particularly, NDS-1 focuses on the strengthening of some value chains of 1) Agro-based, 2) Pharmaceutical, 3) Bus and Truck assembly, 4) Iron and steel and general engineering, and 5) Plastic waste. As for Aro-based value chain, local agro-processing value chains of soybean, cotton and sugarcane are set as the main target to be strengthened. Present situation, target value and strategy for these agricultural items are as shown in Table 3.1.8.

Table 3.1.8 Target Agro-Based Value Chains to be Strengthened

Target Value Chain	Present Situation	Target Value	Strategy
Soya Bean Value Chain	Estimated oil seed crushing capacity is 610,000 ton per annum which is sufficient to satisfy domestic demand for cooking oil.	[Productivity and Crushing] From 60,000 ton (2020) to 300,000 ton (2025)	- Promote soya bean production through contract farming arrangements involving the private sector
Cotton Value Chain	Antiquated machinery, outdated technology and emergence of competing alternatives such as synthetic fibres have caused low uptake of cotton into the value chain.	[Uptake] From 9,000 ton (2020) to 15,000 ton (2025) [Yarm] From 6,750 ton (2020) to 11,250 ton (2025)	- Attract new investors - Establish the cotton value chain retooling revolving fund - Promote of use of 100% cotton fabric in the production of apparels - Strength antidumping measures to reduce the influx of second-hand clothes
Sugar Cane Value Chain	Utilized for bio-mass (No detail description)		

Source: The Survey team based on NDS-1

4) Infrastructure and utilities

The goal of this field is "Restoration of basic infrastructure services" such as road, energy, transport, water and sanitation, ICT and housing. In order to achieve improved infrastructure and access to services, the following strategies are set.

- Maintaining and repairing existing infrastructure and equipment
- Completing on-going and stalled projects

- Attracting foreign direct investment in infrastructure
- Up-scaling private sector investment in the provision of public infrastructure
- Promoting facilities that cater for people with disabilities
- Promoting research and development in infrastructure
- Capacitating implementing agencies
- Designing and implementing climate proofing and resilient infrastructure
- Promoting infrastructure sharing

The target of water supply field is to increase water storage capacity from the current 15.423 x 10^6 mega litres to 16.979 x 10^6 mega litres by 2025. Strategies to achieve this target are shown as below.

- Development of the National Dam Safety Plan and its implementation, strengthening existing capacities for water resources management and the further development of water resources to cater for existing and future demand as well as reducing hydrological and climatic vulnerability
- Rehabilitation and development of basic water storage and transport infrastructure facilities such as canals, pipelines and treatment plants
- Capacity building for institutions with responsibilities of water resource management
- Drilling and hydrological investigations as well as expansion of hydrological stations in order to provide basic information for management of national water resources.
- Inspection programme for all major dams in the country to assess risks to public safety, extent of water losses, and extent of siltation
- Commercialisation of ZINWA operation to ensure cost recovery when supplying raw and treated water for agricultural, household and industrial use

3.2 AGRICULTURE DEVELOPMENT STRATEGY

3.2.1 National Agriculture Policy Framework (NAPF, 2018-2030, First Draft) (June 2018)

(1) Outline

Zimbabwe has for many years operated without an updated standalone Comprehensive Agricultural Policy. Instead, the country has been using the "Zimbabwe Agricultural Policy Framework: 1995 to 2020", which was formulated in 1994. Given that this framework was outdated, the then Ministry of Agriculture, Mechanization and Irrigation Development, now MLAFWRR, with support from Food and Agriculture Organization (FAO) and other stakeholders undertook a process to update the 1994 framework. The need to put in place a National Agriculture Policy Framework (NAPF) to guide investments and sub-sector strategies to sustainably transform the sector is now more urgent than before.

The restructured agricultural sector has created opportunities and challenges in the agricultural sector in Zimbabwe. The sector has been facing a myriad of challenges relating to low production and productivity, lack of markets, poor access to existing markets, and access to finance among others. As a result, agricultural investment has sharply declined, negatively affecting agricultural productivity and overall production. The NAPF will guide the development of a new and relevant policy and regulatory framework that responds to the needs of the restructured and evolving agricultural sector.

The overall objective of the NAPF is to provide policy guidance and direction on how to promote and support the sustainable flow of investments to transform the agricultural sector through increased and sustained agricultural production, productivity and competitiveness. The NAPF provides a relevant and evidence-based framework to guide and coordinate the development of sector-specific policies that will provide more details, priorities, implementing means, and enforcement mechanisms. Specific of the

NAPF objectives are to 1) Identify key challenges constraining agricultural performance, 2) Define objectives, strategic initiatives and development results/outcomes for the agricultural sector and 3) Articulate a road map to strengthen agricultural performance and achieve the following.

- National and household food and nutrition security
- Optimum levels of foreign currency, income and employment
- Increase agriculture's contribution to the GDP
- Sustainable industrial development through the provision of adequate agricultural raw materials
- Improve agricultural market access and competitiveness
- A conducive policy and regulatory environment for agricultural development.

(2) Target

The overall goal of the NAPF is to create an environment that enhances the sustainable flow of investment into the agricultural sector towards enhancing productivity and production, ensure food and nutrition security, and promote national economic growth and development. A prosperous, diverse and competitive agriculture sector, ensuring food and nutrition security and significantly contributing to national development.

(3) Strategy

The NAPF has motivated fundamental principles and elements required to stimulate investments. There is need to operationalise this framework by providing a compendium of investment opportunities and plans across all agro-ecological zones of the country. The key elements to promote and facilitate the flow of investment into agriculture in the compendium must include, at the minimum, the followings.

- Development of an agricultural investment strategy. This calls for the completion of key subsector investments strategies which are aligned to the NAPF
- Investment promotion and facilitation
- Agriculture value chain infrastructure development
- Developing or strengthening trade policy
- Agricultural financial sector development
- Human resources development, research, and innovation
- Rethinking tax policy in relation to agricultural development
- Risk management - crop, livestock and drought insurance, and disaster risk reduction and management
- Responsible business conduct - labour standards, environmental regulations, corruption, equitable benefit sharing, etc.
- Sustainable use of natural resources and environmental management - use of clean energy, smart agriculture, use of green technologies, etc.

3.2.2 Maize, Wheat and Soyabean Production Recovery Plan (February 2020)

(1) Outline

The continued decline in maize, wheat and soyabean production levels is a significant threat on national food security and is imposing insurmountable pressure on the fiscus as the country's food import requirements increase. This is against a backdrop of foreign currency shortages and increased global commodity prices.

The Recovery Plan contained herein, is a response to the call by the Cabinet Committee on Grain

Mobilization to put in place solid interventions to reverse the negative production trends, attain self-sufficiency and allow the country to move away from the perpetual importation of these strategic commodities. Achieving this enables the agriculture sector to occupy its rightful position in steering the country towards attainment of Vision 2030.

(2) Target

The Recovery Plan will target to put 80,000 ha of winter wheat, and 200,000 ha and 40,000 ha of summer maize and soyabean respectively. Since the country is constrained by the current irrigation capacity of 170,000 ha, the programme will target 80,000 ha and 10,000 ha under irrigated maize and soyabean, respectively. The rest of the targeted area will be under dryland. This alternative will be limited to a few farmers in the maize belt and areas with high rainfall potential. In such cases, climate proofing by replacing up to 50,000 ha of maize and 10,000 ha of soyabeans with traditional grains and sunflower respectively will be considered together with water-harvesting techniques such as ripping, wet ripping and Conservation Agriculture which will be made mandatory. Traditional grains and sunflower can replace maize in stock feed manufacture and reduce human livestock competition on maize. Expected cropping programmes are as shown in Table 3.2.1.

Table 3.2.1 Maize, Soyabean (Summer), Wheat (Winter) Cropping Programme

Cropping Season	Crops	Irrigated Area			Dryland Area			Total	
		Target Area	Expected Yield	Output	Target Area	Expected Yield	Expected Output	Area	Output
		(ha)	(ton/ha)	(ton)	(ha)	(ton/ha)	(ton)	(ha)	(ton)
Summer	Maize	80,000	8	640,000	70,000	5	315,000	150,000	955,000
	Traditional Grains	-	-	-	50,000	3	150,000	50,000	150,000
	Soyabean	10,000	3	30,000	20,000	2	30,000	30,000	60,000
	Sunflower	-	-	-	10,000	2	20,000	10,000	20,000
Winter	Wheat	80,000	5	400,000	-	-	-	80,000	400,000
Total Area (ha)		170,000	-	-	150,000	-	-	320,000	-

Source: The Survey team based on Maize, Wheat and Soyabean Production Recovery Plan

Winter wheat production will target 80,000 ha to produce 400,000 ton of wheat at 5 ton/ha average yield per hectare. The beneficiaries for winter cropping shall be A1 and A2 farmers with irrigation.

(3) Strategy

The following key points are very crucial for the success of the Recovery Plan.

- Adopting scientific methods (Conservation Agriculture) to climate proof Government Programs
- Timely provision of inputs (fertilizers, seeds, agrochemicals and other key utilities)
- Soil conditioning (liming) to improve fertilizer/nutrient use efficiency
- Availability of key utilities such as power and fuel to farmers
- Crowding in the private and the financial services sectors
- Meticulous vetting, onboarding, tracking and monitoring of Productivity Enhancing Programmes
- Access to appropriate finance for inputs and working capital
- Continuous support of the targeted farmers with irrigation and mechanization services to improve efficiencies and climate proofing, respectively
- Capacitating the extension service delivery system so that it becomes responsive and provision of the same to farmers
- Government-wide coordination, monitoring and evaluation of the entire facets of the Recovery Plan.

3.3 IRRIGATION DEVELOPMENT STRATEGY

3.3.1 National Accelerated Irrigation Rehabilitation and Development Programme (January 2018)

(1) Outline

This programme is developed by new government inaugurated in 2017 and published by Ministry of Finance and Economic Development. This programme consists of the review of irrigation policy/programme done by the previous government, present irrigation situations, and direction of future irrigation development.

In the Programme, dysfunctional of a significant number of irrigation schemes despite efforts have been done by GoZ and development partners is recognized as an important challenge in irrigation sector. The Programme assesses that the country has a total identified preliminary potential irrigable area of 5,000,000 ha (2,500,000 ha full and 2,500,000 ha partial irrigation) but the current total area equipped with irrigation facilities is 206,000 ha only, out of which 161,000 ha is currently functional with 45,000 ha requiring rehabilitation. Additionally, some of the functional irrigation schemes still need upgrading to be compatible with new irrigation technologies to improve on irrigation efficiencies and uniformities as well as reducing labour and power costs.

(2) Target Values

The target irrigated area to be increased through the Programme is as show in Table 3.3.1. Increasing functional irrigation schemes at least 120,000 ha under the A1 Farm, Old Resettlement Area and Communal Land in 10 years is set as one of the targets.

Table 3.3.1 Target Values of Irrigated Area (ha)

Land Use	Present	Shor Term Plan (0 - 3 years)	Mid Term Plan (4 - 10 years)	Long Term Plan (11 - 25 years)
Communal Land	15,000	20,000	121,000	423,000
A1 Farm & Old Resettlement Area	15,000	41,000	196,000	588,000
A2 Farm	50,000	61,000	220,000	703,000
ARDA	18,000	21,000	271,000	723,000
PLANTATIONS	63,000	63,000	63,000	63,000
Total	**161,000**	**206,000**	**871,000**	**2 500 000**

Source: National Accelerated Irrigation Rehabilitation and Development Programme

(3) Strategies

In order to achieve the target values, irrigation rehabilitation and development of at least 200 ha per district annually over the next 10 years is required, and three components, 1) Development of irrigation infrastructure, 2) Agricultural development and 3) Project management, are to be implemented to realize the target. Main activities under each of components are shown in Table 3.3.2. In addition, interventions from development partners are expected to accelerate the realization of the target.

Table 3.3.2 Main Activities under each of Components

Component	Main Activities
Development of Irrigation Infrastructure	- Prepare detailed designs and implementation plan, and supervise the civil works - Develop headworks including construction of pump house, installation of pumps, conveyance and distribution systems pipelines - Develop infield works which will constitute land clearing and levelling, water application equipment, and infrastructure

Component	Main Activities
Agricultural Development	- Secure accessibility to credit to procure inputs and agricultural implementation - Train farmers in group formation and management, water use management, crop production and marketing - Train the field extension staff in water use management, crop husbandry practices (including IPPM), and marketing
Project Management	- Monitor project by DOI and established Project Implementation Units, and the National Accelerated Irrigation Rehabilitation and Development Technical Committee

Source: The Survey team based on National Accelerated Irrigation Rehabilitation and Development Programme

(4) Project Selection Criteria

The following criteria are set to select target rehabilitation, operationalisation of non- functional one, and new irrigation schemes project.

- Underutilized water bodies
- Guaranteed water supply at 10% yield for dams
- Plot share of not more than 2 ha per householder
- Potential irrigability of the soils
- Social cohesion of the beneficiary community
- Socio- economics and livelihood dynamics among other factors

3.3.2 Accelerated Irrigation Rehabilitation and Development Plan 2021-2025 (11th October 2020)

(1) Outline

This Plan describes direction of irrigation development taking into account the results of TSP implemented from 2018 to 2020. It is described in the Plan that Zimbabwe, and southern Africa in general, are predicted to become drier in the decades ahead due to climate change, and consequently, climate-proof agriculture to ensure household and national food security, reducing food imports, promoting exports, enhancing employment creation, deepening value addition and beneficiation and improving livelihoods are required.

Also, the Plan analyses the present situation of irrigation development as below.

- Zimbabwe has potential to irrigate over 2,000,000 ha by 10,000 dams.
- A paltry 216, 000 ha have been developed.
- The developed area includes 55,000 - 60,000 ha under plantations.
- Leaving annual cropping potential at 120,000 ha discounting the 45,000 ha which is dysfunctional on A1 and A2 farmers.
- Smallholder irrigation schemes in Communal Lands and Old Resettlement Areas are on 26, 000 ha.

(2) Target Values

In order to realize the climate-proof agriculture, 1) Promotion of conservation agriculture, 2) Revitalization of dysfunctional irrigation scheme, and 3) New irrigation scheme development are required. With regard to new irrigation scheme development, irrigated area would be increased 420,000 ha by 2025 from the current 216,000 ha. Also, rehabilitation of 71,000 ha (26,000 ha smallholder irrigation schemes and 45,000 ha A1 and A2 farms) is to be implemented (see Table 3.3.3).

Table 3.3.3 Target Irrigated Area (ha)

Item	Base Value	Target Value					
	2020	2021	2022	2023	2024	2025	Total
Irrigated Area (= Irrigated area of the previous year + new irrigation scheme development of the year)	216,000	245,900	381,400	394,400	407,900	420,000	420,000
New Irrigation Scheme Development		29,900	135,500	13,000	13,500	12,100	204,000
Rehabilitation of the Existing Irrigation Scheme		41,000	15,000	15,000	0	0	71,000

Source: The Survey team based on Accelerated Irrigation Rehabilitation and Development Plan 2021-2025

(3) Strategies

The following three components are planned to achieve the target values.

1) Irrigation scheme rehabilitation and revitalisation (in Communal Land)

- Rehabilitation and revitalization of over 450 irrigation schemes in Communal Lands, on 26,000 ha and a concomitant farmer capacitation to assure sustainability of these irrigation schemes

2) Irrigation scheme rehabilitation and revitalisation (in A1 and A2 Farm)

- Rehabilitation and revitalization of the 45,000 ha on A1 and A2 Farms, through regulatory reforms, governance improvement, business transformation and farmers capacitation

3) New irrigation development

- Lowveld Green Zone and Irrigation Development on 100,000 ha under composition of public and private sector
- Various schemes and projects linked to dams in communal and resettlement areas on 83,000 ha

In addition to these three components, establishment a Presidential District Irrigation Vision 2030 Accelerator Model for 12,000 ha is planned.

Also, the activities below are planned as cross-component activities.

- To improve the efficiency of water use by adopting modern irrigation methods
- To improve access to finance, inputs, markets and improve governance and business ethic for irrigation schemes
- To improve the policy and regulatory environment to accelerate dam construction and irrigation infrastructure development
- To promote and incentivise the establishment of micro-water harvesting and irrigation methods for households

Furthermore, irrigation schemes having high priority to be developed are mentioned in the Plan (see Table 3.3.4). In addition, the Plan includes recommended irrigation scheme lists by districts as well.

Table 3.3.4 Prioritized Irrigation Schemes to be Developed

Target	Contents
Lowveld Green Belt (New Irrigation Scheme Development)	- Establish 100,000 ha by 2025 Tokwe Mkosi 40,000 ha Runde- Tande 30,000 ha Bulawayo Kraa 12,000 ha Kanyemba 15,000 ha Masvingo Green belt 3,000 ha - Target of each year; 35,000 ha by 2020, 50,000 ha by 2023 and 70,000 ha by 2024

Target	Contents
Scaling Up Irrigation Development	- Establish 30,000 ha by 2025 through scaling up the existing irrigation schemes Gwayi-Shangani 15,000 ha Biri 3,000 ha Marovanyati 1,250 ha Causeway 1,250 ha and others
Rehabilitation of Irrigation on A1 and A2 farms	- Establish facilities such and Maka (drip irrigation) and Pedstock (house) facilities to accelerate irrigation rehabilitation - Develop new on farm irrigation schemes - Establish 45,000 ha by 2023
Presidential Rural Irrigation Vision 2030 Accelerator Model	- Develop 200 ha per each district per year - Establish 12,000 ha by 2025 - Promotion of roof top water harvesting and use of foot pumps - Promotion of efficient irrigation methods such as drip irrigation and center pivots.

Source: The Survey team based on Accelerated Irrigation Rehabilitation and Development Plan 2021-2025

3.4 WATER RELATED POLICIES, STRATEGIES, LAWS AND REGULATIONS

3.4.1 Water Act (Revised in 2005)

(1) Outline

This Act describes right, management agencies, procedure, regulation, penalties and so on in respect to water use. No person shall be entitled to ownership of any water in Zimbabwe and no water shall be stored, abstracted, apportioned, controlled, diverted, used or in any way dealt with except in accordance with this Act.

(2) Implementation Agencies of Water Resources Development

Implementation agencies of water resources development are 1) ZINWA, 2) Catchment Council and 3) Sub-Catchment Council. ZINWA shall, within a period of not more than ten years from the date on which an approved outline plan came into operation, review the operative outline plan and decide whether or not a new outline plan should be prepared.

(3) Application and Approval of Water Resource Development

A person who intends to construct water storage works capable of storing not more than 5,000 m^3 of water on a public stream for the storage of water for primary purposes shall in writing notify the Catchment Council, every other owner, lessee or occupier of riparian land which is contiguous to the proposed water storage works. No person shall apply for a permit to construct in a public stream water works capable of storing in excess of 5 million m^3 of water or abstracting more than 100 litres/sec without first obtaining the consent in writing of the Minister.

A permit shall be valid for twenty years (or shorter or longer period) as a Catchment Council, with the approval of the Secretary, may fix. No person shall cede, sell or otherwise alienate a permit except with the consent of the Catchment Council concerned, granted after consultation with the Secretary.

If any two or more owners of land consider that 1) there should be a combined water scheme for the area comprising the land owned by them; and 2) recourse should be had to artificial means of storing or supplying water in the area, they shall address to the Catchment Council a petition in the prescribed form stating. A Catchment Council may, in allocating the quantity of water to be used within a scheme, allocate for primary purposes such quantity of water as it thinks fit.

Whenever an order or other decision of a Catchment Council in respect of an application for a permit to use water for an irrigation scheme or any other matter is likely, in the opinion of the Catchment Council,

substantially to affect the supply of water for primary purposes of the occupants of any Communal Land, the order or other decision shall not take effect unless the approval of the Minister responsible for the administration of the Communal Land Act, has first been obtained.

(4) Water Shortage

Whenever the volume of water in any river system or part thereof for the use of which permits have been granted proves insufficient to satisfy all the permits, the Catchment Council shall revise, reallocate or reapportion the permits upon such conditions and in such manner as will ensure the equitable distribution and use of the available water.

If the Minister, on the recommendation of ZINWA and in consultation with the Catchment Council concerned, is of the opinion that the use of water in any catchment area is approaching the limit of the potential and that it is necessary or desirable in the public interest to make a declaration, he may, by notice in the Gazette and in a newspaper circulating in the area concerned, declare the area to be a water development restriction area.

If the Minister, acting on the recommendation of ZINWA and in consultation with the Catchment Council concerned, is of the opinion that the flow of water in any public stream has at any time ceased or if the flow of water or the level of water in the storage works has fallen or is likely to fall below the level of the usual flow or acceptable level of storage works in the public stream, he may, by notice in the Gazette, declare any area specified in the notice to be a water shortage area for such period, not exceeding twelve months, as may be specified in the notice. A Catchment Council may 1) suspend or amend any permits, 2) make orders in relation to the abstraction, appropriation, control, diversion or use of any water;

(5) Dam Construction

1) Categorization

Table 3.4.1 Dam Category

Category	Criteria			Remarks
	Height	Storage Capacity (at Full Supply Level)	Foundation	
Large Dam	15 m or more	1,000,000 m^3 or more	Require specific treatment	Height is measured from the non-overflow crest of the wall of the structure to the lowest point on the downstream face of the wall.
Small Dam	More than 8 m but less than 15 m	More than 500,000 m^3 but less than 1,000,000 m^3	-	

Source: The Survey team based on Water Act

The owner of dam regardless of its category shall report to the Secretary when construction works are commences and completed, and an emergency situation such as flood happens. Particularly, the owner of large dam has to report construction supervision and results of periodical inspections additionally.

2) Land acquisition

The Minister may, in consultation with the Catchment Council concerned, whenever he considers it necessary in the public interest to do so, by notice in the Gazette and in a newspaper circulating in the area concerned, reserve any area comprising a potential dam basin or a potential dam site or both against any one or more. The Minister shall by registered letter give notice of a reservation to every owner, lessee or occupier of land in the area in respect of which the reservation is made. Publication in the Gazette of a notice shall have the effect of prohibiting the doing of the acts specified in such notice on the land in the area reserved in terms of that subsection:

The Minister shall pay compensation to any person who is injuriously affected by a reservation construction. Any person who wishes to claim compensation payable shall, within sixty days from the date of publication of the notice or such longer period as the Minister may, on good cause shown allow, submit a claim in writing to the Minister specifying in detail the nature of the loss or damage caused to him by the reservation concerned.

(6) Others

Any persons who formulate and implement any proposal for the use, management or exploitation of water resources, due consideration shall be given to 1) the protection, conservation and sustenance of the environment, and 2) the right of access by members of the public to places of leisure or natural beauty related to water or water bodies.

If passage, irrigation and drainage function and mining operation in a land is affected by the constructed structure, any countermeasures such as bridges, aqueducts, culverts and other works shall be arranged as compensation works.

3.4.2 Revised Protocol on Shared Watercourses in the Southern Africa Development Community (7th August 2000)

(1) Outline and Objectives

This Protocol describes the provisions in respect to international rivers which run across the national border (hereinafter referred to as "shared watercourses") in SADC territories.

The overall objective of this Protocol is to foster closer cooperation for judicious, sustainable and co-ordinated management, protection and utilisation of shared watercourses and advance the SADC agenda of regional integration and poverty alleviation. Fourteen countries (Angola, Botswana, DR Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, The Kingdom of Swaziland, Tanzania, Zambia and Zimbabwe) of SADC signed on this Protocol.

In order to achieve the objectives, the activities below are planned.

- Promote and facilitate the establishment of shared watercourse agreements and Shared Watercourse Institutions for the management of shared watercourses
- Advance the sustainable, equitable and reasonable utilisation of the shared watercourses
- Promote a co-ordinated and integrated environmentally sound development and management of shared watercourses
- Promote the harmonisation and monitoring of legislation and policies for planning, development, conservation, protection of shared watercourses, and allocation of the resources thereof
- Promote research and technology development, information exchange, capacity building, and the application of appropriate technologies in shared watercourses management.

(2) Specific Provision

Specific provisions in the Protocol are shown in Table 3.4.2.

Table 3.4.2 Specific Provisions

Item	Contents
Planned Measures	- State Parties shall exchange information and consult each other and, if necessary, negotiate the possible effects of planned measures on the condition of a shared watercourse. - Before a State Party implements or permits the implementation of planned measures which may have a significant adverse effect upon other Watercourse States, it shall provide those States with timely notification thereof.

Item	Contents
Planned Measures (Cont.)	- Unless otherwise agreed, a State Party providing a notification shall allow the notified States a period of six months within which to study and evaluate the possible effects of the planned measures and to communicate the findings to it. - The notifying State shall cooperate with the notified States by providing them, on request, with any additional data and information that is available and necessary for an accurate evaluation. - The notifying State shall not implement or permit the implementation of the planned measures without the consent of the notified States. - If the notifying State receives no communication within 6 months, it may proceed with the implementation of the planned measures, in accordance with the notification and any other data and information provided to the notified States. - During the course of the consultations and negotiations after the notifying State received reply from the notified State, the notifying State shall, if so requested by the notified State at the time it makes the communication, refrain from implementing or permitting the implementation of the planned measures for a period of six months unless otherwise agreed. - If a State Party has reasonable grounds to believe that another Watercourse State is planning measures that may have a significant adverse effect upon it, the former State may request the latter to issue the notice. - In the event that the implementation of planned measures is of the utmost urgency in order to protect public health, public safety or other equally important interests, the State planning the measures may skip some provisions for immediate proceeding the implementation. In such case, a formal declaration of the urgency of the measures shall be communicated without delay to the other Watercourse States together with the relevant data and information.
Environmental Protection and Preservation	- State Parties shall, individually and, where appropriate, jointly, protect and preserve the ecosystems of a shared watercourse. - State Parties shall, individually and, where appropriate, jointly, prevent, reduce and control the pollution and environmental degradation of a shared watercourse. - State Parties shall take all measures necessary to prevent the introduction of species, alien or new, into a shared watercourse which may have effects detrimental to the ecosystems of the watercourse resulting in significant harm to other Watercourse States. - Watercourse States shall take steps to harmonise their policies and legislation in this connection.
Management of Shared Watercourses	- Watercourse States shall, at the request of any of them, enter into consultations concerning the management of a shared watercourse, which may include the establishment of a joint management mechanism. - Unless otherwise agreed, Watercourse States shall participate on an equitable and reasonable basis in the construction and maintenance or defrayal of the costs of such regulation works as they may have agreed to undertake. - Watercourse States shall, at the request of any of them which has reasonable grounds to believe that it may suffer significant adverse effects, enter into consultations with regards to a) the safe O&M of installations, facilities, or other works related to a shared watercourse and b) the protection of installations, facilities or other works from wilful or negligent acts or the forces of nature.
Prevention and Mitigation of Harmful Conditions	- State Parties shall individually and, where appropriate, jointly take all appropriate measures to prevent or mitigate conditions related to a shared watercourse that may be harmful to other Watercourse States, whether resulting from natural causes or human conduct, such as floods, water-borne diseases, siltation, erosion, salt-water intrusion, drought or desertification. - State Parties shall require any person intending to use the waters of a shared watercourse within their respective territories for purposes other than domestic or environmental use or who intends to discharge any type of waste into such waters, to first obtain a permit, licence or other similar authorisation from the relevant authority within the State concerned.
Emergency Situations	- State Parties shall, without delay, notify other potentially affected States, the SADC Water Sector Co-ordinating Unit and competent international organisations of any emergency situations originating within their respective territories and promptly supply the necessary information to such affected States and competent organisations with a view to co-operate in the prevention, mitigation, and elimination, of harmful effects of the emergency.

Source: The Survey team based on Revised Protocol on Shared Watercourses in the Southern Africa Development Community

3.5 ENVIRONMENTAL PROTECTION

3.5.1 Laws and Regulations Related to the Environmental Protection

Major laws and regulations related to the environmental protection in Zimbabwe are shown in Table 3.5.1. The Environmental Management Act (Chapter 20:27) sets out the basic principle of the environmental management in Zimbabwe and giving the function of Environmental Management Authority (EMA) as the regulatory authority. Environmental Impact Assessment (EIA) system in Zimbabwe is regulated by the Environmental Management (Environmental Impact Assessment and Ecosystems Protection) Regulations, setting under the Environmental Management Act.

The Parks and Wildlife Act (Chapter 20:14) designates the national parks and sanctuaries of the wildlife, as the national protected area. The Water Act sets out the establishment of Catchment Council and licensing for public water use.

Table 3.5.1 Major Laws and Regulations Related to the Environmental Protection

Laws, Regulations	Latest Revision Year	Main Contents
Environmental Management Act (Chapter 20:27)	2005	- Basic principle of environmental management - General description of EIA system - Establishment of EMA and its roles and responsibilities
Parks and Wildlife Act (Chapter 20:14)	2002	- Protected areas and inhabited species - Wise use of natural resources for tourisms - Establishment of Zimbabwe Parks and Wildlife Management Authority (ZIMPARKS) and its roles and responsibilities
Water Act (Chapter 20:24)	2002	- Establishment of catchment council - Licensing for public water use
Environmental Management (Environmental Impact Assessment and Ecosystems Protection) Regulations, SI-7	2007	- Procedure of EIA (applications, approvals, etc.)
Environmental Management (Atmospheric Pollution Control) Regulations, SI-72	2009	- Regulations and licensing for the operation of establishments that emit air polluted substances - Environmental standard for air pollution
Environmental Management (Effluent and Solid Waste Disposal) Regulations, SI-6	2007	- Regulations and licensing for the operation of establishments that discharge polluted effluent - Environmental standard for effluent and solid waste disposal

Source: The Survey team

3.5.2 EIA System

Overview of the EIA system in Zimbabwe is summarized in Table 3.5.2. Application procedure for the Environmental approval from EMA is required for the projects classified as the "First Schedule" shown in the Environmental Management Act. In general, dams and irrigation projects are classified into the "First Schedule".

Process of the environmental approval procedure is shown in the same table (Table 3.5.2). Project implementer shall complete this environmental approval procedure before commencement of the project implementation. In the first stage of the process, EMA reviews the "Prospectus" in which the environmental overview of the project is described. After the review of the "Prospectus", reviewed results are categorizes as a) Need EIA, b) Need Environment Management Plan (EMP), c) Exemption, or d) Rejection by EMA and notified to the project implementer.

In the second stage of the process, the project implementer prepares the EIA report if the result of the first stage is "a) Need EIA", while the EMP is applied in case of "b) Need EMP". In case of "c) Exemption", second stage process is exempted. In case of "d) Rejection", "Prospectus" shall be resubmitted, and reviewed again by EMA.

The EIA report and the EMP in the second stage of the process should be prepared by the consultant registered by EMA. Duration of the EMA's review is around 80 days (First process: within 20 days, Second stage: within 60 days) while preparation period also should be considered around three months for procurement of the consultant and their reporting work including survey. And, if in case of EIA is applied in the second stage, application fee shall be paid to EMA as review fee, costing around 1 % (0.8 %, 1% or 1.2%) of the project cost.

Table 3.5.2 EIA System in Zimbabwe

Items	Contents
Overview of EIA System	Projects classified as the "First Schedule" shown in the article 97 of the Environmental Management Act is required to apply for the environmental approval from EMA. After the review of EMA, a Certificate is issued to the approved project.
Projects Requiring the Environmental Approval (Projects Classified as the "First Schedule")	***1. Dams and man-made lakes*** ***2. Drainage and irrigation*** (a) drainage of wetland or wildlife habitat, ***(b) irrigation schemes*** 3. Forestry (a) conversion of forest land to other use, (b) conversion of natural woodland to other use within the catchment area of reservoirs used for water supply, irrigation or hydropower generation or in areas adjacent to the parks and wildlife estate. 4. Housing developments 5. Industry (a) chemical plants, (b) iron and steel smelters and plants, (c) smelters other than iron and steel, (d) petrochemical plants, (e) cement plants, (f) lime plants, (g) agro-industries, (h) pulp and paper mills, (i) tanneries, (j) breweries, (k) industries involving the use, manufacture, handling, storage, transport or disposal of hazardous or toxic materials. 6. Infrastructure (a) highways, (b) airports and airport facilities, (c) new railway routes and branch lines, (d) new towns or townships, (e) industrial sites for medium and heavy industries. 7. Mining and quarrying (a) mineral prospecting, (b) mineral mining, (c) ore processing and concentrating, (d) quarrying 8. Petroleum production, storage and distribution (a) oil and gas exploration and development, (b) pipelines, (c) oil and gas separation, processing, handling and storage facilities, (d) oil refineries 9. Power generation and transmission (a) thermal power stations, (b) hydropower schemes, (c) high-voltage transmission lines 10. Tourist, resorts and recreational developments (a) resort facilities and hotels, (b) marinas, (c) safari operations 11. Waste treatment and disposal (a) toxic and hazardous waste: incineration plants, recovery plants (offsite), wastewater treatment plants (off-site), landfill facilities, storage facilities (offsite), (b) municipal solid waste: incineration, composting and recovery/recycling plants, landfill facilities, (c) municipal sewage: waste treatment plants, outfalls into aquatic systems, effluent water irrigation schemes 12. Water supply (a) groundwater development for industrial, agricultural or urban water supply, (b) major canals, (c) cross-drainage water transfers, (d) major pipelines, (e) water withdrawals from rivers or reservoirs
Process of the Environmental Approval	**First Stage** - Project implementer submits the "Prospectus" to EMA as the first step. "Prospectus" describes the environmental overview of the project which include following information. *Project summary, locations, base of the environmental condition in project sites, major environmental impacts, mitigation measures, project costs, TOR and regal framework. - EMA reviews the "Prospectus" within 20 days and result is notified to the submitter. - Reviewed result is notified by either a) Need EIA, b) Need EMP, c) Exemption, or d) Rejection. - In case of a) or b), review will be forwarded to the next step in second stage. In case of c), review of second stage will be exempted and in case of d), project implementer must submit the "Prospectus" again **Second Stage** - In case that review result of first stage is a), EIA report shall be prepared. In case of the review result of first stage is b), EMP shall be prepared. - EMA reviews the EIA report or the EMP within 60 days. - In case that the EIA report or the EMP are approved, a Certificate is issued by the EMA. **Review cost of EMA, and the qualified person for preparation of reports** - "Prospectus" shall be prepared by the project implementer or the registered consultants by the EMA. Review cost of "Prospectus" by EMA is about 900 USD. - The EIA report or the EMP shall be prepared by the registered consultants by the EMA. In case of the EIA report, the review cost of EMA is applied either 0.8 %, 1 % or 1.2 % of the project costs. **After insurance of the Certificate** - Project implementer shall submit the progress report to the EMA, quarterly. - The Certificate is valid for two years. However, the deadline can be extended for one year for the projects that are started but not completed within the specified period.

Source: The survey team based on the Environmental Management Act (Chapter 20:27), Environmental Management (Environmental Impact Assessment and Ecosystems Protection) Regulations 2007, and hearing from EMA.

3.5.3 Protected Areas and Eco Systems

(1) Protected Areas Designated by Parks and Wildlife Management Act

In Zimbabwe, the Parks and Wildlife Act has been established to protect wildlife and ecosystems, as well as wise use of the tourism resources. The Act divides the national protected areas into five categories for different purposes of management. Sixty-five (65) sites (about 5 million ha) are designated as the national protected areas in Zimbabwe in the Act. The list of the national protected areas is shown in Table 3.5.3 while those locations are shown in Figure 3.5.1.

Table 3.5.3 National Protected Areas Designated by the Parks and Wildlife Management Act

Category	Sub-category	Name of Protected Area (size: ha) and Place		
		Name (size: ha)	District	Province
I. NATIONAL PARKS	i) National Parks on Parks and Wildlife Land	1) Chizarira (191,000 ha)	Binga	Matabeleland North
		2) Gonarezhou (505,300 ha)	Chiredzi	Masvingo
		3) Matusadona (140,700 ha)	Nyaminyami	Manicaland
		4) Chimanimani (17,110 ha)	Chimanimani	Manicaland
		5) Mana Pools (219,600 ha)	Hurungwe	Mashonaland West
		6) Kazuma Pan (31,300 ha)	Hwange	Matabeleland North
		7) Hwange (1,465,100 ha)	Hwange	Matabeleland North
		8) Victoria Falls "A" (1,904 ha) Victoria Falls "B" (436 ha)	Hwange	Matabeleland North
		9) Zambezi (56,010 ha)	Hwange	Matabeleland North
		i) Sub-Total:	**2,628,460 ha**	**(9 places)**
	ii). National Parks on Rhodes Estate	10) Rhodes Nyanga (47,150 ha)	Nyanga	Manicaland
		11) Rhodes Matopos (42,400 ha)	Matobo	Matabeleland South
		ii) Sub-Total:	**89,550 ha**	**(2 places)**
		Total (First Schedule):	**2,718,010 ha**	**(11 places)**
II. BOTANICAL RESERVES AND BOTANICAL GARDENS	i) Botanical Reserves on Parks and Wildlife Land	1) Pioneer Area (38 ha)	Beitbridge	Matabeleland South
		2) Tolo River (44 ha)	Beitbridge	Matabeleland South
		3) South Camp (26 ha)	Beitbridge	Matabeleland South
		4) Chisekera Hot Springs (95 ha)	Chiredzi	Masvingo
		5) Mawari Raphia Palm (34 ha)	Mt Darwin	Mashonaland Central
		6) Tingwa Raphia Palm (290 ha)	Mt Darwin	Mashonaland Central
		7) Haroni Forest (20 ha)	Chimanimani	Manicaland
		8) Rusitu Forest (150 ha)	Chimanimani	Manicaland
		9) Sebakwe Acacia Karoo (60 ha)	Kwekwe	Midlands
		10) Sebakwe Great Dyke (165 ha)	Kwekwe	Midlands
		11) Sebakwe Mountain Acacia (53 ha)	Kwekwe	Midlands
		12) Mazoe "A" (43 ha), Mazoe "B" (3 ha)	Harare	Harare
		13) Bunga Forest (495 ha)	Mutare	Manicaland
		14) Vumba (42 ha)	Mutare	Manicaland
		i) Sub-Total:	**1,558 ha**	**(14 places)**
	ii) Botanical Gardens on Parks and Wildlife Land	15) National Botanic (67 ha)	Harare	Harare
		16) Vumba (200 ha)	Mutare	Manicaland
		ii) Sub-Total:	**267 ha**	**(2 places)**
	iii) Botanical Gardens on Trust Land	17) Ewanrigg (286 ha)	Goromonzi	Mashonaland East
		iii) Sub-Tota:	**286 ha**	**(1 place)**
		Total (Second Schedule):	**2,111 ha**	**(17 places)**
III. SANCTUARIES AND SPECIALLY PROTECTED ANIMALS	i) Sanctuaries on Parks and Wildlife Land	1) Maniinii Pan (300 ha) *(Birds)*	Chiredzi	Masvingo
		2) Melsetter Eland (1,800 ha) *(Animals)*	Chimanimani	Manicaland
		3) Mbaze Pan (40 ha) *(Birds)*	Nkayi	Matabeleland North
		4) Nyamanyetsi (2,480 ha) *(Animals)*	Guruve	Mashonaland Central
		5) Mushandike (12,900 ha) *(Animals)*	Masvingo	Masvingo
		i) Sub-Total:	**17,520 ha**	**(5 places)**
	ii) Sanctuaries on Rhodes Estate	6) Rhodes-Bulawayo Sanctuary (1,100 ha) *(Birds)*	Matobo	Matabeleland South
		ii) Sub-Total:	**1,100 ha**	**(1 place)**
		Total (Third Schedule):	**18,620 ha**	**(6 places)**
IV. SAFARI AREAS	Safari Areas on Parks and Wildlife Land	1) Tuli (41,600 ha)	Beitbridge, Gwanda	Matabeleland South
		2) Chete (108,100 ha)	Binga	Matabeleland North
		3) Chipinga (26,100 ha)	Chipinge	Manicaland

Category	Sub-category	Name of Protected Area (size: ha) and Place		
		Name (size: ha)	District	Province
		4) Malapati (15,400 ha)	Chiredzi	Masvingo
		5) Chinsa (171,300 ha)	Gokwe	Midlands
		6) Hartley (44,500 ha)	Chegutu	Mashonaland West
		7) Sibilobilo A (2,270 ha)	Nyaminyami	Matabeleland West
		Sibilobilo B (2,130 ha)	Nyaminyami	Matabeleland West
		8) Charara (169,200 ha)	Kariba, Hurungwe	Mashonaland West
		9) Hurungwe (289,400 ha)	Kariba, Hurungwe	Mashonaland West
		10) Doma (94,500 ha)	Makonde	Mashonaland West
		11) Umfurudzi (76,000 ha)	Shamva	Mashonaland Central
		12) Dande (52,300 ha)	Guruve	Mashonaland Central
		13) Chelvore (339,000 ha)	Hurungwe	Mashonaland West
		14) Sapi (118,000 ha)	Hurungwe	Mashonaland West
		15) Deka (51,000 ha)	Hwange	Matabeleland North
		16) Matetsi (295,500 ha)	Hwange	Matabeleland North
		Total (Forth Schedule):	**1,897,200 ha**	**(16 places)**
V. RECREATIONAL PARKS	i) Recreational Parks on Parks and Wildlife Land	1) Chibwatata (6 ha)	Binga	Motabeleland North
		2) Kavira (50 ha)	Binga	Motabeleland North
		3) Lake Kariba (287,200 ha)	Binga, Nyaminyami, Hwange	Motabeleland North
		4) Ngezi (5,800 ha)	Kadoma	Mashonaland West
		5) Umfuli (12,700 ha)	Chegutu	Mashonaland West
		6) Lake Robertson (11,200 ha)	Chegutu, Makonde, Harare	Mashonaland West Harare
		7) Lake Cunningham (4,172 ha)	Insiza	Matabeleland South
		8) Sinoia Caves (120 ha)	Makonde	Mashonaland West
		9) Manjirenji (3,400 ha)	Zaka	Masvingo
		10) Bangala (2,700 ha)	Zaka, Masvingo	Masvingo
		11) Sehakwe (2,600 ha)	Kwekwe	Midlands
		12) Robert McIlwaine (6,180 ha)	Harare	Harare
		13) Umzingwane (1,233 ha)	Umzingwane	Matabeleland South
		14) Kyle (16,900 ha)	Masvingo	Masvingo
		i) Sub-Total:	**354,261 ha**	**(14 places)**
	ii) Recreational Parks on Rhodes Estate	15) Lake Matopos (2,900 ha)	Matobo	Matabeleland South
		ii) Sub-Total:	**2,900 ha**	**(1 place)**
		Total (Fifth Schedule):	**357,161 ha**	**(15 places)**
		Grand Total:	**4,993,102 ha**	**(65 places)**

Source: The Survey team based on the information of the Parks and Wildlife Act, 2002 (Chapter 20:14)

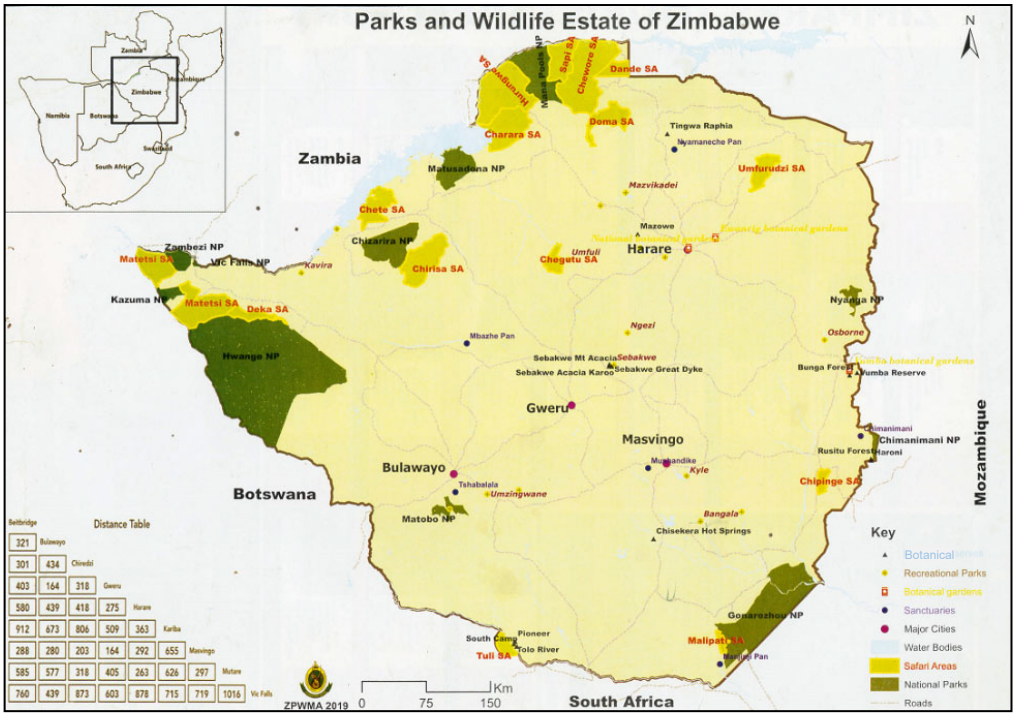


Figure 3.5.1 Location of the Designated Protection Areas (National Parks, Safari Areas, etc) in Zimbabwe

Source: ZIMPARKS

(2) International Important Areas for Biodiversity

1) Ramsar convention wetlands

Zimbabwe signed the Ramsar Convention in 2013. Seven sites (about 450,000 ha) have been designated as the Ramsar wetlands in Zimbabwe based on the information updated in 2016. List of the Ramsar wetlands in Zimbabwe is summarized in Table 3.5.4 and those locations are shown in Figure 3.5.2.

Table 3.5.4 Ramsar Convention Wetlands in Zimbabwe

No.	Site Name	Site No.	Area (ha)	Location
1	Cleveland Dam	No. 2102	1,050 ha	Harare Province
2	Chinhoyi Caves Recreational Park	No. 2103	33 ha	Mashonaland West Province
3	Driefontein Grasslands	No. 2104	201,194 ha	Masvingo, Midlands and Mashonaland East Province
4	Lake Chivero and Manyame	No. 2105	29,260 ha	Mashonaland West Province
5	Mana Pools National Park	No. 2106	220,034 ha	Mashonaland West Province
6	Monavale Wetland	No. 2107	507 ha	Harare Province
7	Victoria Falls National Park	No. 2108	1,750 ha	Matabeleland North Province
Total			453,828 ha	

Source: The Survey team based on the information of the Ramsar Convention Secretariat in Web site.

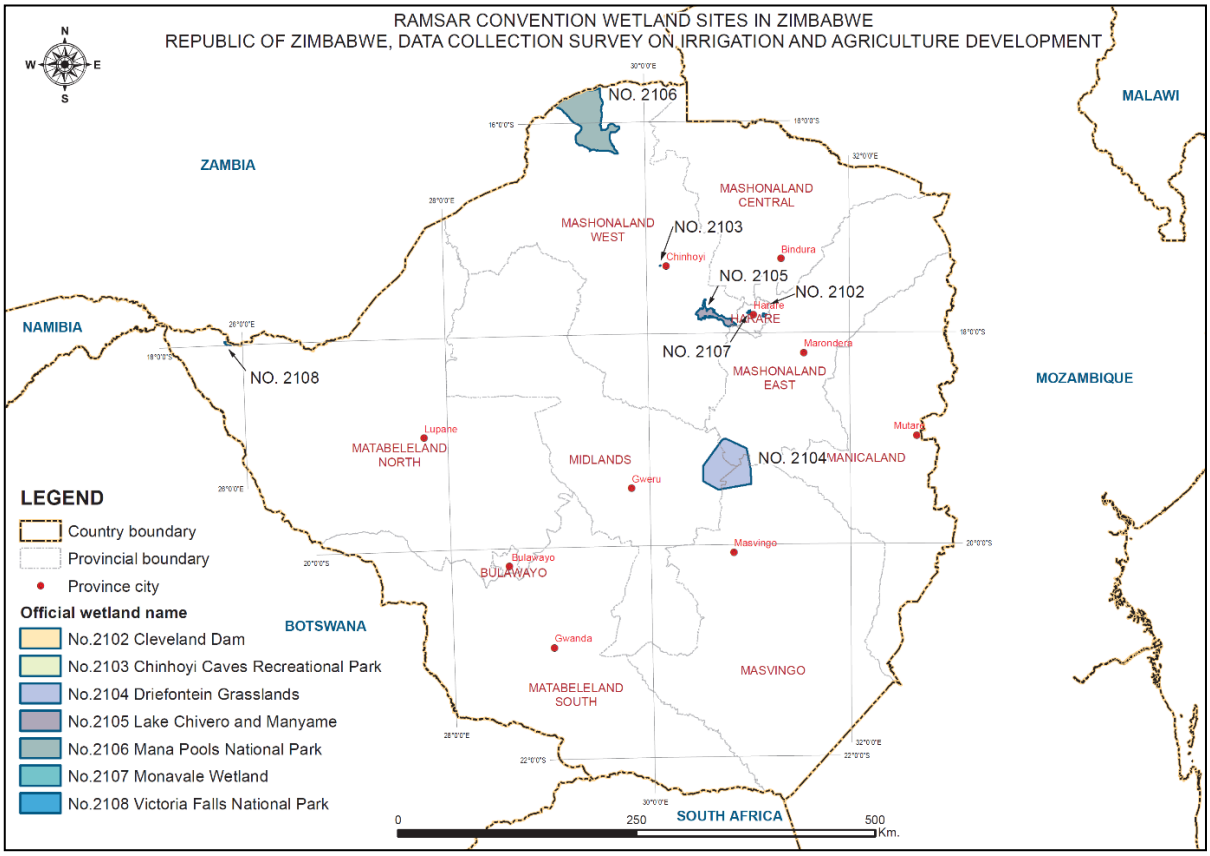


Figure 3.5.2 Location of the Ramsar Convention Wetlands in Zimbabwe

Source: The Survey team based on the information of the Ramsar Convention Secretariat in Web site.

2) Important Bird Area (IBA)

There are twenty sites (about 3,000,000 ha) designated as the IBAs in Zimbabwe. No.6 Chimanimani Mountains (Zimbabwe) (ZW006) is also a designated site of the Alliance for Zero Extinction (AZE). Except for these sites, there is no other sites designated as the Key Biodiversity Areas (KBAs). List of the IBAs in Zimbabwe is summarized in Table 3.5.5 and those locations are shown in Figure 3.5.3.

Table 3.5.5 Important Bird Areas (IBAs) in Zimbabwe

No.	Site Name	Site No.	Area (ha)	Location
1	Nyanga mountains	ZW001	29,000 ha	Manicaland Province
2	Nyanga lowlands/Honde valley	ZW002	11,000 ha	Manicaland Province
3	Stapleford Forest	ZW003	23,000 ha	Manicaland Province
4	Bvumba Highlands	ZW004	25,000 ha	Manicaland Province
5	Banti Forest Reserve	ZW005	1,800 ha	Manicaland Province
6	Chimanimani Mountains (Zimbabwe)	ZW006	21,000 ha	Manicaland Province
7	Haroni - Rusitu junction and Botanical Reserves	ZW007	500 ha	Manicaland Province
8	Chirinda Forest	ZW008	950 ha	Manicaland Province
9	Hwange National Park	ZW009	1,460,000 ha	Motabeleland North Province
10	Chizarira National Park	ZW010	191,000 ha	Motabeleland North Province
11	Batoka Gorge	ZW011	12,000 ha	Motabeleland North Province
12	Middle Zambezi Valley	ZW012	682,500 ha	Mashonaland West Province
13	Robert McIlwaine Recreational Park	ZW013	6,180 ha	Mashonaland West Province
14	Sebakwe Poort	ZW014	3 ha	Midlands Province
15	Wabai Hill (Debshan Ranch)	ZW015	97,857 ha	Mashonaland South Province
16	Matobo Hills	ZW016	300,000 ha	Matabeleland South Province
17	Driefontein grasslands	ZW017	20,000 ha	Masvingo, Midlands and Mashonaland East Province
18	Limpopo - Mwenezi flood-plain and pans	ZW018	70,000 ha	Masvingo Province
19	Mavuradonha Mountains	ZW019	57,500 ha	Mashonaland Central province
20	Save - Runde junction	ZW020	5,000 ha	Masvingo, Manicaland Province
Total			3,014,290 ha	

Source: The survey team based on the information of the Bird Life International Data Zone in Web site.

Locations of the Ramsar sites and IBAs sites are shown in Figure 3.5.3. Most of the sites are located at near the national boundaries.

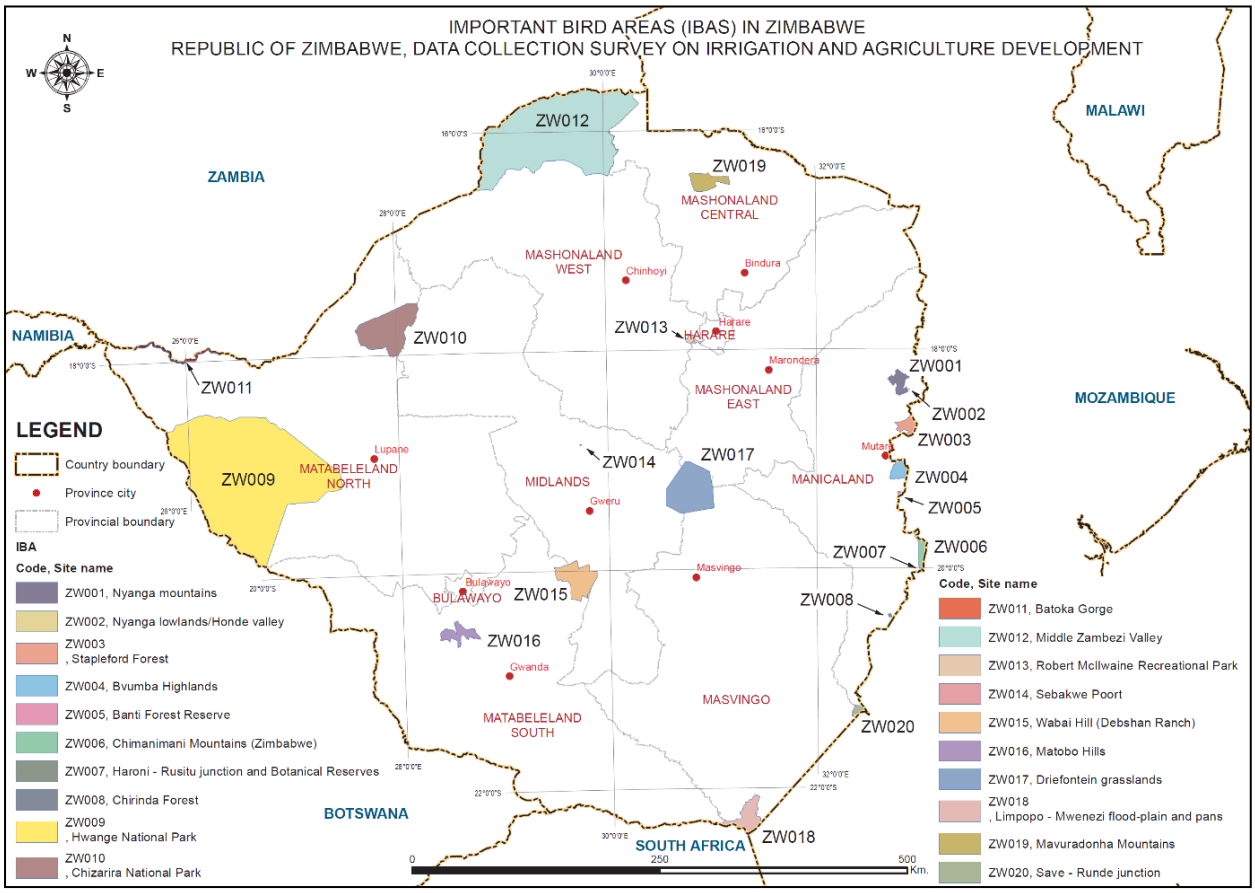


Figure 3.5.3 Location of the Important Bird Areas (IBAs) in Zimbabwe

Source: The survey team based on the information of the Bird Life International Data Zone in Web site.

Many sites of the Ramsar and IBAs as aforementioned are located near national boundaries. Figure 3.5.4 shows the rarity distribution of the species (indicating distribution of rare species in the order of colour of yellow, bright yellow, orange and red from low to high rare degree).

A high degree of rarity is indicated in Manicaland Province, near the Mozambique border, and sites ZW001 to 008 of the IBAs shown in Table 3.5.5 are located in this area.

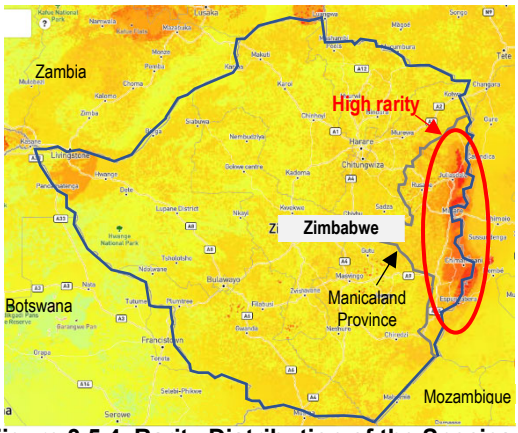


Figure 3.5.4 Rarity Distribution of the Species
Source: The survey team based on the information of IBAT Web Site

3.5.4 Regulations of Sand Extraction and Solid Waste Disposal

(1) Regulation for Extraction of Sand/Gravel Materials

Permission from EMA must be obtained in advance to extraction of sand/gravel materials required for construction works. Contents of the application forms (Application to Extract Clay and Sand Deposit) is shown in Table 3.5.6. Since the extraction potential sites are not designated by EMA, the project must study and propose the extraction site in the application form.

Table 3.5.6 Contents of the Sand Extraction Application Form

No.	Contents	Description
1	Applicant Information	1) Name, 2) Contact, 3) Address, 4) Company Name
2	Site Information	1) Address of the site, 2) Area, 3) Word/ District/ Province, 4) Ownership, 5) Land Category (Communal/ Resettlement/ Urban)
3	Technical Documents (Attachment)	1) Project Summary, 2) Baseline Report, 3) Environmental Management Plan

Source: Application to Extract Clay and Sand Deposit, EMA

(2) Regulation for Solid Waste Disposal

Construction wastes generated during construction works should be disposed properly in accordance with the Environmental Management (Effluent and Solid Waste Disposal) Regulations. The Regulations specify only licensed organization carry out waste treatment. Management procedure for construction wastes should be written in the EIA report (or EMP).

3.5.5 Gap Analysis

The results of the gap analysis between the JICA environmental and social consideration guideline and Zimbabwe's environmental related laws/regulations are shown in Table 3.5.7. The JICA guideline covers the consideration items in more details.

Table 3.5.7 The Result of Gap Analysis between JICA Environmental and Social Consideration Guideline and Zimbabwe's Environmental related Laws/Regulations

Items	JICA Environmental and Social Consideration Guideline	Zimbabwe's Environmental Related Laws/Regulations	GAPs	Policy for filling GAPs
1. Principles	- Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan. (Appendix 1, the JICA Guidelines).	- Environmental Management Act requires the EIA. EIA includes study/ evaluation of environmental impacts, examination of alternatives, mitigation measures and others, and requires to reflect the assessment result to the project planning.	-	-

Items	JICA Environmental and Social Consideration Guideline	Zimbabwe's Environmental Related Laws/Regulations	GAPs	Policy for filling GAPs
2. Information Disclosure	- EIA Reports must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them. - EIA Reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA Reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted. (Section 2.1and the 3rd item of Appendix 2, JICA Guidelines))	- Environmental Management (Environmental Impact Assessment and Ecosystems Protection) Regulations, SI-7 states that EIA report must be written in English, the official language in Zimbabwe, and there must be sufficient consultation with stakeholders. - The regulation also states that EMA has the right to disclose EIA reports. - Environmental Management Act states that EIA reports shall be open for public inspection at all reasonable times.	-	-
3. Public Consultation	- In the case of projects which can cause large scale impacts, JICA encourages project proponents etc. to consult with local stakeholders about their understanding of development needs, the likely adverse impacts on the environment and society, and the analysis of alternatives at an early stage of the project, and assists project proponents as needed. (Appendix 1, JICA Guideline) - In order to have meaningful meetings, JICA encourages project proponents etc. to publicize in advance that they plan to consult with local stakeholders, and to prepare minutes of their meetings after such consultations occur. - Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared. (Section 2.4 and Appendix-2, the JICA Guidelines)	- As mentioned in item 2, EIA report must be prepared with sufficient consultation with stakeholders for reflecting their opinions to the project planning. On the other hand, it is not specified that a record of stakeholder meeting should be made.	Record of stakeholder meeting	A record of stakeholder meeting will be made in accordance with JICA guideline.
4. Impacts to be Assessed	- The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, namely, migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases	- Environmental Management Act states that environment to be assessed in the EIA report should include (a) the natural and man-made resources, physical resources, both biotic and abiotic, occurring in the lithosphere and atmosphere, water, soil, minerals and living organisms whether indigenous or exotic, and the interaction between them, (b) ecosystems, habitats, spatial surroundings and their constituent parts whether natural or modified or constructed by people and communities, including urbanized areas, agricultural areas, rural landscapes, and places of cultural significance, (c) the economic, social, cultural or aesthetic conditions and qualities. The Act also states that EIA report should	Specific items for the impact on social aspects	All assessment items for the impact on social aspects required by JICA guideline will be covered.

Items	JICA Environmental and Social Consideration Guideline	Zimbabwe's Environmental Related Laws/Regulations	GAPs	Policy for filling GAPs
	such as HIV/AIDS, and working conditions including occupational safety. Items to be addressed in the specific project are narrowed down to the needed ones through the scoping process. (Section 2.3, the JICA Guidelines) - In addition to the direct and immediate impacts of projects, the derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects will also be assessed with regard to environmental and social considerations, so far as it is rational. The life cycle impact of a project period is also considered. (Section 2.3, the JICA Guidelines)	cover the direct, indirect, cumulative, short-term and long term effects on the project. On the other hand, any specific items for the impact on social aspects to be assessed are not specified.		
5. Monitoring, Grievance Handling and so on	- Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders. (Section 8.3, the JICA Guidelines) - When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems. (Section 8.4, JICA Guidelines)	- Environmental Management Act specifies that EIA report must include environmental monitoring plan of the project. Project implementer needs to submit a monitoring report quarterly in line with the monitoring plan. - As mentioned on item 2, EIA reports shall be open for public inspection at all reasonable times. On the other hand, the handling of complaints and other problems is not specifically mentioned in the Act.	Grievance handling	Grievance handling procedure will be developed in accordance with JICA guideline.
6. Ecosystem and Biota	- Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests. (Section 6.1, the JICA Guidelines)	- As mentioned in item 4, scope of examination of impacts in EIA report covers ecosystems and habitats.	-	-
7. Indigenous People	- Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses. (Section 8, the JICA Guidelines)	- Considerations on indigenous people are not mentioned in the related laws/ regulations.	Considerations for indigenous people	In case indigenous people are identified in the project area, due consideration will be given.

Source: The Survey team

3.6 RESETTLEMENT AND LAND ACQUISITION SYSTEM

3.6.1 Land Ownership

As mentioned in 2.1.3, agricultural lands in Zimbabwe are classified into Commercial Farms (Large Scale and Small Scale), Resettlement Areas and Communal Lands. Commercial Farms are the lands that have been occupied by commercial farmers since colonial times.

Resettlement Areas are the lands that have been acquired by the GoZ and allocated under the program. The land reform program was carried out in two phases, and the lands acquired and allocated under phase-1 is called Old Resettlement Area. Land acquired and allocated under Phase-2 FTLRP (after 1998) is called as A1 and A2 Farms. Land ownership of Resettlement Areas belongs to the State.

Communal Lands, formerly known as Tribe Trust Lands, are the lands where African origin people were forcibly relocated and settled around 1930. Land ownership of Communal Lands belongs to the State.

While land ownership of both Resettlement Areas and Communal Lands belongs to the State, the reality of individual use right differs by each land category. In case of A1 and A2 Farms, individual right for land use is permitted by a government offer letter. For A2 Farm, 99-year lease right is granted to individual or group.

On the other hand, due to the historical origins of the Old Resettlement Area and Communal Lands, distribution of individual land use on those lands has been managed by traditional customs. On the ground, traditional leaders of the region are authorized to allocate land use of local people under the supervision of the Rural District Council (RDC).

Table 3.6.1 Land ownership in Zimbabwe (Except for Urban Area)

Category	Land Type	Type of Lands	Ownership	Form of Use
Commercial Farms		- Large Scale Commercial Farms - Small Scale Commercial Farms	Individual	Private
Resettlement Areas	A1, A2 Farms	Resettlement lands allocated under the FTLRP (Phase-2 programme)	State	A1: Personal use and occupation are approved by the government A2: Lands are leased by the government (99 years)
	Old Resettlement Area	Resettlement lands allocated under the old resettlement programme (Phase-1 programme)	State	Traditional Leaders allocate land use of individual farmers under the supervision of RDC.
Communal Land		Agricultural lands / Residential lands allocated as Communal Lands		

Source: The Survey team

Table 3.6.2 shows the main laws and regulations related to the land system in Zimbabwe. The Land Commission Act regulates the acquisition of land by the government and the management of resettlement land of A1 and A2 Farms. The Communal Land Act regulates the management of Communal Lands. The Traditional Leaders Act provides for the appointment and empowerment of traditional leaders (Chiefs, Headmen and Village leaders), and the procedure for allocation of land by traditional leaders with the permission by RDC.

Table 3.6.2 Main Laws and Regulations related to the Land System in Zimbabwe

Laws, Regulations	Latest Revision	Main Contents
Land Commission Act (Chapter 20:29)	2018	- Acquisition and disposal of land by the government - Settlement of persons on, and the alienation of, agricultural land - Control of the subdivision and lease of land for farming or other purposes - Repeal the Agricultural Land Settlement Act [Chapter 20:01]
Land Acquisition Act (Chapter 20:10)	2004 *(Complied in the Land Commission Act.)*	- Empower the President and other authorities to acquire land and other immovable property compulsorily in certain circumstances - Regulating compensation for the acquisition of land
Communal Land Act (Chapter 20:04)	2002	- Definition, regulation of the Communal Land - Permission of the land use and occupation by RDC - Cooperating with traditional leaders for land allocation considering traditional customs
Traditional Leaders Act (Chapter 29:17)	2001	- Role and responsibility of traditional leaders - Providing authorization of Chief, Headman, Village leaders, as the traditional leaders - Allocation of land by traditional leaders and permission from (RDC

Source: The Survey team

In the Traditional Leaders Act, the village shall be established in case of new irrigation development and land shall be used and managed in accordance with this Act. Next page is an example of actual land allocation in new irrigation development.

[The procedure of land allocation under new irrigation development project]

The administrative divisions of Zimbabwe are, in descending order, Province - District - Ward, but the traditional land divisions of Province - Chief - Village is still function (see Figure 3.6.1). This traditional division is the basis for the distribution of beneficiary area under new irrigation development.

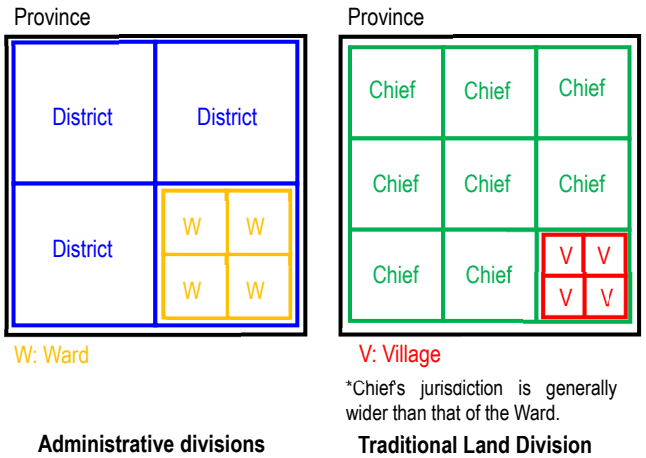


Figure 3.6.1 Administrative Divisions and Traditional Land Divisions
Source: The Survey team

When an irrigation development project is planned in village A, the Chief who has jurisdiction over village A holds a meeting not only with village A but also with the heads of villages B to D under his jurisdiction. Also, the Chief invites people from villages B to D other than A to migrate to the irrigated area (see Figure 3.6.2). Therefore, the beneficiaries of the irrigation development will not be the owners of the plots to be irrigated, but will be determined by recruitment. Due to this procedure, beneficiary farmers and farmland area per beneficiary farmer will not be fixed until the decision to the migration.

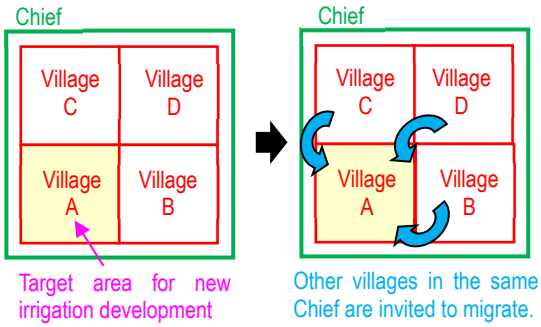


Figure 3.6.2 Allocation of Beneficiary Area under Irrigation Development Project
Source: The Survey team

The DOI has conducted an economic analysis and found that a minimum of 0.5 ha of field area per beneficiary household is required to meet food self-sufficiency and pay the required O&M costs under irrigated agriculture, and has set this as the minimum allocation (although the DOI is considering changing this to 1.0 ha/beneficiary household, as many cases have been identified where even 0.5 ha is not sufficient to get enough food and pay the required O&M fee). However, in case if there are a large number of applicants for resettlement, the Chief may allow all applicants to resettle, in that case the area of irrigated plots allocated per beneficiary household may be less than 0.5 ha.

For example, a centre pivot was introduced by CESVI in the Murove district of Masvingo Province. However, due to the large number of applicants and the Chief's decision to allow all applicants to migrate, the total area of plots per beneficiary household is about 0.2 ha. According to the interviews with the beneficiary farmers, their food intake (harvest from their own plots plus purchases from the market) has increased, but not enough to meet their needs (see Table 3.6.3). The irrigation scheme does not yet charge O&M fees for irrigation facilities and it is not clear whether each beneficiary farmer will be able to contribute sufficient O&M costs.

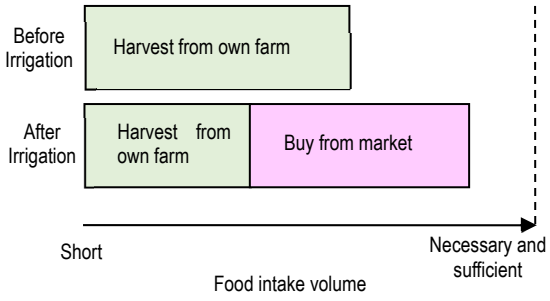


Figure 3.6.3 Diagram of Changes in Food Intake Volume before and after Irrigation (Example from Murove Irrigation Scheme)
Source: The Survey team

3.6.2 Compensation for the Resettlement in Public Project

The gap analysis described in the Guruve Remedial Resettlement Action Plan (RAP) 2018, prepared by the WB's Zimbabwe National Water Project, is shown in Table 3.6.3. The plan states that the WB's Operational Policy (OP 4.12) is to be applied as the compensation policies for resettlement and land acquisition that are not covered by Zimbabwean law.

Table 3.6.3 The Gap Analysis in the Resettlement Action Plan of the World Bank Project

No.	Item	Gap between WB's OP4.12 and Zimbabwean Law
1	Compensation for Loss of Asset	OP4.12 includes eligibility for compensation of illegally built structures, including those of squatters as long as the area was occupied or used prior to the established cut-off date. In Zimbabwean law, Project Affected Persons (PAPs) would not be entitled to compensation In Zimbabwe.
2	Compensation Based on Land Status	Zimbabwe law requires the consideration of different value of land based on the status, i.e. whether a landholder has formal title and property is located in a commercial market versus land that is under traditional land tenure. The WB policy does not distinguish between such different aspects of land status.
3	Compensation for Loss of Land	The WB policy has a preference of land for land compensation. In Zimbabwean law, the preference is for land for land compensation for customary land transaction, but cash compensation in urban areas.
4	Timing of Compensation	The WB policy requires resettlement as an upfront activity; resettlement compensation must be completed ahead of project impact. Zimbabwean low does not clearly stipulate the timing of compensation.
5	Livelihood Restoration	The WB policy requires adequate resettlement assistance and rehabilitation of livelihoods to restore socio-economic standard of PAPs. Zimbabwean law does not define the extent of resettlement or livelihood restoration required.
6	Project Inclusiveness	The WB policy requires that PAPs are integral to project design and are seen as project beneficiaries. Zimbabwean law does not have similar requirements.
Policies in the Resettlement Action Plan of the Zimbabwe National Water Project (WB)		
The Zimbabwe National Water Project follows the policy of WB (OP 12.4) and considers following points: - Compensation of customary land will be made on market values, which would be equal to or greater than replacement values as opposed to seeing customary land as a free commodity. - The Project will recognize entitlements of all PAPs who are adversely impacted by Project activities regardless of rights, title to structures or any other fixed or moveable assets or access to such assets. - Eligible PAPs are entitled to full compensation for replacement cost and any associated rehabilitation assistance as defined in the resettlement action plan; the ombudsman office has legislative oversight of any grievances that may arise in regard to ZINWA's responsibilities under the Project. - The Resettlement Action Plan (RAP) census will establish formal ownership where relevant as well as cohabitation to ensure that a gender-balanced approach is applied in accordance with the principle set out for attention to vulnerable groups. - The project will ensure, as part of the consultation process, that all community leaders, whether traditional or government officials, are included and informed.		

Source: The Survey team based on the information of the Guruve Remedial Resettlement Action Plan (RAP) 2018, Zimbabwe National Water Project

CHAPTER 4 INSTITUTIONAL ARRANGEMENTS OF THE AGRICULTURE AND IRRIGATION SECTOR

4.1 CURRENT STATUS OF INSTITUTIONAL DEMARCATION ON IRRIGATION DEVELOPMENT PROJECTS

The actual implementation structure of irrigation development (survey, plan, design and construction supervision) including dam development is like upper figure in Figure 4.1.1. Among the water body facilities, large dams are developed by ZINWA and small dams are developed by DOM. On the other hand, irrigation schemes are developed by DOI and transferred to IMC after completion of scheme construction. Pumps are managed by ZINWA or DOM if they are installed at the same time as the dam construction, or by IMC if they are installed by IMC after the dam construction.

IMC operates and maintains the irrigation scheme. If a serious situation happens and its required measure is beyond IMC's capacity, DOI supports IMC. After transferring irrigation scheme from DOI to IMC, AGRITEX starts supporting IMC, such as training for beneficiary farmers such as farming activities.

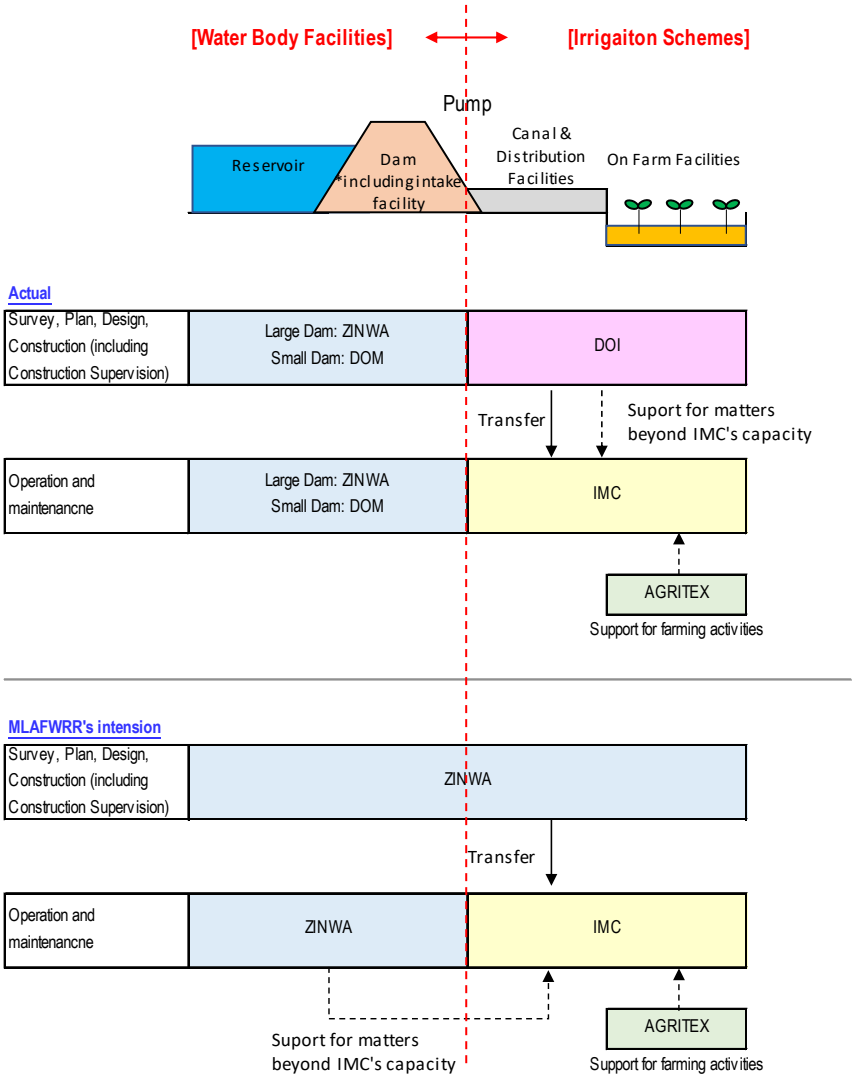


Figure 4.1.1 Institutional Demarcation on Irrigation Development

Source: The Survey team based on interview to DOI, DOM and ZINWA

On the other hand, MLAFWRR intends to establish a system in which ZINWA will implement the water source facilities and the irrigation scheme as well, as shown in the lower figure in Figure 4.1.1. ZINWA will continue to implement the water source facilities, and the irrigation scheme will be transferred from ZINWA to IMC (although ZINWA will support for the matters beyond IMC's capacity). Although a number of dams have been constructed in Zimbabwe, the stored water under many of them has not been used effectively due to the lack of irrigation schemes (see 6.4.1). MLAFWRR intends to put in place the above arrangements to improve this situation.

This kind of gap between actual and the Ministry's intension in institutional demarcation on irrigation development is due to institutional restructuring history (see Figure 4.1.2). Originally, ZINWA and DOI

were established under the different agencies, ZINWA was established as a parastatal agency under Ministry of Water and Rural Resettlement, whilst DOI was established as one of the blanch sections of AGRITEX, not a department. In 2004, DOI was stated under Ministry of Water Resources, and therefore both ZINWA and DOI were positioned under the same ministry, thus creating a single agency to implement the whole chain of development from water supply facilities to irrigation schemes. However, in 2008, ZINWA was positioned under a ministry responsible for water resources and DOI was under ministry responsible for agriculture again.

Institutional restructuring had been done continuously after 2008 and present MLAFWRR was established in 2020 finally. ZINWA and DOI were positioned under the same ministry again.

ZINWA, however, did not have capacity to conduct irrigation scheme development, since ZINWA had almost no irrigation engineers as they have developed only water body facilities. As of July 2021, the situation is almost same since only one year has passed after establishment of the present ministry, and therefore ZINWA still conducts water body facilities only and DOI conducts irrigation schemes only, as same as before.

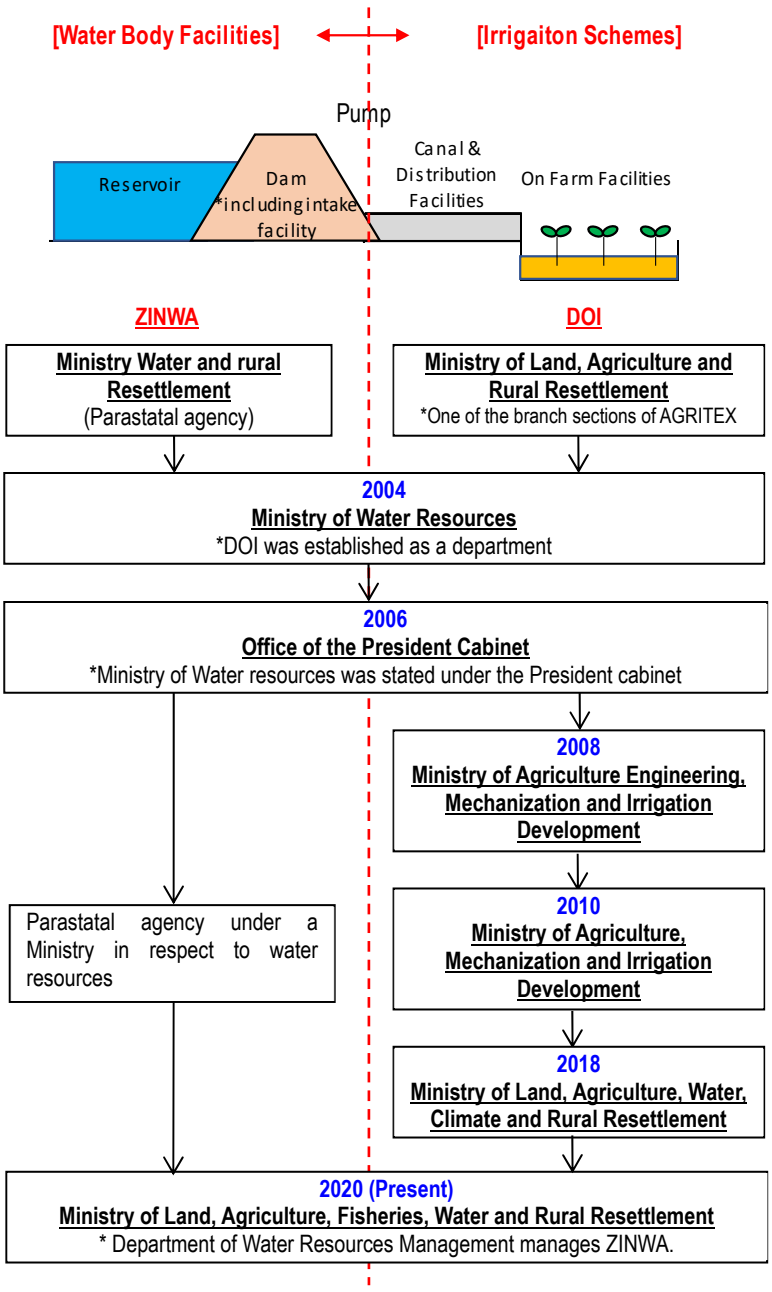


Figure 4.1.2 Institutional Restructuring (ZINWA and DOI)

Source: The Survey team based on interview with DOI, DOM and ZINWA

In future, ZINWA's capacity on irrigation development would be strengthened and ZINWA will be an agency which can conduct all the works related to irrigation development. On the other hand, DOI, according to the interview, does not have any ideas about their mandate after transferring the right and mandate in respect to irrigation development to ZINWA.

4.2 MINISTRY OF LAND, AGRICULTURE, FISHERIES, WATER AND RURAL RESETTLEMENT (MLAFWRR)

The organogram of MLAFWRR is shown as Figure 4.2.1. The name of ministry includes "Fisheries" but fisheries is still one of the sections under Livestock Production Department.

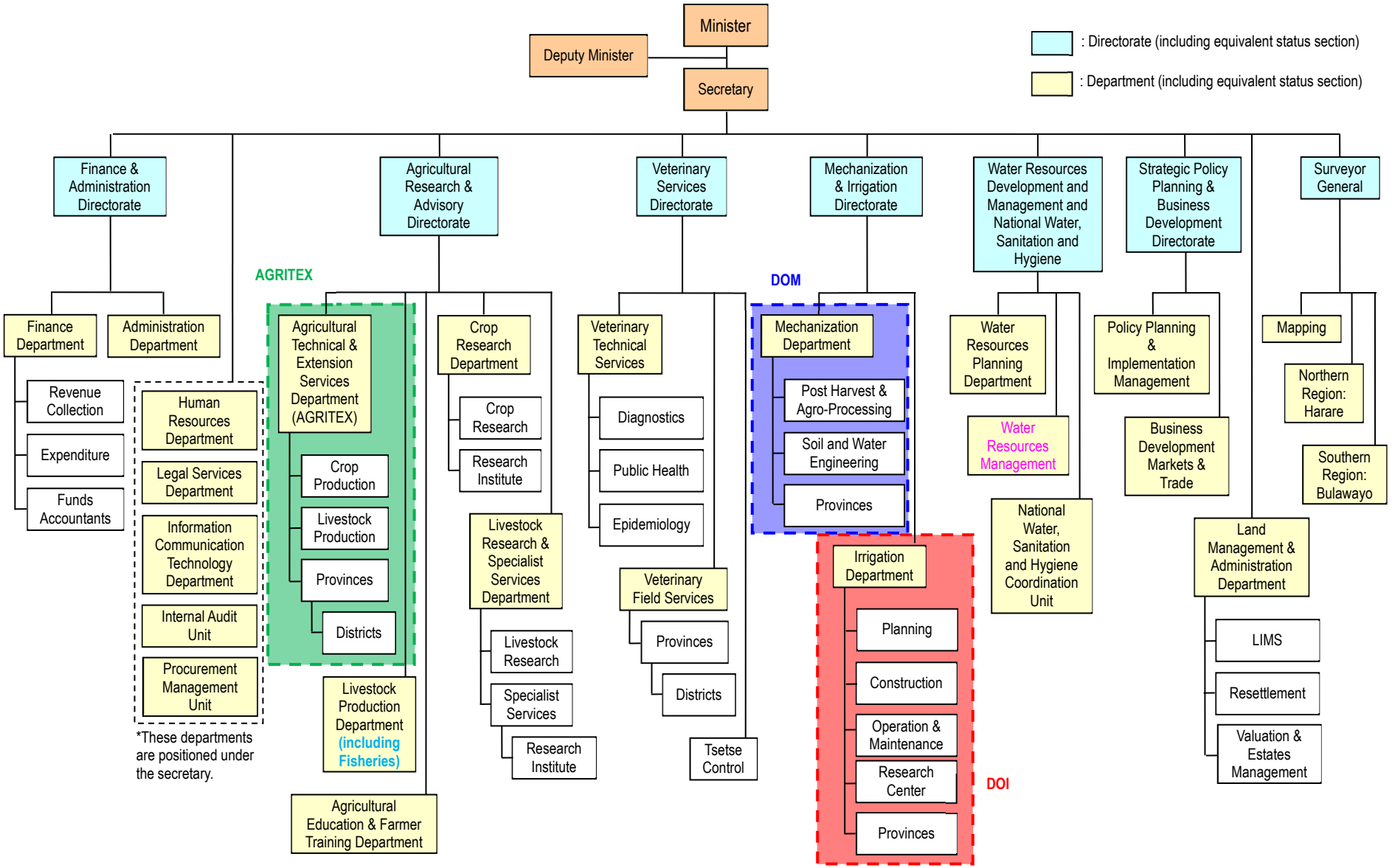


Figure 4.2.1 Organogram of Ministry of Land, Agriculture, Fisheries, Water and Rural Resettlement

Source: The Survey team based on a document provided by DOI

4.2.1 Department of Irrigation (DOI)

(1) Mandates of Headquarter

The mandates of DOI are survey, plan, design, construction supervision, and O&M of the irrigation scheme development projects. DOI headquarter in Harare has four sections and their main mandates are shown in Table 4.2.1. In addition to these mandates, headquarter conducts the management of projects/programmes and support for Provincial DOI.

Table 4.2.1 Mandates of Sections under DOI Headquarter

Section	Main Mandates
Planning	Feasibility study of irrigation scheme development
Construction	Detail design and tendering of irrigation facilities (not only civil works but also pump facilities)
O&M	Formulation of O&M plan, training for IMC about O&M
Research Center	Addressing of cross-sectional challenges and demonstration of new technology

Source: The Survey team based on interview with DOI

(2) Structure of Provincial DOI and Relation with the Headquarter

DOI has its provincial offices in 8 provinces, excluding Harare and Bulawayo. Figure 4.2.2 illustrates a typical organogram of a Provincial DOI. Basically, provincial DOI has one Provincial Irrigation Engineer, 6 on average of Project Engineers and some of Irrigation Technicians. The main works of Provincial Irrigation Engineers is to manage the Provincial DOI. Project Engineers conduct survey, plan, design, construction supervision, and O&M of the irrigation scheme development projects, and Irrigation Technicians support Project Engineers. As its name suggests, Project Engineers are assigned by projects, not by areas.

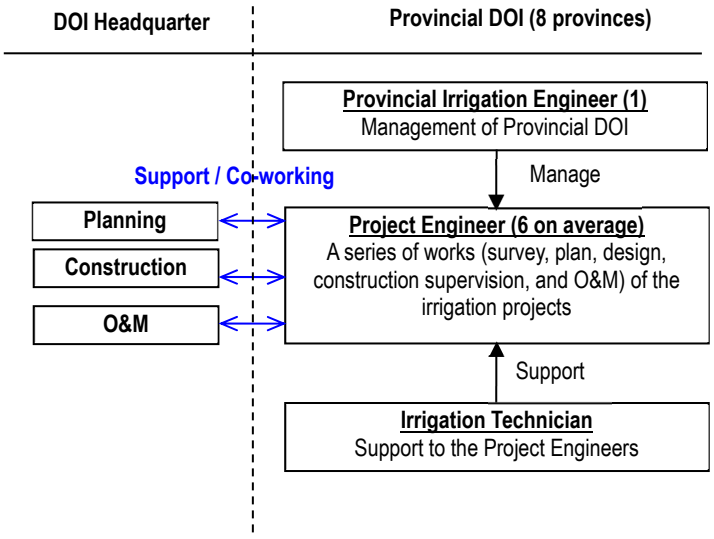


Figure 4.2.2 Typical Organogram of Provincial DOI and Its Relation with the Headquarter

Source: The Survey team based on interview with DOI

The main actors of the irrigation scheme development are Project Engineers of the Provincial DOI. As already discussed, Project Engineers conduct a series of irrigation scheme development, from survey to O&M, and their position is very close to the beneficiary farmers. Since headquarter also has survey, construction, and O&M sections, their works is support to and co-work with the Project Engineers. If work volume is over the capacity of Provincial DOI and headquarter, some works are outsourced, and they manage this outsourced works as well.

Principally, formulation of irrigation scheme development project is based on the request from the beneficiary farmers. Beneficiary farmers submit the application to Irrigation Technicians, whose position is closest to the beneficiary farmers, and Irrigation Technicians with Project Engineers assess the validity of the application. If an application is judged as validate, that application is delivered to headquarter through Provincial Irrigation Engineer. The works of the Provincial DOI is not only just assess the application. They know about natural and socio-economic conditions of the project sites, and therefore they examine if it is possible to compile some application as one project in some cases.

4.2.2 Department of Mechanization (DOM)

(1) Mandates of Headquarter

The mandates of DOM are 1) Agricultural mechanization, 2) Post harvest and processing, and 3) Development of small dams. DOM headquarter in Harare has two sections and their main mandates are shown in Table 4.2.2. In addition to these mandates, headquarter conduct the management of projects/programmes and support for Provincial DOM.

Table 4.2.2 Mandates of Sections under DOM Headquarter

Section	Main Mandates	
Post Harvest and Agro-Processing	1) Agricultural mechanization 2) Post harvest and processing	- Procurement, lease and repairing of tractors, harvesters as well as some attachments such as boom sprayer
Soil and Water Engineering	3) Development of small dam	- Survey, plan, design, construction supervision, and O&M of dams with height less than 15m - Watershed conservation

Source: The Survey team based on interview with DOM

In a project namely "More Food Project" under Post Harvest and Agro-Processing section, many agricultural machineries were procured from Belarus and DOM leases to the farmers. Although the owner of the machineries is DOM, number of branch offices and officers of DOM is limited to implement the leasing works and therefore leasing works are outsourced to a bank which has widely distributed branch offices, especially in the rural area. The bank carries out the contract about leasing agreement with farmers and collection of rental fee. The collected rental fee is transferred from bank to DOM after deduction of commission and utilized for repairing works by DOM. DOM is the responsible agency in respect to the repairing works and farmers request DOM the repairing directly, since any works related to repairing works are out of bank's works.

Soil and Water Engineering section develops small dams. In "Water Act", definition of small dam is 1) dam height is from 8 m to 15 m or storage capacity is less than 500,000 m^3 (see 3.4.1). However, this section develops dams with its height less than 8 m. The section develops dams with its height less than 8 m by themselves but develops dams with its height from 8 m to 15 m through consultation with ZINWA.

This section also implements watershed conservation works, particularly works to mitigate sedimentation volume produced from farmlands and/or bare lands in the catchment area, since many of dams loss a part of its storge capacity due to sediments provided from its catchment area. The main work contents are 1) Construction of drainage canals in the farmlands in the catchment area (see Figure 4.2.3) and 2) Arrangement of gabion works on the gully erosion. Although, forestation may produce same effect as these measures, forestation is the mandate of Forestry Commission under Ministry of Environment, Climate, Tourism and Hospitality Industry.

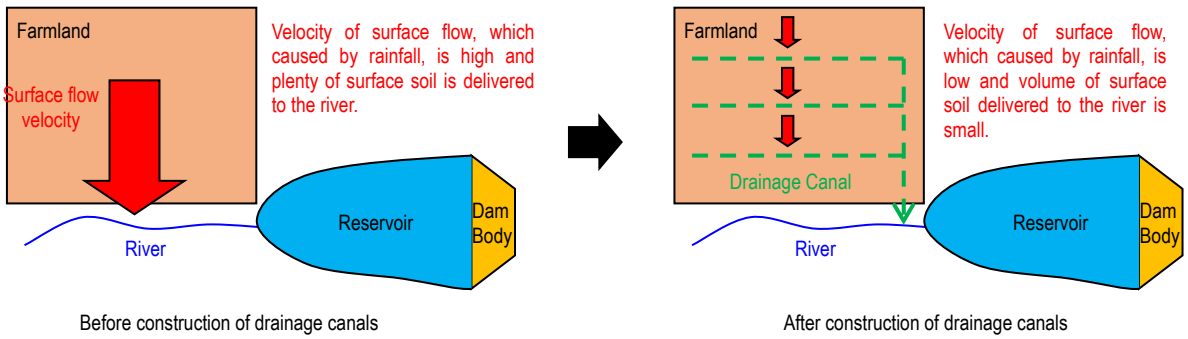


Figure 4.2.3 Watershed Conservation Works by DOM

Source: The Survey team based on interview with DOM

(2) Structure of Provincial DOM and Relation with the Headquarter

Typically, Provincial DOM has from 8 to 10 staff members consist of one Provincial Mechanization Engineer, some Engineers, Technicians, and Technical Assistants. The main actors of mechanization and small dam development are Engineers of the Provincial DOM. Since required engineering skill for mechanization and dam development are quite different, a Provincial DOM has both mechanization and civil works specialists. In respect to the small dam development, an Engineer carries out a series of works, survey, plan, design, construction supervision, and O&M, and headquarter supports them. Additionally, each Provincial DOM has at least one watershed conservation specialist.

4.2.3 Department of Agricultural Technical & Extension Services (AGRITEX)

The main mandates of AGRITEX are 1) Training to farmers about farming activities, livestock and agro-business, 2) Promotion of new technology for farmers, and 3) Promote farmers' understanding for agricultural policy and strategies.

AGRITEX has headquarter in Harare, provincial offices, and district offices. The main mandates of headquarter are policy planning, research and development, development of training materials, and management of projects/programmes. Whilst, mandate of district offices is instruction to the farmers and provincial offices' one is to act as back stopper of the district offices.

The headquarter has crop experts (tobacco, cotton, oil plants, pulse, grain, potato and etc), livestock experts (cow/pig, poultry/sheep/goat, aquaculture), agro-economists, extension experts, horticulture experts, and land use experts. On the other hand, provincial offices have Provincial Extension Director, Agronomist, Livestock Experts and Horticulture Experts, also district offices have District Extension Director, Agronomist, Livestock Experts, Horticulture Experts and Extension Officers (65 - 200 extension officers/district).

4.3 ZIMBABWE NATIONAL WATER AUTHORITY (ZINWA)

(1) Main mandates

ZINWA is an authority under Department of Water Resources Management, MLAFWRR. The mission of ZINWA is "To sustainably deliver quality water to all whilst making strategic water infrastructure investments that facilitate human and economic development". The mandates of ZINWA are survey, plan, design, construction supervision, and O&M of any water related projects in Zimbabwe, such as large dam, domestic water including wells and treatment facilities, irrigation water, industry water, and mining water. Also, ZINWA has been conducting hydrological observation (meteorological observation is the mandate of MSD, Ministry of Environment, Climate, Tourism and Hospitality Industry).

In respect to domestic water in the rural cities, ZINWA manages a series of works 1) water body (dam), 2) delivering system from dam to treatment plant, 3) treatment plant, 4) delivering system to individual housings, 5) charging water fee for users, and 6) collection of water fee. While in the urban cities, ZINWA conducts 1) water body (dam) and 2) delivering system from dam to treatment plant only, and water company established by cities are responsible for management of facilities after treatment plant.

In respect to the irrigation development, Engineering and Hydrological Service Division is the responsible section of large dams' survey, plan, design, construction supervision, and O&M. Also, irrigation scheme development, as already discussed, is becoming their mandate. This was a measure expected to improve present dam utilization situation. There were many dams constructed but its stored

water had not been utilized for irrigation since no irrigation facilities have not been constructed (see 6.4.1). It is expected if dam and irrigation scheme are developed at the same time, irrigation scheme would be functional just after completion of dam construction. At present, however, ZINWA has almost no irrigation engineers and actually DOI is still dealing the irrigation scheme development.

(2) Blanch Offices

ZINWA has headquarter in Harare and blanch offices by watersheds, Gwayi, Manyame, Mazowe, Mzingwane, Sanyati, Save, Runde and Manyame watersheds, not by provinces. The mandates of headquarter are policy planning, projects/programmes management, and procurement. Whilst blanch offices' one is technical support and hydrological data provision to Catchment/Sub-Catchment Committee (see 3.4.1). If there is no Sub-Catchment Committee, a ZINWA blanch office can execute Sub-Catchment Committee's function on behalf of the Committee, such as water fee collection and issuing some approval.

4.4 IRRIGATION MANAGEMENT COMMITTEE (IMC)

IMC is a corporative consists of beneficiary farmers under the irrigation scheme. Its mandate is O&M of irrigation schemes. Since there is no registration system of IMC, IMC is like a self-help group. However, it is almost the official group as its constitution shall be approved by RDC. The member of IMC shall pay 50 USD/ha to IMC as water fee. IMC members' salary, irrigation facility rehabilitation fee, and water fee for ZINWA are covered by this water fee from the members. According to the interview with DOI, almost all the farmers pay their water fee to IMC (payment rate is almost 100%) since ZINWA stops providing water if water fee from IMC is not enough.

4.5 ENVIRONMENTAL MANAGEMENT AGENCY (EMA)

EMA is an agency established under the Environmental Management Act of Zimbabwe. EMA is responsible for the regulation and control of the sustainable management of the country's natural resources and environmental protection. EMA consists of three divisions: Environmental Protection, Environmental Management Services, and Finance Administration. The Environmental Planning and Monitoring Department under the Environmental Management Services Division is in charge of EIA review for the projects.

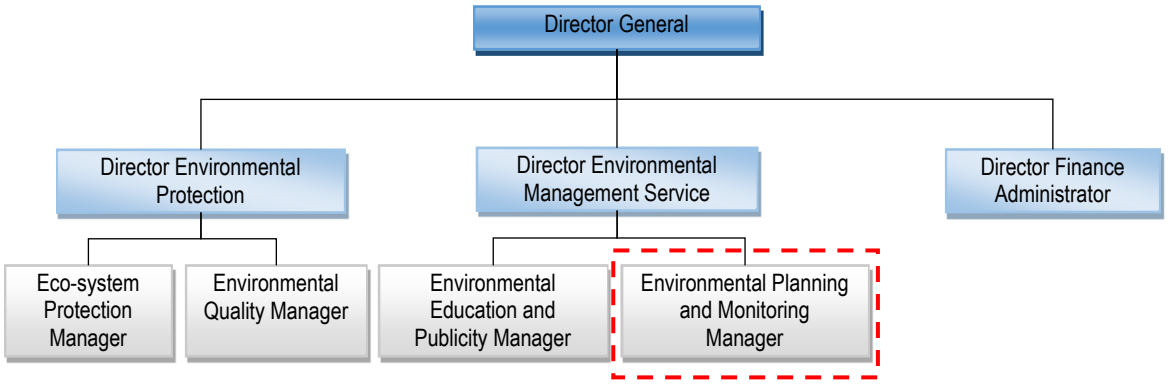


Figure 4.5.1 Organogram of EMA
Source: EMA Website

CHAPTER 5 SURVEY ON SIX DAMS CONSTRUCTED UNDER THE "PROJECT ON MEDIUM SIZE DAMS IN MASVINGO PROVINCE"

5.1 OUTLINE OF SIX DAMS

Specification of six target dams and those locations are shown in Table 5.1.1 and Figure 5.1.1 respectively.

Table 5.1.1 Specification of the Target Six Dams

Dam Name			Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja
District			Masvingo	Mwenezi	Bikita	Bikita	Zaka	Gutu
Communal Land			Nyajena	Matibi No.1	Bikita	Matsai	Ndanga	Gutu
River			Mmedzi	Nusaverema	Chinyamatumwa	Chenyere	Musuche	Mutora
Catchment Area (km2)			41.9	131.6	16.4	27.2	31.1	52.8
Annual Yield (MCM)			2.891	4.454	1.689	1.306	3.349	4.171
Water Level	Design flood level (EL.m)		532.0	682.5	752.5	665.5	647.0	1,150.0
	Full water level (EL.m)		529.0	680.0	751.0	664.0	644.0	1,149.0
	Dead water level (EL.m)		518.5	675.0	741.0	655.5	633.0	1,143.0
Submerged Area (km2)			1.299	2.504	0.471	0.356	0.711	0.644
Storage Capacity	Reservoir Yield (MCM)		1.012	0.757	0.642	0.313	1.298	0.659
	Total (MCM)		5.840	7.526	2.338	1.546	3.238	2.082
	Effective (MCM)		5.672	6.653	2.255	1.453	3.132	1.831
	Dead (MCM)		0.168	0.873	0.083	0.093	0.106	0.251
Specification	Dam type		Zone Type fill dam	Zone Type fill dam	Zone Type fill dam	Zone Type fill dam	Zone Type fill dam	Zone Type fill dam
	Crest Level (EL.m)		533.2	683.7	753.7	666.7	648.2	1,151.1
	Non-overflow crest level (EL.m)		532.7	683.0	753.0	666.0	647.5	1,150.5
	Basement level (EL.m)		512.5	666.0	732.0	646.0	626.5	1,130.5
	Height (m)*		18.8	12.7	18.8	18.4	19.3	18.7
	Crest length (m)		460	1,700	580	700	625	920
	Crest width (m)		6.0	6.0	6.0	6.0	6.0	6.0
	Upstream slope angle	Upper portion	1:2.0	1:2.25	1:2.0	1:2.0	1:2.0	1:2.0
		Lower portion	1:2.25	1:2.25	1:2.25	1:2.25	1:2.25	1:2.25
	Down stream slope angle	Upper portion	1:1.8	1:2.0	1:1.8	1:1.8	1:1.8	1:1.8
		Lower portion	1:2.0	1:2.0	1:2.0	1:2.0	1:1.8	1:2.0
	Core zone upstream slope angle		1:0.15	1:0.15	1:0.15	1:0.5	1:0.5	1:0.5
	Core zone downstream slope angle		1:0.15	1:0.15	1:0.15	1:0.15	1:0.15	1:0.15
	Embankment volume (m3)		160,400	23,300	186,400	220,900	192,800	164,300
Spillway	Crest Type		Non-gate crest	Non-gate crest	Non-gate crest	Non-gate crest	Non-gate crest	Non-gate crest
	Design flood discharge (m3/s)		415	835	163	228	343	349
	Specific flow (m3/s/km2)		9.90	6.34	9.94	8.38	11.03	6.61
Intake	Maximum intake volume (litter/sec)		76	54	74	23	151	49
Irrigation Type			Gravity	Gravity	Pump	Gravity	Pump	Gravity
Pump	Type		-	-	Double suction volute	-	Double suction volute	-
	Design discharge (litter/sec)		-	-	74	-	151	-
	Lift (m)		-	-	28.5	-	43	-
Canal	Type		Concrete flume	Concrete flume	Steel Pipe	Concrete flume	Steel Pipe	Concrete flume
	Maximum discharge (litter/sec)		76	54	74	23	151	49
	Length (m)		7,940	5,600	870	800	860	4,720
	Diameter (mm)		-	-	300	-	400	-
Night Storage	Capacity (m3)		6,500	4,600	4,300	1,400	8,700	4,300
	Depth (m)		2.0	2.0	2.0	2.0	2.0	2.0
	Scale (m)		70×70	61×61	59×59	44×44	79×79	59×59
Beneficially Area	Farmland Area (ha)		70.0	44.0	50.0	21.0	100.0	51.0
	Irrigated Area (ha)		51.1	36.2	34.7	15.2	70.5	33.3
Benefitted households	Population)		2,800	2,590	1,610	570	3,930	1,710
	Livestocks (LSU)		2,430	1,800	2,000	790	3,000	1,500

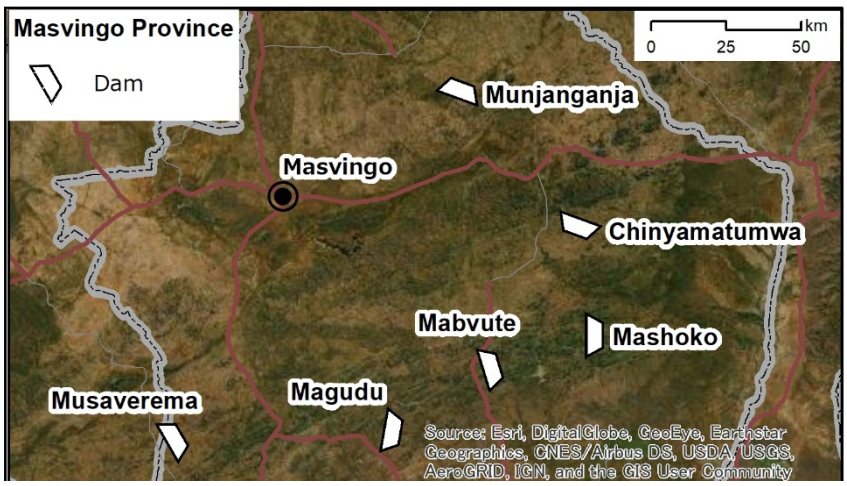


Figure 5.1.1 Location of Six Target Dams

5.2 SURVEY POLICY

The procedure of the survey on the target six dams is shown as Figure 5.2.1. Firstly, field survey to identify deteriorations/damages (and those signal) is carried out and examination on the found deteriorations/damages if they already affect the safety/stability/operation of the facilities is conducted. When field survey is conducted, existing farming situation is surveyed as well. Also, examination on the found deteriorations/damages if they expand and affect the safety/stability/operation of the facilities in the future is carried out as well.

The deteriorations/damages found are evaluated and categorized into three ranks as shown in Table 5.2.1, depending on the timing when the identified deteriorations/damages affect the safety/stability/operation of the facilities. In respect to deteriorations/damages which are already affecting the safety/stability/operation of the facilities or are feared to affect them in the near future (A rank), an "Emergency Repairing Plan" is prepared as an urgent response.

On the other hand, in respect to deteriorations/damages which are not affecting the safety/stability/operation of the facilities at present but may affect them in the long term (B rank), a "Dam Improvement Plan" is prepared as a mid-term and long-term rehabilitation plan. However, the deteriorations/damages which are small and do not require large scale rehabilitation measures are to be rehabilitated through daily/periodical maintenance works by Zimbabwean side and not included in the target for "Dam Improvement Plan". Additionally, change of environment surrounding the six dams in the first 30 years after the construction, especially changes in the social and natural conditions, and challenges in O&M are grasped. Any measures to address these challenges are included in the "Dam Improvement Plan".

After preparation of "Dam Improvement Plan", scoping, a preliminary assessment for environmental and social consideration, is carried out and environmental category is evaluated.

Table 5.2.1 Evaluation Ranks of Deteriorations/Damages Found

Rank	Evaluation Standard
A	Deteriorations/damages that are already affecting the safety/stability/operation of the facilities or are feared to affect them in near future.
B	Deteriorations/damages that are not affecting the safety/stability/operation of the facilities at present but may affect them in the long term.
C	No deteriorations/damages or no signal of them

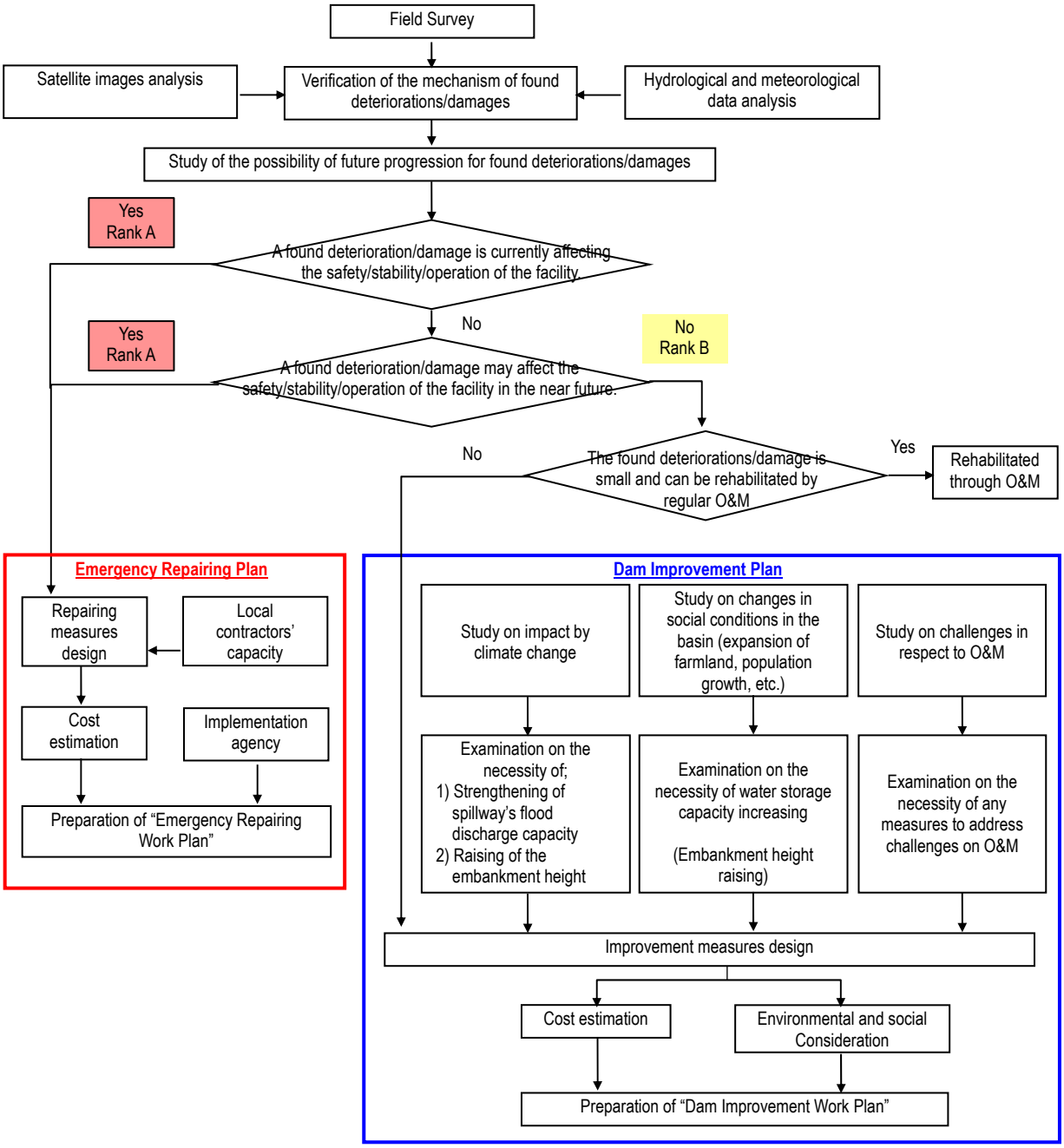


Figure 5.2.1 Procedure of the Survey on Six Dams

The followings are the results of field survey and study on the found deteriorations/damages evaluated as A or B only, which need any repairing works (Refer to Appendix-1 for full survey results, including deteriorations/damages evaluated as C).

5.3 CURRENT STATUS AND DETERIORATION/DAMAGE SITUATIONS OF THE TARGET DAMS

5.3.1 Magudu Dam

(1) Current Status

1) Summary of deteriorations/damages on the facilities

The locations of deteriorations/damages found on Magudu Dam are shown in Figure 5.3.1, and the summary of the evaluation results of each deteriorations/damages are shown in Table 5.3.1

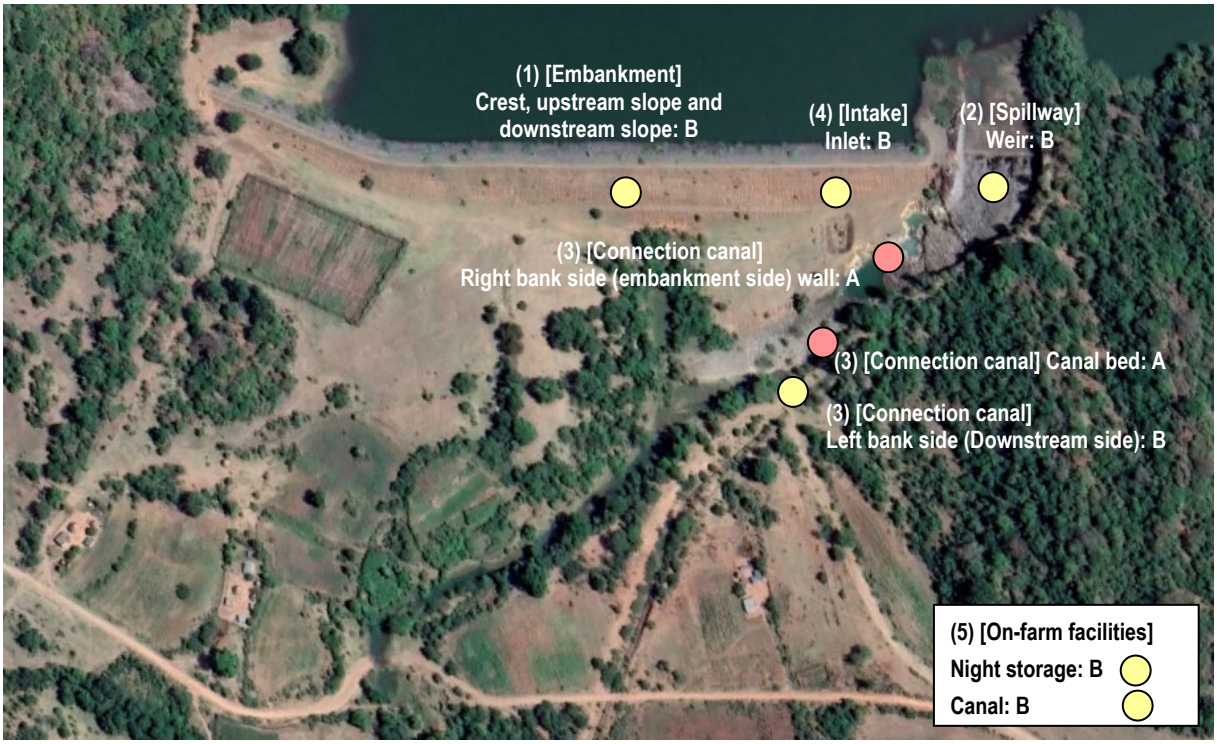


Figure 5.3.1 Locations of Deteriorations/Damages on Magudu Dam

Table 5.3.1 Summary of the Evaluation Results of Deteriorations/Damages on Magudu Dam

NO.	FACILITIES		EVALUATION (A or B)	CONFIRMED PHENOMENON
(1)	Embankment	Crest and upstream slope	B	- Disturbance of riprap, dam body exposure, and erosion
		Downstream slope		- Gully erosion
(2)	Spillway	Weir	B	- Surface concrete peeling at crest and the edge of downstream slope
(3)	Connection canal	Right bank side (embankment side) wall	A	- Two large collapses (one developed 1.5 m from slope protection works for valve house and another 6 m from the edge of embankment)
		Canal bed	A	- Exposure of siphon lining concrete
		Left bank side wall (downstream side)	B	- Collapses on the side wall and the washed away of a bridge
(4)	Intake	Inlet	B	- Disappearance of the gate operation facilities
(5)	On-farm facilities	Night storage	B	- Broken of the discharge gate
		Canal	B	- Spilling out of back side soil

2) Operation and maintenance

ZINWA is responsible for reservoir, embankment (including spillway, spillway channel and connection canal), intake, main canal and night storage, and IMC is responsible for on-farm facilities.

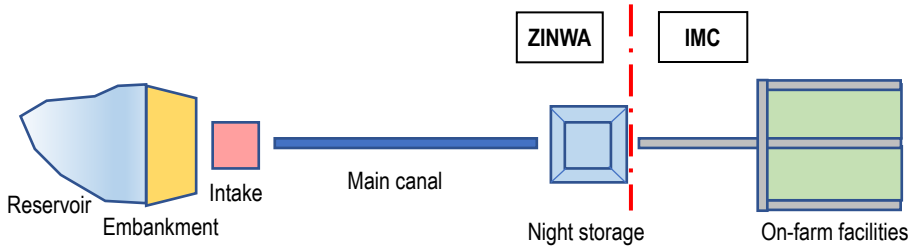


Figure 5.3.2 Pattern Diagram of Management Demarcation of Magudu Dam

A manager of Magudu Dam, ZINWA staff, has applied and gotten budget for maintenance every May to June, and the construction department in ZINWA has been repairing the canal and weeding around the canal since June. Since ZINWA budget, however, has not been enough for all repairs, repairs are being carried out little by little every year. Also, sedimentation in the night storage has been dredged every two years, and on-farm canals were maintained by the support of FAO in 2018.

3) Farming activities

i) Irrigated area

The irrigated area under Magudu Dam irrigation scheme is 52.7 ha. The main cultivated crops are maize (cultivated area about 50 ha), sugar beans (about 28 ha), and wheat (about 16 ha). The typical crop planting period of these main crops is illustrated as Figure 5.3.3. Crop rotation is carried out on these three crops (for example, sugar beans (February-June), wheat (June-September), maize (November-February)). Maize can be planted at any time of the year if water is available.

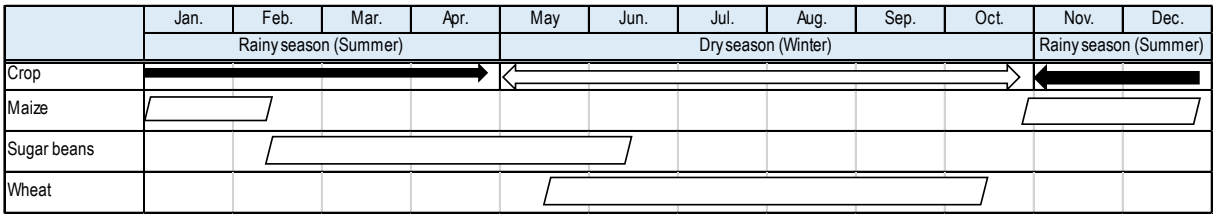


Figure 5.3.3 Typical Crop Planting Period (Magudu Dam: Irrigated Area)

Beneficiary farmers cultivate maize mainly for self-consumption but some of them are sold to locals. The annual consumption of maize is high and one family (about 5 to 6 people) needs about 700 kg because maize is an ingredient of Sadza which is the staple food in Zimbabwe. One beneficiary farmer's maize production is about 400 to 600 kg which is for almost self-consumption. The surplus of sugar beans and wheat is sold to locals because the consumption of them is not so many per one family. The beneficiary farmer's selling price is 14 USD/50 kg (1bag) for maize, 59 USD/50 kg for sugar beans, and 28 USD/50 kg for wheat.

ii) Non-irrigated area

At the non-irrigated area near the irrigated area, farmers cultivate drought-resistant crops such as maize, sorghum, ground-nuts and sweet potatoes in the rainy season only. Farmers cannot plant any crops in the dry season since there is no rainfall. A typical crop planting period is illustrated as Figure 5.3.4.

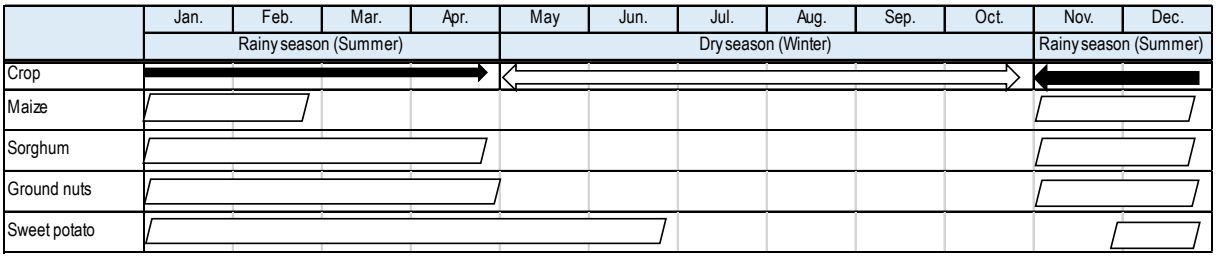


Figure 5.3.4 Typical Crop Planting Period (Magudu Dam: Non-Irrigated Area)

Maize cultivation for staple food is also popular in non-irrigated area but the yield is low. The yield of maize in the irrigated area is about 2 ton/ha, while the yield in the non-irrigated area is only about 0.1 ton/ha. If the irrigation water would be supplied, farmers in the non-irrigated area wish to plant maize, sugar beans, and wheat, which is same crops cultivated in the irrigated area, and therefore the typical crop cultivation period in case irrigation water is supplied is the same as in above Figure 5.3.3.

The estimated changes in the farmland use ratio before and after irrigation is shown in Table 5.3.2.

Table 5.3.2 Estimating Changes in Farmland Use Ratio before and after Irrigation (Magudu Dam)

Crop	Cultivated Area before Irrigation (ha)	Cultivated Area after Irrigation (ha)	Increased Farmland Use Ratio (%)
Maize	0.5	4.0	-
Sorghum	2.5	0.0	-
Ground Nuts	0.5	0.0	-
Pulse	0.5	0.0	-
Sugar Beans	0.0	4.0	-
Wheat	0.0	4.0	-
Total	4.0	12.0	300

If the irrigation becomes possible, it will be able to adjust the planting time of each crop and also to cultivate it in the dry season, so that farmland can be used throughout the year. At present, the farmland has to be divided for each crop because the crops have been cultivated in parallel. But if the issue will be solved after receiving the irrigation water, it is presumed that the farmland utilization rate is expected to be three times compared with before irrigation.

(2) Evaluation of each Deteriorations/Damages on the Facilities

1) Embankment

i) Confirmed situations and those factor(s)

[Crest and upstream slope] Disturbance of riprap, dam body exposure, and erosion (see Figure 5.3.5)

The disturbance of the riprap may be caused by 1) its thin layer which is only one layer with about 20 cm - 30 cm thickness, and 2) intrusion of people and livestock. In addition, after the disturbance of the riprap, the dam body was exposed and erosion occurred due to wind and rain (especially rainfall).

[Downstream slope] Gully erosion (see Figure 5.3.6)

Originally, the downstream slope might be covered with grass. However, it might disappear due to eating and trampling by livestock, and caused the dam body exposure. Finally, gully erosion might occur due to years of rainfall. The depth of erosion is about 80 cm, and it reaches about 1.8 m in some places.

Although eroded dam body has been flowing into the valve house, it has not affected the valve operation yet since IMC has removed out it periodically.

Figure 5.3.5 Disturbance of Riprap, Dam Body Exposure, and Erosion (Crest and Upstream Slope)

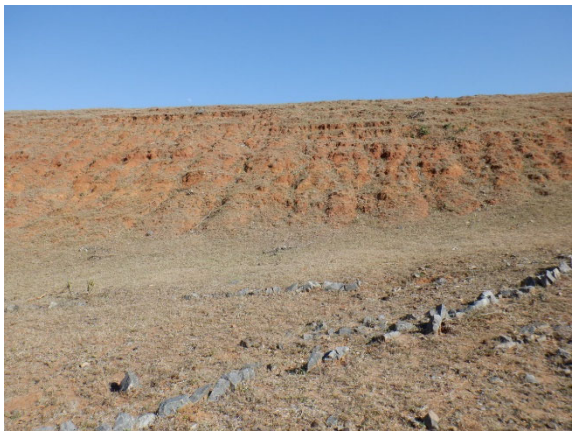


Figure 5.3.6 Gully Erosion (Downstream Slope)

ii) Evaluation of deteriorations/damages

Table 5.3.3 Evaluation Results of Deteriorations/Damages (Magudu Dam: Embankment)

Confirmed Situation	Evaluation	Reason for Evaluation
[Crest and upstream slope] Disturbance of riprap, dam body exposure, and erosion	B	**Impact on facilities at the present time** - Confirmed deteriorations/damages are not significant deformations, cracks, steps, sinking, etc., which are the main signal of the initial stage of embankment collapse. Additionally, even under high water level (FWL-0.8m), there is no seepage on the downstream slope surface. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of the dam. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are the intrusion of people and livestock, and rainfall which are difficult to control. The progress of erosion may cause the reduction of the embankment cross section and affect the stability of embankment and water storage function of dam. Therefore, it is judged that some measures are required in the long term.
[Downstream slope] Gully erosion		

2) Spillway

i) Confirmed situations and those factor(s)

[Weir] Surface concrete peeling at crest and the edge of downstream slope (see Figure 5.3.8)

The concrete peeling at crest of the weir may have been caused by deterioration of mortar concrete and removal of stone masonries by flood.

As for the peeling at the edge of downstream slope, its factors may be 1) Washing away of the rocks around the edge by flood, and 2) disposure and damage of the edge of slope.

Figure 5.3.7 Panoramic View of Weir

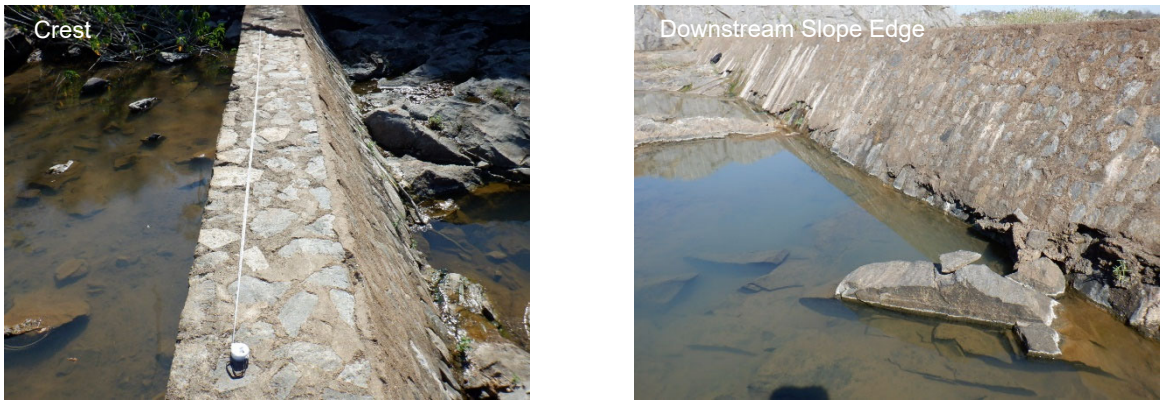


Figure 5.3.8 Surface Concrete Peeling

ii) Evaluation of deteriorations/damages

Table 5.3.4 Evaluation Results of Deteriorations/Damages (Magudu Dam: Spillway)

Confirmed Situations	Evaluation	Reason for Evaluation
[Weir] Surface concrete peeling at crest and the edge of downstream slope	**B**	**Impact on facilities at the present time** - Since the damage is slight, it is judged that confirmed deteriorations/damages do not affect the discharge function. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are the time-related deterioration and flood, which are difficult to control. The progress of situation may affect the discharge function of the spillway. Therefore, it is judged that some measures are required in the long term.

3) Connection canal

i) Confirmed situations and those factor(s)

[Right bank side (embankment side) wall] Two large collapses (one developed 1.5 m from slope protection works for valve house and another 6 m from the edge of embankment) (see Figure 5.3.9)

There is a ditch across the connection canal and collapses may be caused by flow along this ditch. Although this part might have a flat surface just after construction, it may have been eroded by floods over the past 30 years since this portion might be relatively soft. It is supposed that the flood flow changed its direction from downstream to right side due to this ditch, and eroded the right bank side wall leading the collapses (see Figure 5.3.10).

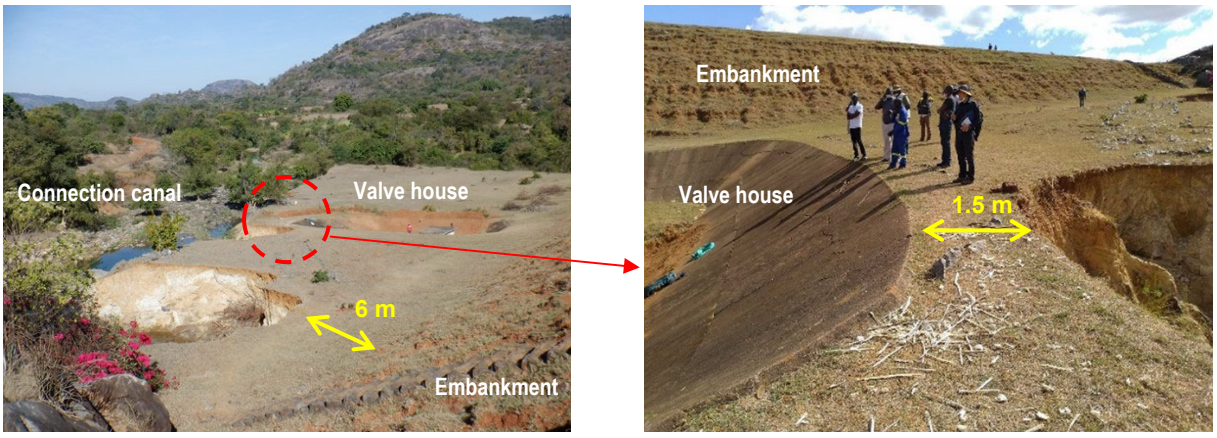


Figure 5.3.9 Collapses on the Right Bank Side (Embankment Side) Wall

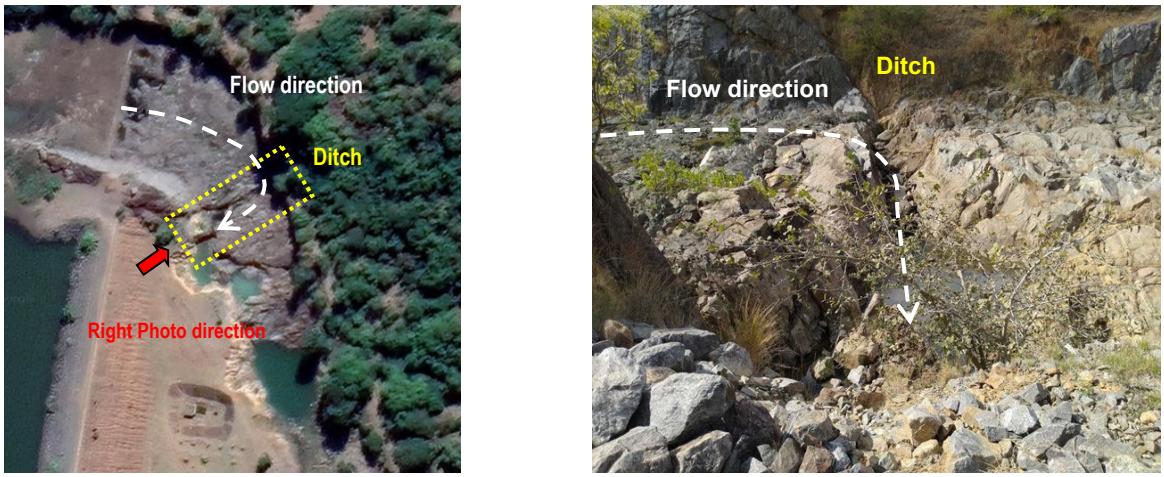


Figure 5.3.10 Suspected Reason of Collapses on the Right Bank Side (Embankment Side) Wall

[Canal bed] Exposure of siphon lining concrete (see Figure 5.3.11)

Since there are many rocks around the siphon lining concrete, the siphon lining concrete might be protected by rock or gabion works, but those have been eroded and washed away by the floods.

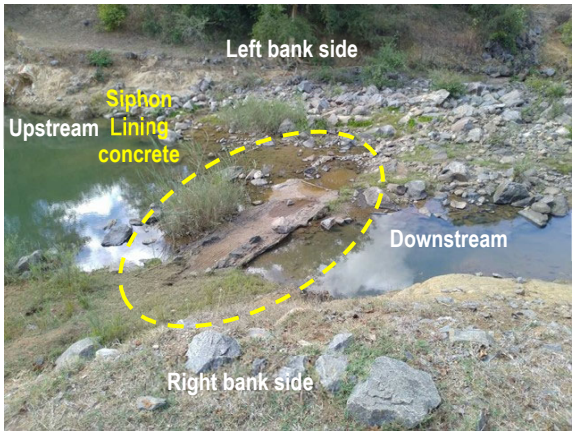


Figure 5.3.11 Exposure of Siphon Lining Concrete

[Left bank side (downstream side) wall] Collapses on the side wall and the washed away of a bridge (see Figure 5.3.12)

The bridge may have been built across the canal, but washed away by the impact of flood waters.

The bridge point is located just downstream of the section where the canal slope changes from steep to gentle, which is a point where flow is disturbed. Additionally, geological feature of left bank side is sandy and relatively soft compared to the scattered rocks on the right side. And therefore, the erosion caused by the flood might concentrate on the left side after the bridge was washed away.

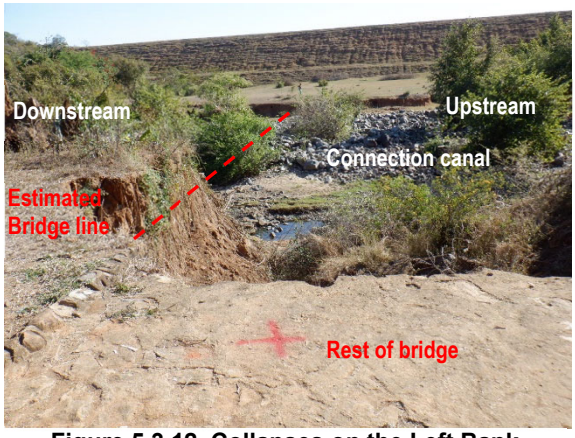
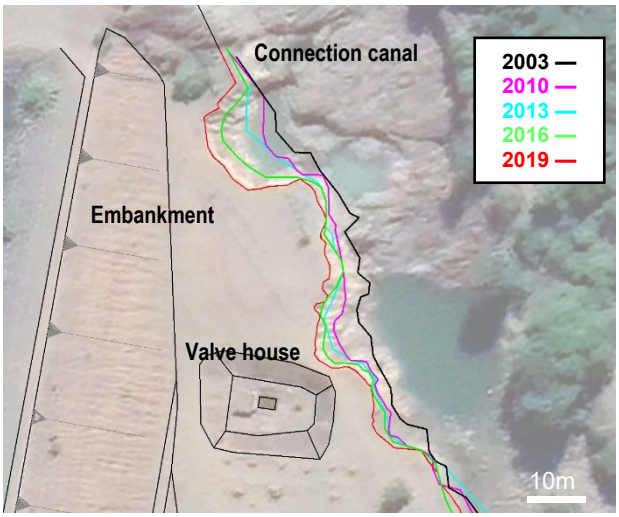


Figure 5.3.12 Collapses on the Left Bank Side Wall, the Washed Away of a Bridge

ii) Evaluation of deteriorations/damages

Table 5.3.5 Evaluation Results of Deteriorations/Damages (Magudu Dam: Connection Canal)

Confirmed Situations	Evaluation	Reason for Evaluation
[Right bank side (embankment side) wall] Two large collapses (one developed 1.5 m from slope protection works for valve house and another 6	A	Impact on facilities at the present time - There is no significant damage on the embankment near the collapse area. Also, here is no seepage from the collapse surface. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of the dam. Also, it does not affect the operation of dam since the discharge valve can be operated.

Confirmed Situations	Evaluation	Reason for Evaluation
m from the edge of embankment)		**Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are flood flow, which is difficult to control. - The average collapse rate since 2003 is assessed according to the past satellite images. Based on this rate, the collapse of 6 m from the embankment may reach the edge of embankment in 2028 (7 years later), while, the collapse of 1.5 m from the slope protection of the valve house may reach the slope protection in 2023 (2 years later).  Source: The Survey team based on Google Earth **Figure 5.3.13 Time Series Collapse Progress** - Once the collapse reaches the edge of the embankment, it affects the stability of embankment. Also, if the collapse reaches the slope protection of the valve house, slope protection would be damaged and a large amount of sediment will flow into the valve house during rainfall, making it impossible to operate the valve. Consequently, irrigation water may not be supplied to the farmland. Also, these may happen within some years. Therefore, it is judged that some emergency repairing measures are required immediately.
[Canal bed] Exposure of siphon lining concrete	**A**	**Impact on facilities at the present time** - Since the required irrigation water volume is being supplied to the farmland. Therefore, it is judged that the confirmed deteriorations/damages do not affect the water intake function. **Possibility of affecting facilities in the future** - Since rocks are scattered around and upstream of the siphon lining concrete, erosion is likely to occur when rocks are delivered by floods and impact the lining concrete. - As erosion progresses and siphon pipes break, sufficient irrigation water would not be supplied to farmland and the irrigation scheme may be dysfunctional. Additionally, erosion due to rock impact which may lead the damage of siphon may occur in the next flood. Therefore, it is judged that some emergency repairing measures are required immediately.
[Left side (downstream side) wall] Collapses on the side wall and the washed away of a bridge	**B**	**Impact on facilities at the present time** - The operator can access the valve house by crossing the canal when there is no water flow in the canal and by turning around from the right side when there is water flow in the canal. Therefore, it is judged that the confirmed deteriorations/damages do not affect the operation of dam. **Possibility of affecting facilities in the future** - If it takes a long time to access the valve house, immediate action cannot be taken in the event of an emergency incident (e.g., filling of the valve house due to a large inflow of sediment). This may result in delays in irrigation water supply. Therefore, it is judged that some measures are required in the long term.

4) Intake

i) Confirmed situations and those factor(s)

[Inlet] Disappearance of the gate operation facilities (see Figure 5.3.14)

All of the intake gate operation facilities (wires and wire winches) are disappeared. They may have been removed due to time-related deterioration or stolen. The intake gate is open at all times and water can be taken.

Figure 5.3.14 Disappearance of the Intake Gate Operation Facilities

ii) Evaluation of deteriorations/damages

Table 5.3.6 Evaluation Results of Deteriorations/Damages (Magudu Dam: Intake)

Confirmed Situations	Evaluation	Reason for Evaluation
[Inlet] Disappearance of the gate operation facilities	B	Impact on facilities at the present time - The intake gate is open all the time and the intake volume is controlled by the discharge valve. Therefore, it is judged that the confirmed deteriorations/damages do not affect the water intake function. Possibility of affecting facilities in the future - When the discharge valve fails, it is necessary to close the intake gate, stop the water intake, and repair the valve. The immediate repairing is required when a valve fails, or the irrigation water supply may be delayed. Therefore, it is judged that some measures are required in the long term.

5) On-farm facilities

i) Confirmed situations and those factor(s)

[Night storage] Broken of the discharge gate (see Figure 5.3.15)

Discharge gate may have become dysfunctional due to time-related deterioration or un-repairing for 30 years after installation.

[Canal] Spilling out of back side soil (see Figure 5.3.16)

When the construction was completed, the elevation of the top of canal wall and farmland surface may have been same, however the back side soil may have spilled out due to the tillage near the canal.

Figure 5.3.15 Broken of the Discharge Gate

Figure 5.3.16 Spilling Out of Canal Back Side Soil

ii) Evaluation of deteriorations/damages

Table 5.3.7 Evaluation Results of Deteriorations/Damages (Magudu Dam: On-Farm Facilities)

Confirmed Situations	Evaluation	Reason for Evaluation
[Night storage] Broken of the discharge gate	**B**	**Impact on facilities at the present time** - The discharge from the night storage is regulated by the outlet sluice valve on the downstream. Therefore, it is judged that the confirmed deteriorations/damages do not affect the operation (irrigation water supply). **Possibility of affecting facilities in the future** - When maintaining and inspecting the sluice valve in the future, it is necessary to close the discharge gate and stop the water flow. If proper maintenance and inspection are not performed when an abnormality occurs in the outlet sluice valve, the outlet sluice valve may break down and the irrigation water supply may be delayed or stopped. Therefore, it is judged that some measures are required in the long term.
[Canal] Spilling out of back side soil	**B**	**Impact on facilities at the present time** - Since the required amount of irrigation water can be passed through, the operation (irrigation water supply) may not be affected. **Possibility of affecting facilities in the future** - When the back side soil spills in the future, the canal may move, joints will open, and then water leaks. Since the occurrence of water leakage causes a decrease in the amount of irrigation water supply and a decrease in the irrigation area, it is judged that some measures are required in the long term.

5.3.2 Musaverema Dam

(1) Current Status

1) Summary of deteriorations/damages on the facilities

The locations of deteriorations/damages found on Musaverema Dam are shown in Figure 5.3.17, and the summary of the evaluation results of each deteriorations/damages are shown in Table 5.3.8.

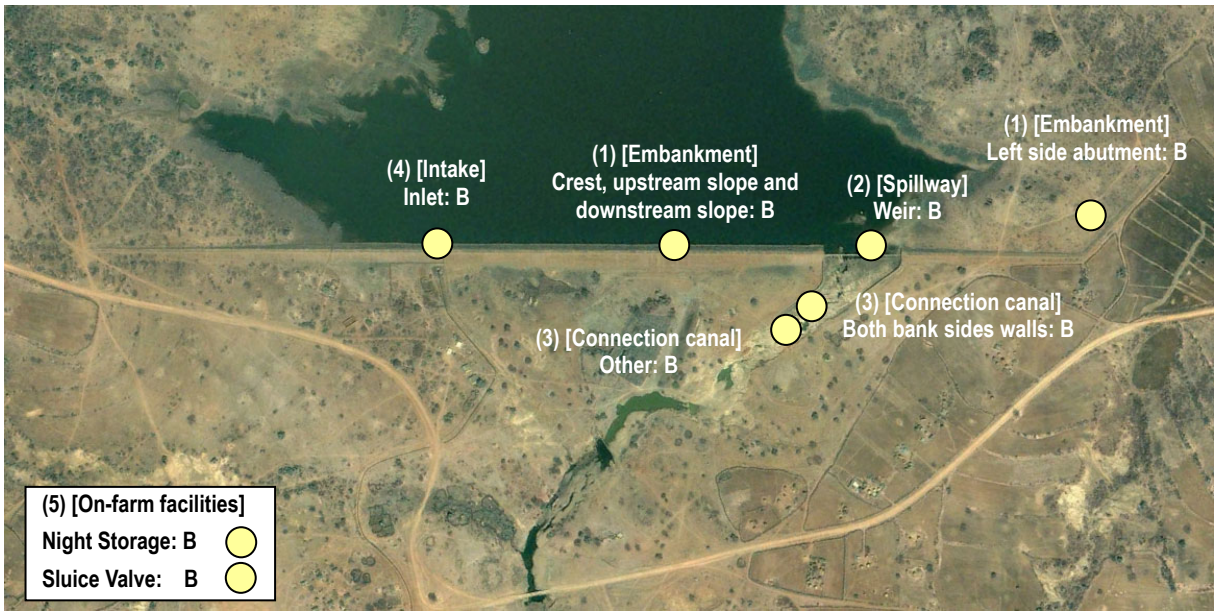


Figure 5.3.17 Locations of Deteriorations/Damages on Musaverema Dam

Table 5.3.8 Summary of the Evaluation Results of Deteriorations/Damages on Musaverema Dam

i	FACILITIES		EVALUATION (A or B)	CONFIRMED PHENOMENON
(1)	Embankment	Crest and upstream slope	B	- Disturbance of riprap, dam body exposure, and erosion
		Downstream slope		- Gully erosion
		Left side abutment	B	- Many trees on and around embankment surface (higher than FWL)
(2)	Spillway	Weir	B	- Surface peeling and lack of stones at crest
				- A slight plant on the left side
(3)	Connection canal	Both bank sides walls	B	- Collapse of side walls
		Other	B	- Crossing road across canal
(4)	Intake	Inlet	B	- Missing of the wires - Rusting all over
(5)	On-farm facilities	Night storage	B	- Broken of the discharge gate
		Sluice valve	B	- Missing parts

2) Operation and maintenance

ZINWA is responsible for reservoir, embankment (including spillway, spillway channel and connection canal), intake and main canal, and IMC is responsible for night storage and on-farm facilities.

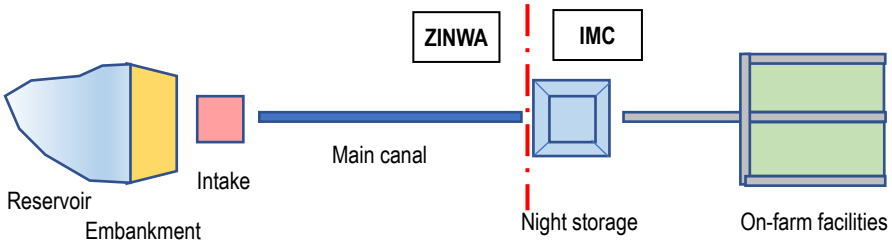


Figure 5.3.18 Pattern Diagram of Management Demarcation of Musaverema Dam

Dredging of sedimentation in the night storage has been carried out once a year. A beneficiary farmer shall pay 100 USD/ha/year for IMC as a facilities management fee (Commitment Fee) and this Commitment Fee is utilized to repair the facilities. This regulation in respect to Commitment Fee was institutionalized by a programme, namely "Smallholder Irrigation Revitalisation Programme" with support by IFAD (see Table 2.3.2).

3) Farming activities

i) Irrigated area

The irrigated area under Musaverema Dam irrigation scheme is 38 ha, and the farmland is divided into three blocks A, B, and C (1 block is about 12 to 13 ha). The crop rotation is carried out in three blocks and the cultivated crops in the blocks is changed depending on the season. The main cultivated crops are maize, sugar beans, wheat, and ground nuts. The typical crop planting period of these main crops is illustrated as Figure 5.3.19.

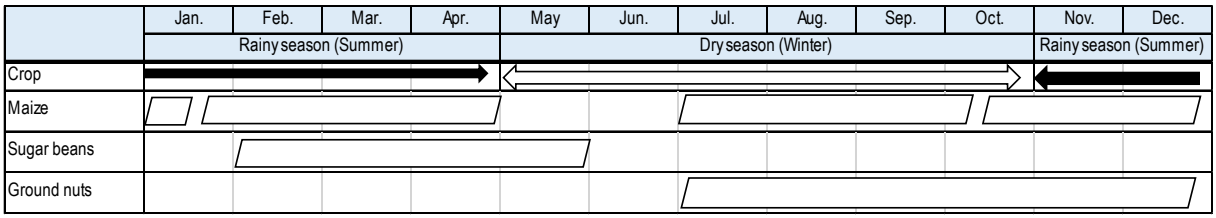


Figure 5.3.19 Typical Crop Planting Period (Musaverema Dam: Irrigated Area)

Maize is mainly for self-consumption and if there is a surplus, it is sold, and sugar beans and ground nuts are mainly for sale. About 75 % of the harvest is sold to locals and about 25 % is sold to GMB. GMB came to pick up even if the sales volume was small until 2002, but now GMB does not come to pick up unless the quantity is over 10 tons. Therefore, if beneficiary farmers want to sell less than 10 ton, they have to arrange transportation to GMB by themselves. The beneficiary farmer's selling price is 62.5 USD/50 kg for sugar beans and 12.5 USD/50 kg for ground nuts. Also, 3 USD/50 kg is required for transportation cost to the GMB deposit (Neshuro area, about 30km distance from the irrigated area).

ii) Non-irrigated area

Chipwanya village is a non-irrigated area close to the irrigated area. The farmers cultivate maize and ground nuts for self-consumption, and sorghum and sunflower as feed crops for livestock (chicken, etc.)

in the rainy season only, no planting in the dry season. The typical crop cultivation period of these main crops is illustrated as Figure 5.3.20.

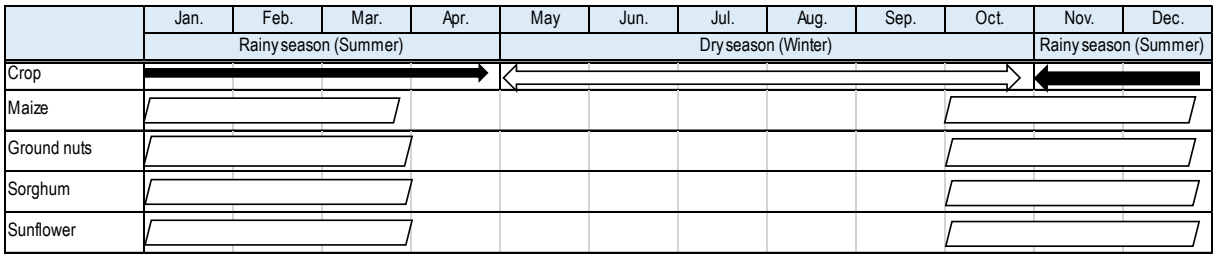


Figure 5.3.20 Typical Crop Planting Period (Musaverema Dam: Non-Irrigated Area)

The cultivation period of all the crops overlaps at the same time due to the crops can be cultivated in the rainy season only. The source of income is mainly from the sale of livestock because most of the maize and ground nuts are consumed in-house. The farmland management is mainly livestock production and cultivate self-consumption crops during the rainy season.

If the irrigation water would be supplied, farmers in the non-irrigated area wish to plant maize and wheat in dry season. The expected crop planting period in that case is illustrated as Figure 5.3.21

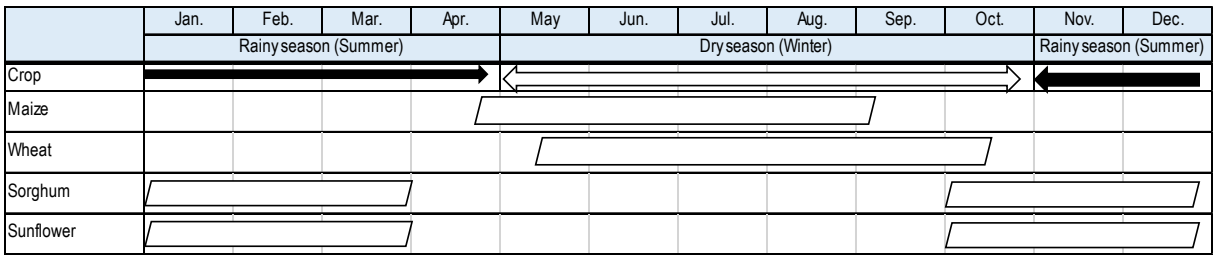


Figure 5.3.21 Expected Crop Planting Period (Musaverema Dam)

After the irrigation water is supplied, it will be possible to cultivate in the dry season, so the farmers intent to shift the planting time of maize to the dry season and start wheat cultivation. Also, sorghum and sunflower, which are produced as forage crops, will continue to be planted in the rainy season. Estimated changes in the farmland use ratio before and after irrigation is shown in Table 5.3.9

Table 5.3.9 Estimating Changes in Farmland Use Ratio before and after Irrigation (Musaverema Dam)

Crop	Cultivated Area before Irrigation (ha)	Cultivated Area after Irrigation (ha)	Increased Farmland Use Ratio (%)
Maize	0.98	1.0	-
Ground nuts	0.36	0.0	-
Sorghum	0.18	1.0	-
Sunflower	0.12	1.0	-
Pulse	0.36	0.0	
Wheat	0.0	1.0	-
Total	2.0	4.0	200

If irrigation becomes possible, it will be possible to plant in dry season, so it is estimated to be double the farmland utilization through rainy season cropping plus dry season cropping. Also, the farmers in non-irrigated area could increase the production of food crops for self-consumption so that it can be increased the self-sufficiency rate. If there is a surplus, they will use it for stockpiling as an emergency measure such as food shortage.

(2) Evaluation of each Deteriorations/Damages on the facilities

1) Embankment

i) Confirmed situations and those factor(s)

[Crest and upstream slope] Disturbance of riprap, dam body exposure, and erosion (see Figure 5.3.22)

The disturbance of the riprap may be caused by 1) its thin layer which is only one layer with about 20 cm - 30 cm thickness, and 2) intrusion of people and livestock. In addition, after the disturbance of the riprap, the dam body was exposed and erosion occurred due to wind and rain (especially rainfall).

[Downstream slope] Gully erosion (see Figure 5.3.23)

Originally, the downstream slope might be covered with grass. However, it might disappear due to eating and trampling by livestock, and caused the dam body exposure. Finally, gully erosion might occur due to years of rainfall. The depth of erosion is about 20 cm.

Figure 5.3.22 Disturbance of Riprap, Dam Body Exposure, and Erosion（Crest and Upstream Slope）

Figure 5.3.23 Gully Erosion (Downstream Slope)

[Left side abutment] Many trees on and around embankment surface (higher than FWL) (see Figure 5.3.24)

Since the range of the abutment on the left side of the spillway is above the FWL, it is supposed that trees are growing on the embankment due to the influence of trees from the surrounding areas. Additionally, it is necessary to bypass the downstream of the connection canal in order to reach the left side abutment, and this situation may have caused the insufficient tree removal.

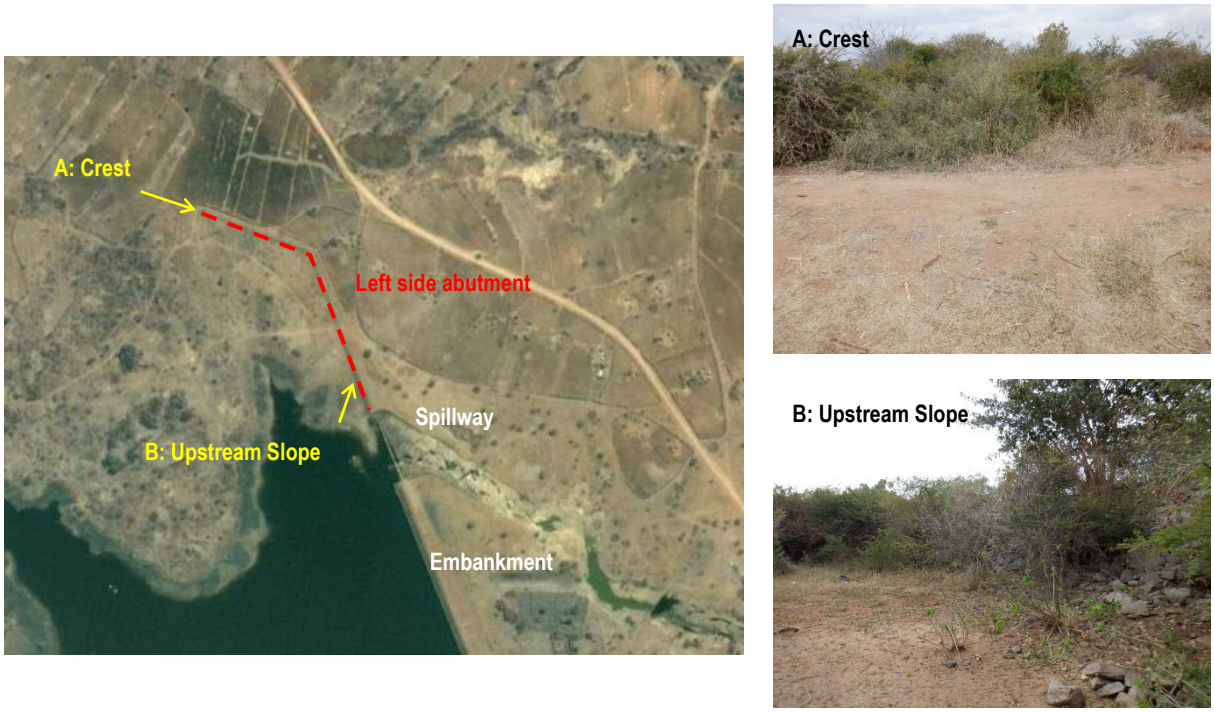


Figure 5.3.24 Trees on and around the Left Side Abutment

ii) Evaluation of deteriorations/damages

Table 5.3.10 Evaluation Results of Deteriorations/Damages (Musaverema Dam: Embankment)

Confirmed Situations	Evaluation	Reason for Evaluation
[Crest and upstream slope] Disturbance of riprap, dam body exposure, and erosion	B	**Impact on facilities at the present time** - Confirmed deteriorations/damages are not significant deformations, cracks, steps, sinking, etc., which are the main signal of the initial stage of embankment collapse. Additionally, even under high water level (FWL-0.6m), there is no seepage on the downstream slope surface. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of the dam. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are the intrusion of people and livestock, and rainfall which are difficult to control. The progress of erosion may cause the reduction of the embankment cross section and affect the stability of embankment and water storage function of dam. Therefore, it is judged that some measures are required in the long term.
[Downstream slope] Gully erosion		
[Left side abutment] Many trees on and around embankment surfaces (higher than FWL)	B	**Impact on facilities at the present time** - The area where trees are mainly growing is above the FWL, and there is no drop-off of the dam body due to fallen trees. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of dam. **Possibility of affecting facilities in the future** - Overgrowth of trees on and around the embankment prevents proper monitoring and detection of significant deformations, cracks, steps, sinking, etc. which are the main signal of the initial stage of embankment collapse, and may affect the stability of embankment. Therefore, it is judged that some measures are required in the long term.

2) Spillway

i) Confirmed situations and those factor(s)

[Weir] Surface peeling and lack of stones at crest (see Figure 5.3.26)

The concrete peeling at crest of the weir may have been caused by deterioration of mortar concrete and removal of stone masonries by flood.

[Weir] A slight plant on the left side (see Figure 5.3.27)

The factors may be 1) shallow water depth at upstream of the weir and 2) insufficient management since it is necessary to access the weir from the downstream of the connection canal and this may cause the insufficient maintenance.

Figure 5.3.25 Panoramic View of Weir

Figure 5.3.26 Surface Peeling and Lack of Stones

Figure 5.3.27 Plants on the Left Side

ii) Evaluation of deteriorations/damages

Table 5.3.11 Evaluation Results of Deteriorations/Damages (Musaverema Dam: Spillway)

Confirmed Situations	Evaluation	Reason for Evaluation
[Weir] Surface peeling and lack of stones at crest	B	Impact on facilities at the present time - Since the damage is slight, it is judged that confirmed deteriorations/damages do not affect the discharge function. Possibility of affecting facilities in the future - The scale of confirmed deteriorations/damages would expand in the future because its factors are the time-related deterioration, flood, and insufficient maintenance, which are difficult to control. The progress of situation may affect the discharge function of the spillway. Therefore, it is judged that some measures are required in the long term.
[Weir] A slight plant on the left side		

3) Connection canal

i) Confirmed situations and those factor(s)

[Both bank sides walls] Collapse of side walls (see Figure 5.3.28)

Since the flood marks can be seen up to a height close to the surrounding ground surface, it is assumed

that the collapse progressed over time due to the rise of the water level in the canal during the flood. Additionally, there is no energy dissipation structure to reduce the velocity of the floodwaters. The high velocity of the floodwaters may have eroded the sidewalls and cause the collapse too.

While, there are no houses or other structures in the surrounding area which would be affected by the progress of the collapse.

Figure 5.3.28 Collapse of Side Walls on Both Bank Sides

[Other] Crossing road across canal (see Figure 5.3.29)

The reason why people pass the canal may be that there are no bridges that can safely cross the canal.

Figure 5.3.29 Crossing Road

ii) Evaluation of deteriorations/damages

Table 5.3.12 Evaluation Results of Deteriorations/Damages (Musaverema Dam: Connection Canal)

Confirmed Situations	Evaluation	Reason for Evaluation
[Both bank sides walls] Collapse of side walls	B	**Impact on facilities at the present time** - There are no important structures such as houses, farmland, or embankments around the collapse points. Therefore, it is judged that confirmed deteriorations/damages do not affect the stability of embankment and the surrounding area. **Possibility of affecting facilities in the future** - Considering the cracks on the walls and the condition of the sediment in the canal, it is estimated that not much time has passed since the last collapse. Also, there is a possibility that the collapse would progress by rainfall and flood, and affect the surrounding sidewalks. Therefore, it is judged that some measures will be required in the long term.
[Other] Crossing road across canal	B	**Impact on facilities at the present time** - Since there have been no reports of accidents, it is judged that the neighbours have taken adequate precautions when they cross. **Possibility of affecting facilities in the future** - Passing the canal, especially during the rainy season, can cause accidents, so it is judged that some measures are required in the long term.

4) Intake

i) Confirmed situations and those factor(s)

[Inlet] Missing of the wires (see Figure 5.3.30)

The wires may have been removed due to time-related deterioration or stolen. The intake gate is open at all times and water can be taken.

[Inlet] Rusting all over (see Figure 5.3.30)

This may be due to the insufficient maintenance after the wire disappeared.

Figure 5.3.30 Winch for Intake Gate Operation

ii) Evaluation of deteriorations/damages

Table 5.3.13 Evaluation Results of Deteriorations/Damages (Musaverema Dam: Intake)

Confirmed Situations	Evaluation	Reason for Evaluation
[Inlet] Missing of the wires	B	**Impact on facilities at the present time** - The intake gate is open all the time and the intake volume is controlled by the discharge valve. Therefore, it is judged that the confirmed deteriorations/damages do not affect the water intake function. **Possibility of affecting facilities in the future** - When the discharge valve fails, it is necessary to close the intake gate, stop the water intake, and repair the valve. The immediate repairing is required when a valve fails, or the irrigation water supply may be delayed. Therefore, it is judged that some measures are required in the long term.
[Inlet] Rusting all over		

5) On-farm facilities

i) Confirmed situations and those factor(s)

[Night storage] Broken of the discharge gate (see Figure 5.3.31)

Discharge gate may have become dysfunctional due to time-related deterioration or un-repairing for 30 years after installation.

[Sluice valve] Missing parts (see Figure 5.3.32)

A sluice valve was added in front of original sluice valve by IMC in 2020, and the sluice valve on the rear side is the original one installed 30 years ago and discharge volume cannot be controlled. The front side sluice valve has some leakage and missing parts, however, it may have been left unsolved because there is almost no water leakage.

Figure 5.3.31 Broken of the Discharge Gate

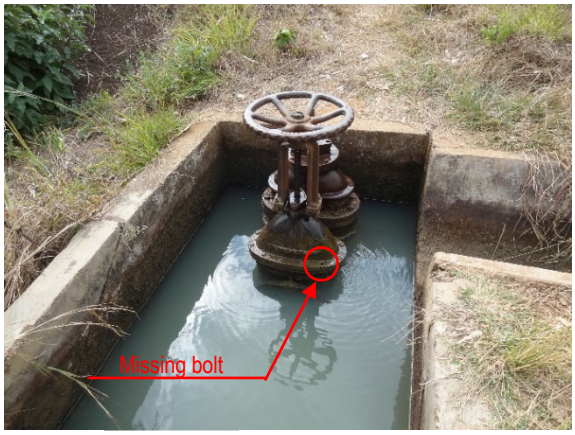


Figure 5.3.32 Missing Parts of Sluice Valve

ii) Evaluation of deteriorations/damages

Table 5.3.14 Evaluation Results of Deteriorations/Damages (Musaverema Dam: On-Farm Facilities)

Confirmed Situations	Evaluation	Reason for Evaluation
[Night storage] Broken of the discharge gate	B	**Impact on facilities at the present time** - The discharge from the night storage can be regulated by the outlet sluice valve on the downstream. Therefore, it is judged that the confirmed deteriorations/damages do not affect the operation (irrigation water supply). **Possibility of affecting facilities in the future** - When maintaining and inspecting the sluice valve in the future, it is necessary to block the discharge gate and stop the water flow. If proper maintenance and inspection are not performed when an abnormality occurs in the outlet sluice valve, the outlet sluice valve may break down and the irrigation water supply may be delayed or stopped. Therefore, it is judged that some measures are required in the long term.
[Sluice valve] Missing parts	B	**Impact on facilities at the present time** - There is almost no water leakage from the sluice valve. Therefore, it is judged that the confirmed deteriorations/damages do not affect the operation (irrigation water supply). **Possibility of affecting facilities in the future** - If the missing parts will have been left untreated, the water stopping function of the sluice valve will be deteriorated and water leakage may occur. The occurrence of water leakage causes a decrease in the amount of irrigation water supply and a decrease in the irrigated area. Therefore, it is judged that some measures are required in the long term.

5.3.3 Chinyamatumwa Dam

(1) Current Status

1) Summary of deteriorations/damages on the facilities

The locations of deteriorations/damages found on Chinyamatumwa Dam are shown in Figure 5.3.33, and the summary of the evaluation results of each deteriorations/damages are shown in Table 5.3.15.

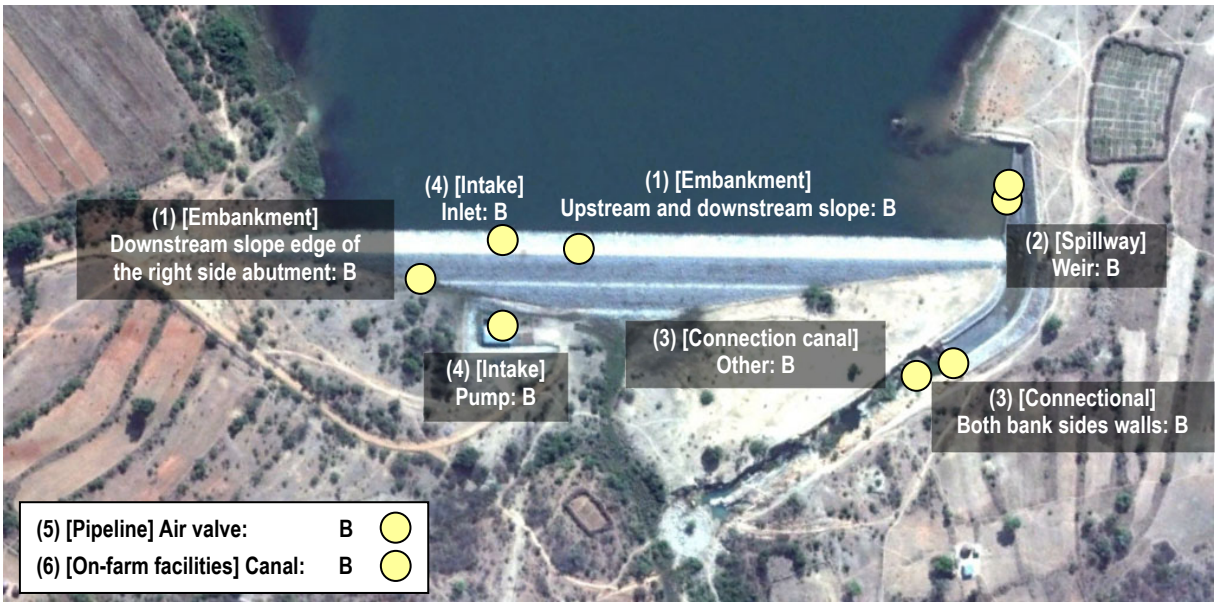


Figure 5.3.33 Locations of Deteriorations/Damages on Chinyamatumwa Dam

Table 5.3.15 Summary of the Evaluation Results of Deteriorations/Damages on Chinyamatumwa Dam

NO.	FACILITIES		EVALUATION (A or B)	CONFIRMED PHENOMENON
(1)	Embankment	Upstream and downstream slope	B	- Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees
		Downstream slope edge of the right side abutment	B	- Seepage and slight flow
(2)	Spillway	Weir	B	- Slight damage on the crest
			B	- Leakage from downstream slope
(3)	Connection canal	Both bank sides walls	B	- Collapse of side walls at the end of the spillway channel
		Other	B	- Crossing road across canal
(4)	Intake	Inlet	B	- Disappearance of the gate operation facilities
		Pump	B	- Insufficient supply volume
(5)	Pipeline	Air valve	B	- Small amount of water leakage
(6)	On-farm facilities	Canal	B	- Spilling out of back side soil

2) Operation and maintenance

ZINWA is responsible for reservoir, embankment (including spillway, spillway channel, and connection canal), intake (including pumps) and pipeline, and IMC is responsible for night storage and on-farm facilities.

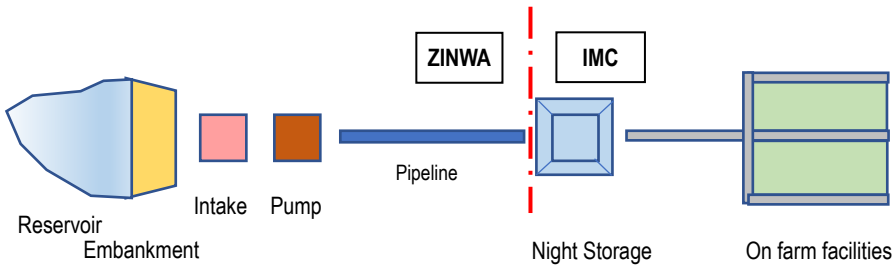


Figure 5.3.34 Pattern Diagram of Management Demarcation of Chinyamatumwa Dam

The pumps, pipeline and on-farm facilities were repaired in 2019 with support by FAO. The pumps were repaired in June 2019, however, they worked only two days and stopped working. Since then, irrigation has not been possible, and therefore, a series of facilities from the reservoir to the end of the on-farm facilities have not been maintained.

Through the site inspection in this Survey, it was suspected that the cause of the pumps' dysfunctional was short circuit of a breaker. A breaker was replaced on 8th July 2021 according to the recommendation by the Survey team, and two pumps resumed operation. AGRITEX officials are urging farmers to resume irrigated agriculture.

3) Farming activities

i) Irrigated area

As of end July 2021, the Chinyamatumwa Dam irrigation scheme is unable to supply irrigation water due to dysfunction of pumps. For this reason, the farmers cultivate crops in the rainy season only with rainfall and cannot cultivate any crops in the dry season. The main cultivated crops are maize and sugar beans for self-consumption. The current typical crop planting period is illustrated as Figure 5.3.35.

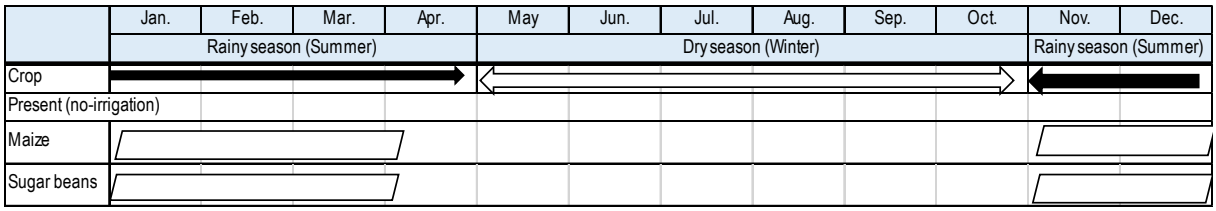


Figure 5.3.35 Typical Crop Planting Period (Chinyamatumwa Dam: Current (Non-Irrigated))

The typical crop planting period, when irrigation water was available previously, is illustrated as Figure 5.3.36.

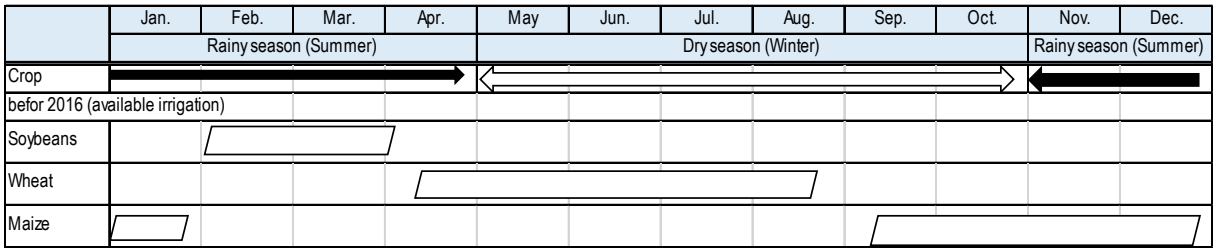


Figure 5.3.36 Typical Crop Planting Period (Chinyamatumwa Dam: Previous (Irrigated))

When irrigation water was available before, soybeans, wheat, and maize were planted as crop rotation throughout the year. All crops were produced mainly for self-consumption, but the surplus was also sold to GMB. The transportation cost to the nearest GMB deposit in Nyika, Bikita area, which is about 34 km distance, is about 2 USD/50 kg. The farmers' selling price for maize was 25 USD/50 kg. The yield of maize in the area is low because irrigation water is not supplied, and it is about 120 to 150 kg/ha.

ii) Non-irrigated area

There are 25 farmers have a total of 20 ha of farmlands (about 0.8 ha/farmer on average) in the non-irrigated area close to the irrigated area. They cultivate crops dependently rainfall. The typical crop planting period main crops is illustrated as Figure 5.3.37

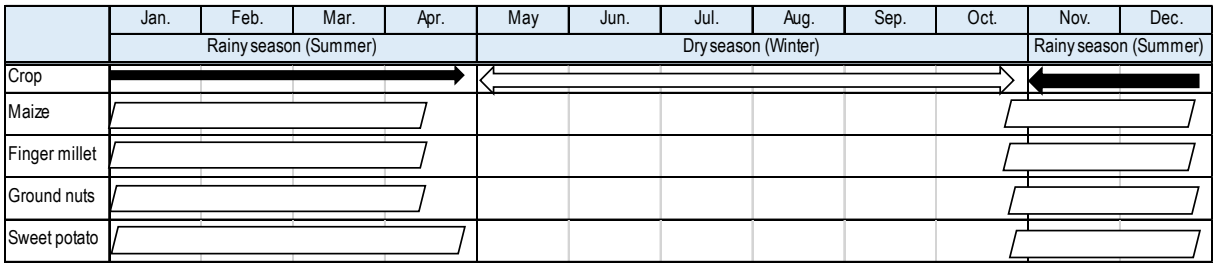


Figure 5.3.37 Typical Crop Planting Period (Chinyamatumwa Dam: Non-Irrigated Area)

The farmers cultivate drought-resistant crops such as maize, finger millet, ground nuts, and sweet potatoes in the rainy season only. All harvested crops are for self-consumption. If the irrigation water would be supplied, farmers in the non-irrigated area wish to plant maize, wheat, and soybeans throughout the year, same as the farmers in the irrigated area. The expected crop planting period is the same as Figure 5.3.36, which is mentioned above. The reason why the farmers are very interested in planting maize, wheat and soybeans is that they are necessary for self-consumption and if there is a surplus, they can be sold to GMB. If the grains are able to be sold to GMB, it will be possible to sell the surplus without worrying about the sales market.

The estimated changes in the farmland use ratio before and after irrigation is shown in Table 5.3.16.

Table 5.3.16 Estimating Changes in Farmland Use Ratio before and after Irrigation (Chinyamatumwa Dam)

Crop	Cultivated Area before Irrigation (ha)	Cultivated Area after Irrigation (ha)	Increased Farmland Use Ratio (%)
Maize	17.0	20	-
Finger millet	1.0	0	-
Ground nuts	1.2	0	-
Sweet potato	0.8	0	-
Wheat	0.0	20	-
Soybeans	0.0	20	-
Total	20.0	60	300

If the irrigation becomes possible, the crops can be cultivated throughout the year. The farmer intends to plant maize for self-consumption, and to plant wheat and soybeans for selling. It is presumed that the farmland utilization rate after irrigation is expected to be three times compared with before irrigation.

(2) Evaluation of each Deteriorations/Damages on the Facilities

1) Embankment

i) Confirmed situations and those factor(s)

[Upstream and downstream slope] Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees (see Figure 5.3.38)

Under the riprap, there may be erosion due to rainfall, and the eroded portions are filled with riprap materials. In addition, the disturbance of the riprap and dam body exposure may be caused by the intrusion of people and livestock. Further, the overgrowth of plants implies the insufficient regular maintenance.

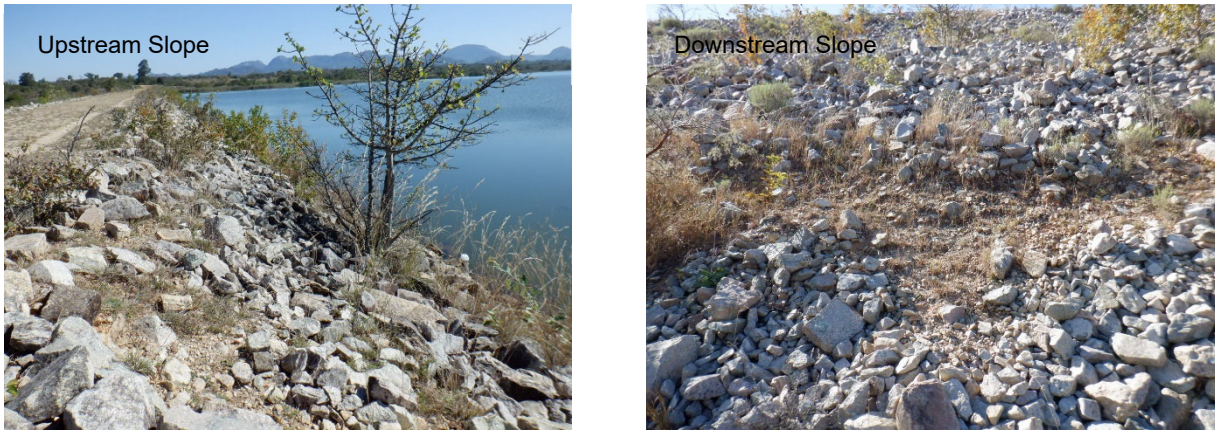


Figure 5.3.38 Upstream and Downstream Slope

[Downstream slope edge of the right side abutment] Seepage and slight flow (see Figure 5.3.39)

Seepage is observed at the edge of downstream slope. Since there is no wetness on the slope surface, The seepage water may come out from the boundary between the abutment and the natural ground.

Figure 5.3.39 Downstream Slope Edge of the Right Side Abutment

ii) Evaluation of deteriorations/damages

Table 5.3.17 Evaluation Results of Deteriorations/Damages (Chinyamatumwa Dam: Embankment)

Confirmed Situations	Evaluation	Reason for Evaluation
[Upstream and downstream slope] Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees.	B	**Impact on facilities at the present time** - Confirmed deteriorations/damages are not significant deformations, cracks, steps, sinking, etc., which are the main signal of the initial stage of embankment collapse. Additionally, even under high water level (FWL-0.2m), there is no seepage on the downstream slope surface. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of the dam. - There is no drop-off of dam body due to fallen trees, and no seepage through roots of plants is observed. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of dam. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are the intrusion of people and livestock, rainfall, and insufficient maintenance which are difficult to control. The progress of erosion may cause the reduction of the embankment cross section and affect the stability of embankment and water storage function of dam. Therefore, it is judged that some measures are required in the long term.
[Downstream slope edge of the right side abutment] Seepage and slight flow	B	**Impact on facilities at the present time** - The flow is slight and it is judged that confirmed deteriorations/damages do not affect the water storage function of dam. **Possibility of affecting facilities in the future** - The volume of seepage may increase over time, which would affect the water storage function of dam. In addition, the flow would cause the erosion of the embankment and the abutment, leading to the reduction of the embankment cross section which may affect the stability of the embankment and water storage function of dam. Therefore, it is judged that some measures are required in the long term.

2) Spillway

i) Confirmed situations and those factor(s)

[Weir] Slight damage on the crest (see Figure 5.3.41)

The damaged on the crest of the weir may have been caused by deterioration of mortar concrete and removal of stone masonries by flood.

[Weir] Leakage from downstream slope (see Figure 5.3.42)

Leakage may be caused by insufficient mortar filling between the gravels during construction.

Figure 5.3.40 Panoramic View of Weir

Figure 5.3.41 Slight Damage on the Crest

Figure 5.3.42 Leakage from Downstream Slope

ii) Evaluation of deteriorations/damages

Table 5.3.18 Evaluation Results of Deteriorations/Damages (Chinyamatumwa Dam: Spillway)

Confirmed Situations	Evaluation	Reason for Evaluation
[Weir] Slight damage on the crest	B	Impact on facilities at the present time - Since the damage is slight, it is judged that confirmed deteriorations/damages do not affect the discharge function. Possibility of affecting facilities in the future - The scale of confirmed deteriorations/damages would expand in the future because its factors are the time-related deterioration, flood, and insufficient maintenance, which are difficult to control. The progress of situation may affect the discharge function of the spillway. Therefore, it is judged that some measures are required in the long term.
[Weir] Leakage from downstream slope	B	Impact on facilities at the present time - The amount of leakage is slight and it is judged that confirmed deteriorations/damages do not affect the water storage function of dam. - The scale of confirmed deteriorations/damages would expand in the future because its factor is insufficient concrete filling, which is difficult to control. The progress of situation may cause the increase of leakage and decrease the water storage capacity of dam. Additionally, it may affect the stability of the weir. Therefore, it is judged that some measures are required in the long term.

3) Connection canal

i) Confirmed situations and those factor(s)

[Both bank sides walls] Collapse of side walls at the end of the spillway channel (see Figure 5.3.43)

There is no basket mat work at the end of the spillway channel, and it is formed like a drop-off. During the floods, disturbance of the flow may occur at this drop-off, eroded both bank sides walls and caused the collapse.

Figure 5.3.43 Collapse of Side Walls on Both Bank Sides at the End of the Spillway Channel

[Other] Crossing road across canal (see Figure 5.3.44)

The reason why people pass the canal may be that there are no bridges that can safely cross the canal.

Figure 5.3.44 Crossing Road

ii) Evaluation of deteriorations/damages

Table 5.3.19 Evaluation Results of Deteriorations/Damages (Chinyamatumwa Dam: Connection Canal)

Confirmed Situations	Evaluation	Reason for Evaluation
[Both bank sides walls] Collapse of both side walls at the end of the spillway channel	B	**Impact on facilities at the present time** - There are no important structures such as houses, farmland, or embankments around the collapse points. Therefore, it is judged that confirmed deteriorations/damages do not affect the stability the stability of embankment and the surrounding area. **Possibility of affecting facilities in the future** - Considering the cracks on the walls and the condition of the sediment in the canal, it is estimated that the progress of the collapse has slowed down. However, rainfall and flooding may cause further collapse and affect the surrounding sidewalks, etc. in future. Therefore, it is judged that some measures are required in the long term.

Confirmed Situations	Evaluation	Reason for Evaluation
[Other] Crossing road across canal	B	Impact on facilities at the present time - Since there have been no reports of accidents, it is judged that the neighbours have taken adequate precautions when they cross. Possibility of affecting facilities in the future - Passing the canal, especially during the rainy season, can cause accidents, so it is judged that some measures are required in the long term.

4) Intake

i) Confirmed situations and those factor(s)

[Inlet] Disappearance of the gate operation facilities (see Figure 5.3.45)

All of the intake gate operation facilities (wires and wire winches) are disappeared. They may have been removed due to time-related deterioration or stolen. The intake gate is open at all times and water can be taken.

Figure 5.3.45 Disappearance of the Intake Gate Operation Facilities

[Pump] Insufficient supply volume

The pumps installed by FAO were not in operation at the start of this Survey, but it was confirmed to be in operation by replacing the breaker. Although the pump became operational, the electricity current value of the pumps was less than the planned one and the pump was not able to deliver the planned flow. The reason why the planned electricity current flow is not achieved is that the transformer is located about 500m away from the pump facility, and the required current volume cannot be supplied due to transmission loss. Although the planned flow rate has not been achieved to the planned one, it has been possible to fill the night storage by taking 1.5 times longer than planned.

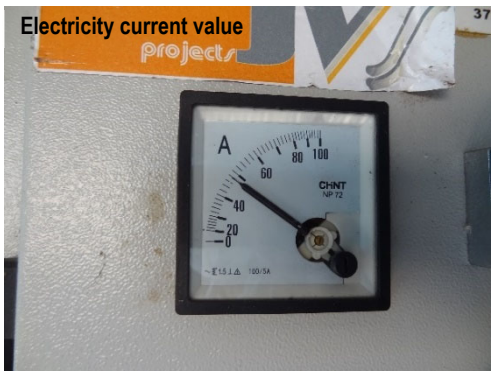


Figure 5.3.46 Sisutaiton of Pumps

ii) Evaluation of deteriorations/damages

Table 5.3.20 Evaluation Results of Deteriorations/Damages (Chinyamatumwa Dam: Intake)

Confirmed Situations	Evaluation	Reason for Evaluation
[Intake] Disappearance of the gate operation facilities	B	Impact on facilities at the present time - The intake gate is open all the time and the intake volume is controlled by the discharge valve. Therefore, it is judged that the confirmed deteriorations/damages do not affect the water intake function. Possibility of affecting facilities in the future - When the discharge valve fails, it is necessary to close the intake gate, stop the water intake, and repair the valve. The immediate repairing is required when a valve fails, or the irrigation water supply may be delayed. Therefore, it is judged that some measures are required in the long term.

Confirmed Situations	Evaluation	Reason for Evaluation
[Pump] Insufficient supply volume	B	**Impact on facilities at the present time** - Although planned water volume cannot be delivered, it is possible to fill the night storage by taking 1.5 times longer than planned. Therefore, it is judged that the confirmed deteriorations/damages do not affect the operation (irrigation water supply). **Possibility of affecting facilities in the future** - The transmission loss may increase due to the aging of the facility and the electricity current flow rate will be lower than at present. In this case the water flow rate may also decrease. If the flow rate decreases, it may not be possible to fill the night storage even if the pumps are operated 24 hours a day. Therefore, it is judged that some measures are required in the long term.

5) Pipeline

i) Confirmed situations and those factor(s)

[Air valve] Small amount of water leakage (see Figure 5.3.47)

The condition of the air valves was confirmed by FAO in 2018, but this leakage may happen due to initial failure, use of low quality parts, and low assembly accuracy.

Figure 5.3.47 Mark of Water Leakage from Air Valve

ii) Evaluation of deteriorations/damages

Table 5.3.21 Evaluation Results of Deteriorations/Damages (Chinyamatumwa Dam: Pipeline)

Confirmed Situations	Evaluation	Reason for Evaluation
[Air valve] Small amount of water leakage	B	**Impact on facilities at the present time** - The amount of water leakage is small assuming from the trace of water leakage from the air valve. Therefore, it is judged that the confirmed deteriorations/damages do not affect the operation (irrigation water supply). **Possibility of affecting facilities in the future** - If the water leakage will have been left unsolved, the water stopping function of the air valve will be deteriorated and the amount of water leakage may increase. Increase in water leakage becomes to a decrease in irrigation water supply and a decrease in irrigated area. Therefore, it is judged that some measures are required in the long term.

6) On-farm facilities

i) Confirmed situations and those factor(s)

[Canal] Spilling out of back side soil (see Figure 5.3.48)

When the construction was completed, the elevation of the top of canal wall and farmland surface may have been same, however the back side soil may have spilled out due to the tillage near the canal.

Figure 5.3.48 Silling Out of Back Side Soil

ii) Evaluation of deteriorations/damages

Table 5.3.22 Evaluation Results of Deteriorations/Damages (Chinyamatumwa Dam: On-Farm Facilities)

Confirmed Situations	Evaluation	Reason for Evaluation
[Canal] Spilling out of back side soil	**B**	**Impact on facilities at the present time** - Since the required amount of irrigation water can be passed through, the operation (irrigation water supply) may not be affected. **Possibility of affecting facilities in the future** - When the back side soil spills in the future, the canal may move, joints will open, and then water leaks. Since the occurrence of water leakage causes a decrease in the amount of irrigation water supply and a decrease in the irrigation area, it is judged that some measures are required in the long term.

5.3.4 Mashoko Dam

(1) Current Status

1) Summary of deteriorations/damages on the facilities

The location of deteriorations/damages found on Mashoko Dam are shown in Figure 5.3.49, and the summary of the evaluation results of each deteriorations/damages are shown in Table 5.3.23.

Figure 5.3.49 Locations of Deteriorations/Damages on Mashoko Dam

Table 5.3.23 Summary of the Evaluation Results of Deteriorations/Damages on Mashoko Dam

NO.	FACILITIES		EVALUATION (A or B)	CONFIRMED PHENOMENON
(1)	Embankment	Upstream and downstream slope	B	- Partial disturbance of riprap and dam body exposure
		Crest, upstream slope and downstream slope	B	- Many trees
(2)	Spillway channel	Other	B	- Crossing road across the canal (basket mat)
(3)	Intake	Inlet	B	- Missing of the wires - Rusting all over
(4)	On-farm facilities	Canal	B	- Spilling out of back side soil
		Diversion	B	- Broken of sluice gate

2) Operation and maintenance

ZINWA is responsible for reservoir, embankment (including spillway, spillway channel, and connection canal), intake, main canal and night storage, and IMC is responsible for on-farm facilities.

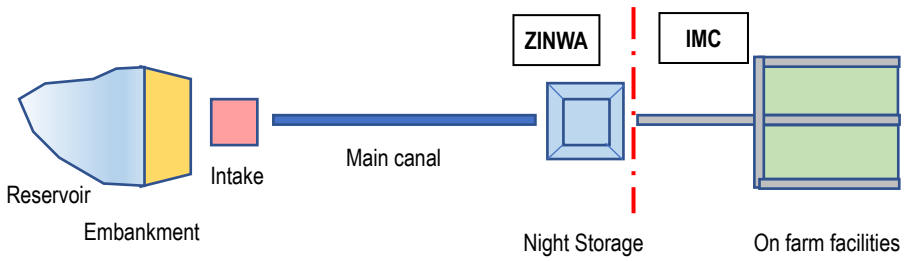


Figure 5.3.50 Pattern Diagram of Management Demarcation of Mashoko Dam

Dredging of sedimentation in night storage has been carried out once a year.

Concrete blocks are arranged on the top of all along the canal walls raising 15 cm of the wall height. This is to allow more water running than planned to flow down with the aim of increasing the irrigated area.

3) Farming activities

i) Irrigated area

The irrigated area under Mashoko Dam irrigation scheme is 30 ha. The main cultivated crops are maize (cultivated area about 24 to 25 ha), sugar beans (about 24 ha) and wheat (about 5 to 6 ha). The typical crop planting period of these main crops is illustrated as Figure 5.3.51.

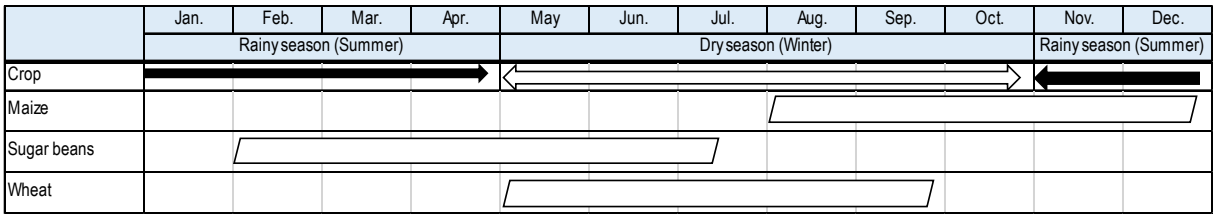


Figure 5.3.51 Typical Crop Planting Period (Mashoko Dam: Irrigated Area)

90 % of maize production and 60-70 % of wheat production are used for self-consumption. On the other hand, 75% of sugar beans production is sold and it is a source of income for beneficiary farmers. The beneficiary farmers mainly sell the sugar beans to locals and the selling price of sugar beans is 41.7 USD/50 kg. This is about twice the selling price of maize 19.4 USD/50 kg, and therefore it means that sugar bean is a highly profitable crop. The selling price of wheat is 41.7 USD/50 kg, which is the same as that of sugar beans.

ii) Non-irrigated area

There is non-irrigated area and a total 16 ha farmland in Chikwarivo village. There is located close to the irrigated area and crops are cultivated during the rainy season only. The main cultivated crops are maize (cultivated area 7-8 ha), ground nuts (5-6 ha), sorghum (2 ha) and sweet potato (1 ha), and all the crops are for self-consumption. The typical crop planting period of these major crops is illustrated as Figure 5.3.52.

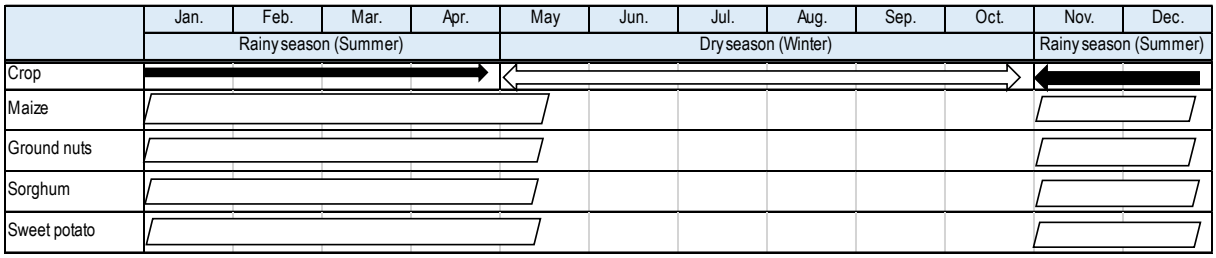


Figure 5.3.52 Typical Crop Planting Period (Mashoko Dam: Non-Irrigated Area)

If the irrigation water would be supplied, farmers in the non-irrigated area wish to plant new crops which are sugar beans and wheat in addition to the existing cultivated crops, such as maize and ground nuts. The farmers intend to increase their income by selling sugar beans, and to cultivate wheat for the demand of self-consumption. When irrigation becomes possible, the expected crop planting period is illustrated as Figure 5.3.53.

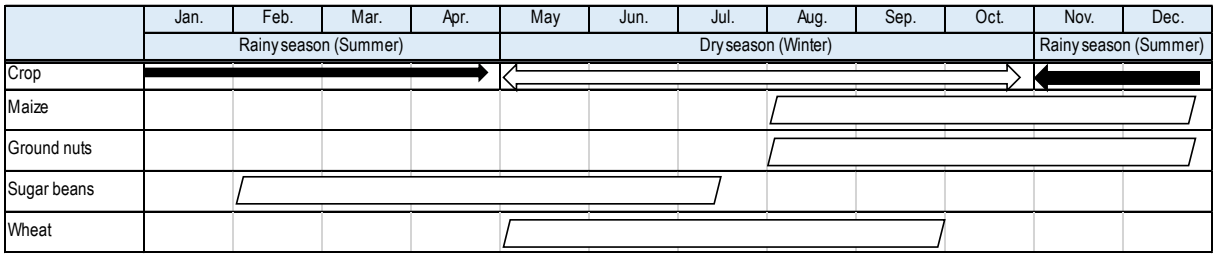


Figure 5.3.53 Expected Crop Planting Period (Mashoko Dam)

The estimated changes in the farmland use ratio before and after irrigation is shown in Table 5.3.24.

Table 5.3.24 Estimating Changes in Farmland Use Ratio before and after Irrigation (Mashoko Dam)

Crop	Cultivated Area before Irrigation (ha)	Cultivated Area after Irrigation (ha)	Increased Farmland Use Ratio (%)
Maize	7-8	7-8	-
Ground nuts	5-6	5-6	-
Sorghum	2	0	-
Sweet potato	1	0	-
Sugar beans	0	16	-
Wheat	0	3	-
Total	16	32	200

After the irrigation water is supplied, dry season cropping will enable farmers to plant sugar beans and wheat, and which is expected to double the farmland utilization per year from 16 ha before irrigation to 32 ha after irrigation.

(2) Evaluation of each Deteriorations/Damages on the Facilities

1) Embankment

i) Confirmed situations and those factor(s)

[Upstream and downstream slope] Partial disturbance of riprap and dam body exposure (see Figure 5.3.54)

The disturbance of the riprap may be caused by the intrusion of people and livestock.

[Crest, and upstream and downstream slope] Many trees (see Figure 5.3.54)

The overgrowth of plants may be caused by the insufficient regular maintenance.

Figure 5.3.54 Partial Disturbance of Riprap, Dam Body Exposure, and Many Trees

ii) Evaluation of deteriorations/damages

Table 5.3.25 Evaluation Results of Deteriorations/Damages (Mashoko Dam: Embankment)

Confirmed Situations	Evaluation	Reason for Evaluation
[Upstream and downstream slope] Partial disturbance of riprap and dam body exposure	B	**Impact on facilities at the present time** - Confirmed deteriorations/damages are not significant deformations, cracks, steps, sinking, etc., which are the main signal of the initial stage of embankment collapse. Additionally, even under high water level (FWL-0.55m), there is no seepage on the downstream slope surface. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of the dam. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are the intrusion of people and livestock, and rainfall which are difficult to control. The progress of erosion may cause the reduction of the embankment cross section and affect the stability of embankment and water storage function of dam. Therefore, it is judged that some measures are required in the long term.
[Crest, and upstream and downstream slope] Many trees	B	**Impact on facilities at the present time** - There is no drop-off of dam body due to fallen trees, and no seepage through roots of plants is observed. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of dam. **Possibility of affecting facilities in the future** - Overgrowth of trees on and around the embankment prevents proper monitoring and detection of significant deformations, cracks, steps, sinking, etc. which are the main signal of the initial stage of embankment collapse, and may affect the stability of embankment. Therefore, it is judged that some measures are required in the long term.

2) Spillway channel

i) Confirmed situations and those factor(s)

[Other] Crossing road across the channel (basket mat) (see Figure 5.3.55)

The reason why people pass the channel may be that there are no bridges that can safely cross the channel.

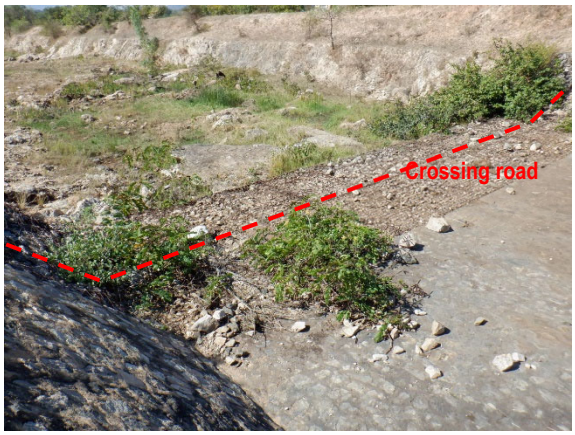


Figure 5.3.55 Crossing Road across the Channel

ii) Evaluation of deteriorations/damages

Table 5.3.26 Evaluation Results of Deteriorations/Damages (Mashoko Dam: Spillway Channel)

Confirmed Situations	Evaluation	Reason for Evaluation
[Other] Crossing road across the channel (basket mat)	B	**Impact on facilities at the present time** - Since there have been no reports of accidents, it is judged that the neighbours have taken adequate precautions when they cross. **Possibility of affecting facilities in the future** - Passing the channel, especially during the rainy season, can cause accidents, so it is judged that some measures are required in the long term.

3) Intake

i) Confirmed situations and those factor(s)

[Inlet] Missing of the wire (see Figure 5.3.56)

The wires may have been removed due to time-related deterioration or stolen. The intake gate is open at all times and water can be taken.

[Inlet] Rusting all over (see Figure 5.3.56)

This may be due to the insufficient maintenance after the wire disappeared.

Figure 5.3.56 Winch for Intake Gate Operation

ii) Evaluation of deteriorations/damages

Table 5.3.27 Evaluation Result of Deteriorations/Damages (Mashoko Dam: Intake)

Confirmed Situations	Evaluation	Reason for Evaluation
[Inlet] Missing of the wires	B	**Impact on facilities at the present time** - The intake gate is open all the time and the intake volume is controlled by the discharge valve. Therefore, it is judged that the confirmed deteriorations/damages do not affect the water intake function. **Possibility of affecting facilities in the future** - When the discharge valve fails, it is necessary to close the intake gate, stop the water intake, and repair the valve. The immediate repairing is required when a valve fails, or the irrigation water supply may be delayed. Therefore, it is judged that some measures are required in the long term.
[Inlet] Rusting all over		

4) On-farm facilities

i) Confirmed situations and those factor(s)

[Canal] Spilling out of back side soil (see Figure 5.3.57)

When the construction was completed, the elevation of the top of canal wall and farmland surface may have been same, however the back side soil may have spilled out due to the tillage near the canal.

[Diversion] Broken of sluice gate (see Figure 5.3.58)

The sluice gate may have been broken due to time-related deterioration or un-repairing for 30 years after installation.

Figure 5.3.57 Spilling Out of Back Side Soil

Figure 5.3.58 Broken of Sluice Gate

ii) Evaluation of deteriorations/damages

Table 5.3.28 Evaluation Results of Deteriorations/Damages (Mashoko Dam: On-Farm Facilities)

Confirmed Situations	Evaluation	Reason for Evaluation
[Canal] Spilling out of back side soil	B	**Impact on facilities at the present time** - Since the required amount of irrigation water can be passed through, the operation (irrigation water supply) may not be affected. **Possibility of affecting facilities in the future** - When the back side soil spills in the future, the canal may move, joints will open, and then water leaks. Since the occurrence of water leakage causes a decrease in the amount of irrigation water supply and a decrease in the irrigation area, it is judged that some measures are required in the long term.
[Diversion] Broken sluice gate	B	**Impact on facilities at the present time** - There is another similar diversion work on the downstream, and it is possible to adjust the flow rate and water level to some extent by this diversion. Additionally, sandbags can be used instead of broken gate in case of emergency. Therefore, it is judged that the confirmed deteriorations/damages do not affect the operation (irrigation water supply). **Possibility of affecting facilities in the future** - If the damage will have been left unsolved, it may not be possible to distribute water as planned. In this case, there may be fields with excess / undersupply of water than the planned amount, which may become to a decrease in the irrigated area. Therefore, it is judged that some measures are required in the long term.

5.3.5 Mabvute Dam

(1) Current Status

1) Summary of deteriorations/damages on the facilities

The location of deteriorations/damages found on Mabvute Dam are shown in Figure 5.3.59, and the summary of the evaluation results of each deteriorations/damages are shown in Table 5.3.29.

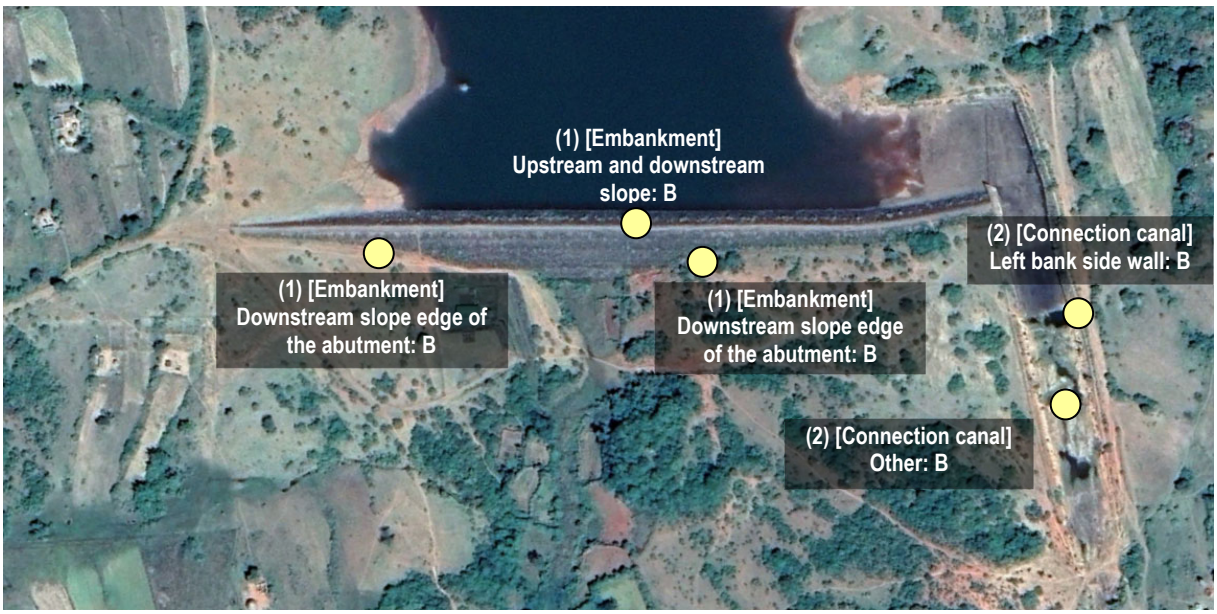


Figure 5.3.59 Locations of Deteriorations/Damages on Mabvute Dam

Table 5.3.29 Summary of the Evaluation Results of Deteriorations/Damages on Mabvute Dam

NO.	FACILITIES		EVALUATION (A or B)	CONFIRMED PHENOMENON
(1)	Embankment	Upstream and downstream slope	B	- Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees
		Downstream slope edge of the abutment	B	- Erosion
(2)	Connection canal	Left bank side wall	B	- Collapse of side wall at the end of the spillway channel
		Other	B	- Crossing road across canal

2) Operation and maintenance

ZINWA is responsible for reservoir, embankment (including spillway, spillway channel, and connection canal), intake (including pump), pipeline and night storage, and IMC is responsible for on-farm facilities.

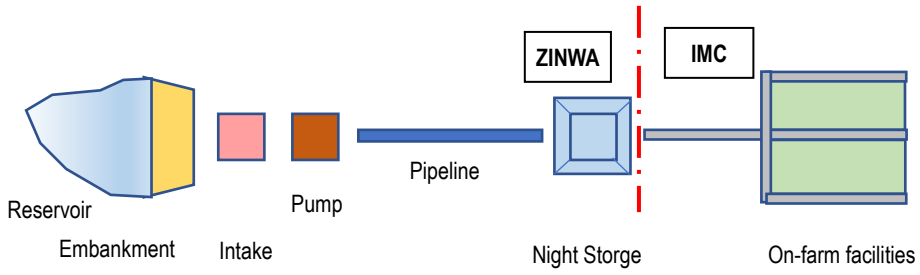


Figure 5.3.60 Pattern Diagram of Management Demarcation of Mabvute Dam

Diesel pump has been subject to maintenance work such as oil change and filter change every 6 months. Dredging of sedimentation in night storage has been carried out once a year. In 2017, with the support by FAO, one out of two diesel pumps was replaced with an electric pump, and pipeline and on-farm facilities were repaired.

3) Farming activities

i) Irrigated area

The irrigated area under Mabvute Dam irrigation scheme is 74 ha, and the main cultivated crops are maize, sugar beans and wheat. The cultivated area of maize is 64 ha, sugar beans 41 ha, and wheat 19.9 ha. The typical crop planting period of these main crops is illustrated as Figure 5.3.61.

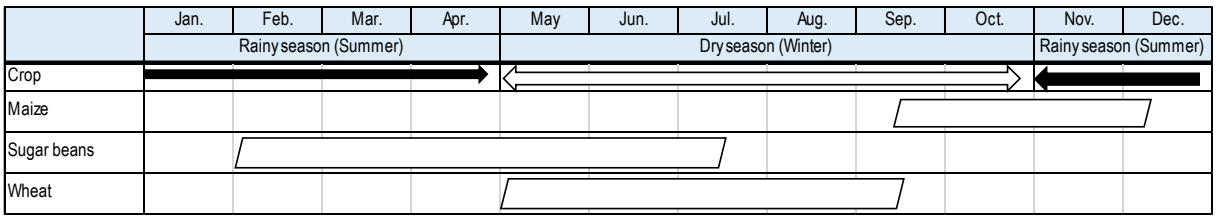


Figure 5.3.61 Typical Crop Planting Period (Mabvute Dam: Irrigated Area)

Although most of the maize are for self-consumption, sugar beans and wheat are sold about 90 % of their production to GMB. Maize is used for self-consumption as a raw material for staple food, while the beneficiary farmers almost sell sugar beans and wheat because they are high selling price. The closest GMB deposit to the area is in Jerera, it is about 35 km distance. The transportation cost to the Jerera GMB deposit is 2 USD/50 kg. The selling price of sugar beans is 80 USD/50 kg and the selling price of wheat is 24 USD/50 kg.

ii) Non-Irrigated area

The Mudavanhu village is non-irrigated area located close to irrigated area. There are 70 farmland households, the average farmland area is 2 ha per house and the total farmland area of the village is estimated to be about 140 ha. The main cultivated crops are maize, sorghum, finger millet and sweet potato, and the typical crop planting period of these main crops is illustrated as Figure 5.3.62.

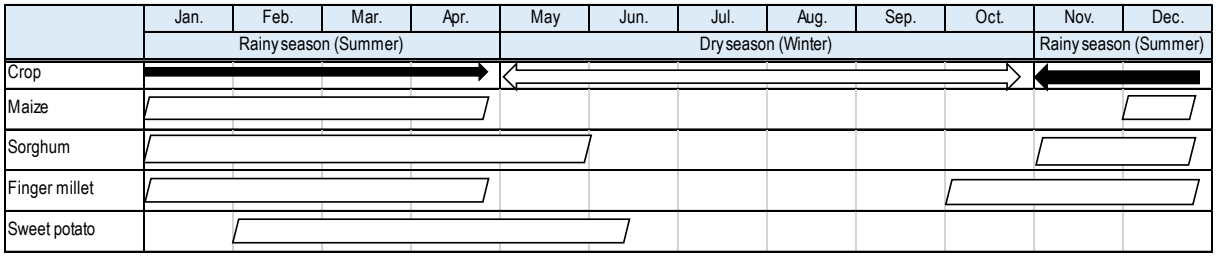


Figure 5.3.62 Typical Crop Planting Period (Mabvute Dam: Non-Irrigated Area)

The farmers cannot plant any crops during the dry season due to water shortage. Almost crops are for self-consumption but the surplus of maize may be sold to the GMB deposit in the Jerera area, same as in the irrigated area. The farmer's selling price of maize is 17.5 USD/50 kg. The yield of maize is around 650 kg/ha and the annual consumption of maize in a small family is about 535 kg to 600 kg (The average of small families consists of five people). Their income is mainly obtained from the sale of livestock (goats, chickens, pigs, cows and etc.).

If the irrigation water would be supplied, farmers in the non-irrigated area wish to plant maize, sugar

beans, potatoes and tomatoes. They want to deliver the products to the nearest Jerera market and selling the products to increase their income. The expected planting period in that case is illustrated as Figure 5.3.63.

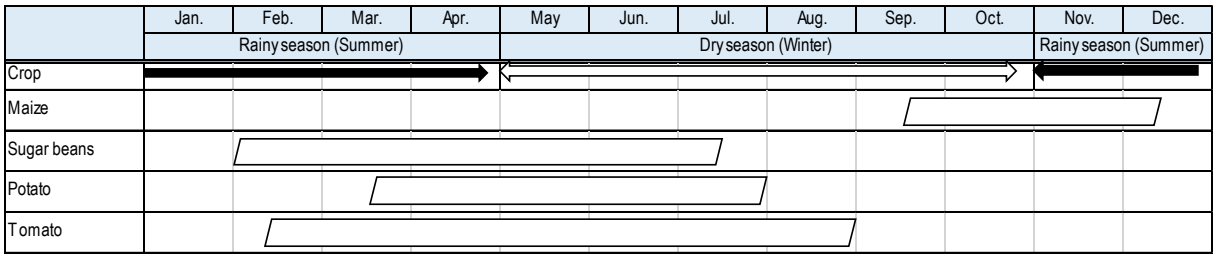


Figure 5.3.63 Expected Crop Planting Period (Mabvute Dam)

When irrigation becomes possible, the farmers would cultivate maize for self-consumption and increase income by sugar beans and tomatoes for selling.

The estimated changes in farmland use ration before and after irrigation facilities is shown in Table 5.3.30

Table 5.3.30 Estimating Changes in Farmland Use Ratio before and after Irrigation (Mabvute Dam)

Crop	Cultivated Area before Irrigation (ha)	Cultivated Area after Irrigation (ha)	Increased Farmland Use Ratio (%)
Maize	1.0	2.0	-
Sorghum	0.2	0/0	-
Finger millet	0.2	0.0	-
Sweet potato	0.2	0.0	-
Coarse cereal	0.4	0.0	-
Sugar beans	0.0	1.4	-
Potato	0.0	0.3	-
Tomato	0.0	0.3	
Total	2.0	4.0	200

If the irrigation becomes possible, crop planting will be possible per year and it is estimated that the farmland utilization area will be double.

(2) Evaluation of each Deteriorations/Damages on the Facilities

1) Embankment

i) Confirmed situations and those factor(s)

[Upstream and downstream slope] Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees (see Figure 5.3.64)

Under the riprap, there may be erosion due to rainfall, and the eroded portions are filled with riprap materials. In addition, the disturbance of the riprap and dam body exposure may be caused by the intrusion of people and livestock. Further, the overgrowth of plants implies the insufficient regular maintenance.

Figure 5.3.64 Upstream and Downstream Slope

[Downstream slope edge of the abutment] Erosion (see Figure 5.3.65)

Even under the high water level condition (FWL-0.4m), there is no flow, seepage and wetness on the downstream slope surface and edge. Therefore, rainfall runoff from embankment slope might made a flow path at the edge of the slope.

In addition, it is thought that erosion was caused by the un-construction of drainage canal at the edge of the slope.

Figure 5.3.65 Downstream Slope Edge

ii) Evaluation of deteriorations/damages

Table 5.3.31 Evaluation Results of Deteriorations/Damages of (Mabvute Dam: Embankment)

Confirmed Situations	Evaluation	Reason for Evaluation
[Upstream and downstream slope] Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees.	B	**Impact on facilities at the present time** - Confirmed deteriorations/damages are not significant deformations, cracks, steps, sinking, etc., which are the main signal of the initial stage of embankment collapse. Additionally, even under high water level (FWL-0.4m), there is no seepage on the downstream slope surface. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of the dam. - There is no drop-off of dam body due to fallen trees, and no seepage through roots of plants is observed. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of dam. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are the intrusion of people and livestock, rainfall, and insufficient maintenance which are difficult to control. The progress of erosion may cause the reduction of the embankment cross section and affect the stability of embankment and water storage function of dam. Therefore, it is judged that some measures are required in the long term.
[Downstream slope edge of the abutment] Erosion	B	**Impact on facilities at the present time** - Erosion is observed at the edge of downstream slope only and therefore it is judged that the stability of the embankment is not affected. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factor is rainfall which is difficult to control. The progress of erosion may cause the reduction of the embankment cross section and affect the stability of embankment and water storage function of dam. Therefore, it is judged that some measures are required in the long term.

2) Connection canal

i) Confirmed situations and those factor(s)

[Left bank side wall] Collapse of side wall at the end of the spillway channel (see Figure 5.3.66)

There is no basket mat work at the end of the spillway channel, and it is formed like a drop-off. During the floods, disturbance of the flow may occur at this drop-off, eroded both bank sides walls and caused the collapse.

[Other] Crossing road across the canal (see Figure 5.3.67)

The reason why people pass the canal may be that there are no bridges that can safely cross the channel.

Figure 5.3.66 Collapse of Left Bank Side Wall at the End of the Spillway Channel

Figure 5.3.67 Crossing Road

ii) Evaluation of deteriorations/damages

Table 5.3.32 Evaluation Results of Deteriorations/Damages (Mabvute Dam: Connection Canal)

Confirmed Situations	Evaluation	Reason for Evaluation
[Left bank side wall] Collapse of side wall at the end of the spillway channel	**B**	**Impact on facilities at the present time** - There are no important structures such as houses, farmland, or embankments around the collapse points. Therefore, it is judged that confirmed deteriorations/damages do not affect the stability of embankment and the surrounding area. **Possibility of affecting facilities in the future** - Considering the cracks on the walls and the condition of the sediment in the canal, it is estimated that the progress of the collapse has slowed down. However, rainfall and flooding may cause further collapse and affect the surrounding sidewalks, etc. in future. Therefore, it is judged that some measures are required in the long term.
[Other] Crossing road across canal	**B**	**Impact on facilities at the present time** - Since there have been no reports of accidents, it is judged that the neighbours have taken adequate precautions when they cross. **Possibility of affecting facilities in the future** - Passing the canal, especially during the rainy season, can cause accidents, so it is judged that some measures are required in the long term.

5.3.6 Munjanganja Dam

(1) Current Status

1) Summary of deteriorations/damages on the facilities

The location of deteriorations/damages found of Munjanganja Dam are shown in Figure 5.3.68, and the summary of the evaluation results of each deteriorations/damages are shown in Table 5.3.33.

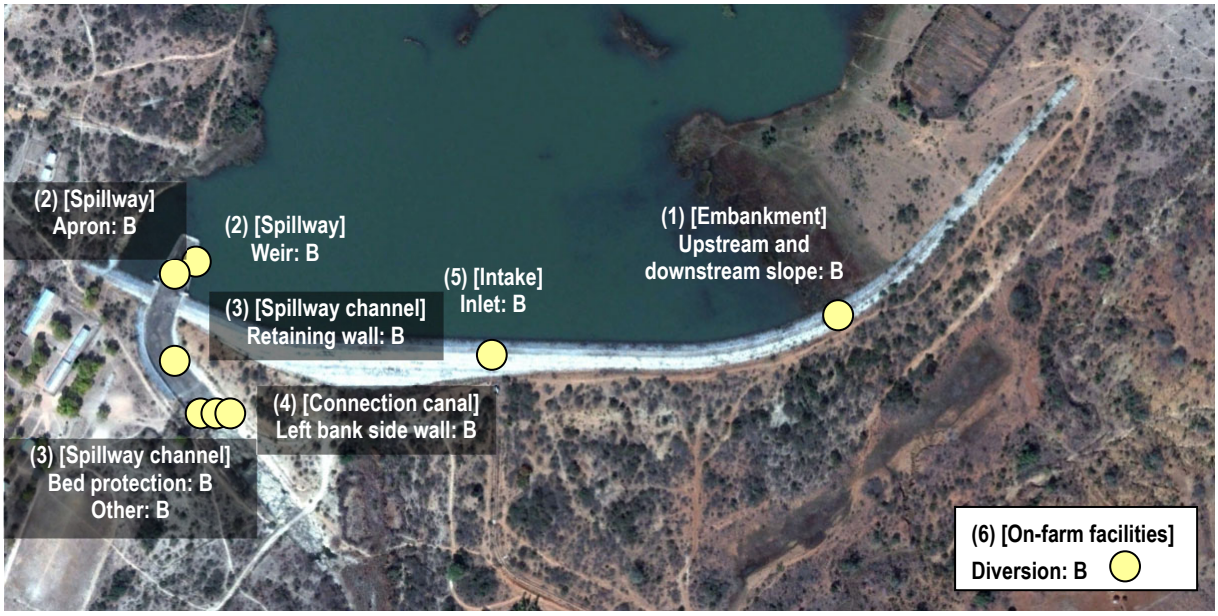


Figure 5.3.68 Locations of Deteriorations/Damages on Munjanganja Dam

Table 5.3.33 Summary of the Evaluation Results of Deteriorations/Damages on Munjanganja Dam

NO.	FACILITIES		EVALUATION (A or B)	CONFIRMED PHENOMENON
(1)	Embankment	Upstream and downstream slope	B	- Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees
(2)	Spillway	Weir	B	- Leakage from downstream slope
		Apron	B	- Open and damaged joints
(3)	Spillway channel	Retaining wall	B	- Cracks at the top of walls
		Bed protection	B	- Spilling out of basket mat on the right bank side
		Other	B	- Crossing road across the channel
(4)	Connection canal	Left bank side wall	B	- Collapse of side walls at the end of the spillway channel
(5)	Intake	Inlet	B	- Missing of the wires
(6)	On-farm facilities	Diversion	B	- Broken of sluice gate

2) Operation and maintenance

ZINWA is responsible for reservoir, embankment (including spillway, spillway channel, and connection canal), intake, and IMC is responsible for main canal, night storage and on-farm facilities.

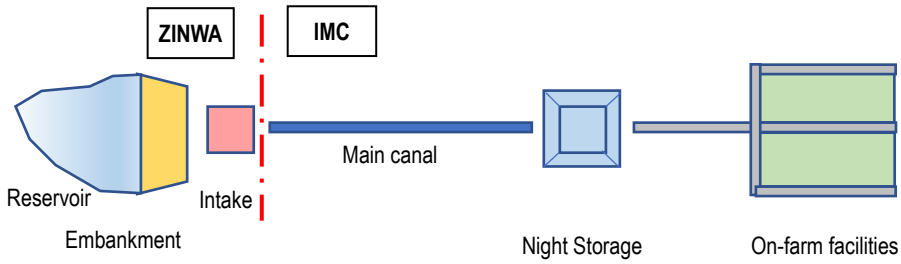


Figure 5.3.69 Pattern Diagram of Management Demarcation of Munjanganja Dam

Dredging of sedimentation in night storage has not been carried for 30 years after completion of the construction, but almost no sedimentation is confirmed. In 2019, on-farm facilities were repaired with the support by FAO.

3) Farming activities

i) Irrigated area

The irrigated area under Munjanganja Dam irrigation scheme is 51 ha, and the main cultivated crops are maize (cultivated area about 30-35 ha), sugar beans (about 20 ha) and wheat (about 20 ha). The typical crop planting period of these main crops is illustrated as Figure 5.3.70.

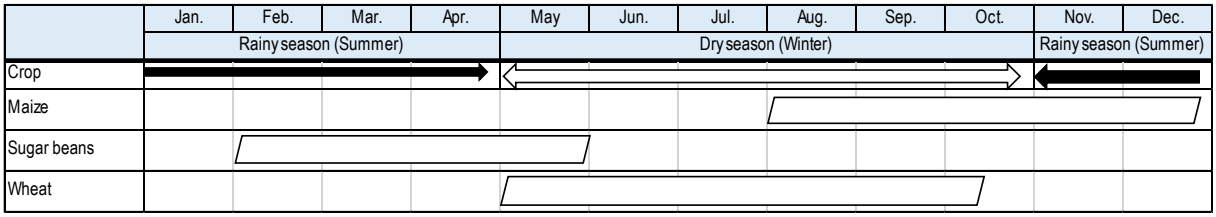


Figure 5.3.70 Typical Crop Planting Period (Munjanganja Dam: Irrigated Area)

The farmland area per beneficiary farmer is around 0.2 ha - 0.6 ha. Most of the cultivated crops are for self-consumption but the surplus of maize and wheat (about 10% of each harvest, about 100 kg - 300 kg of maize and about 60 kg - 240 kg of wheat) is sold to GMB. The yield of maize is 5 ton/ha, wheat is 3-4 ton/ha and sugar bean is 2 ton/ha. The beneficiary farmer's selling price of maize is 16 USD/50kg, wheat is 26 USD/50 kg and sugar beans is 50 USD/50 kg.

ii) Non-Irrigated area

The main cultivated crops in the non-irrigated area close to the irrigated are maize, finger millet, sorghum and ground-nuts. The farmers in this non-irrigated area cannot plant any crops during the dry season. The typical crop planting period of these main crops is illustrated as Figure 5.3.71.

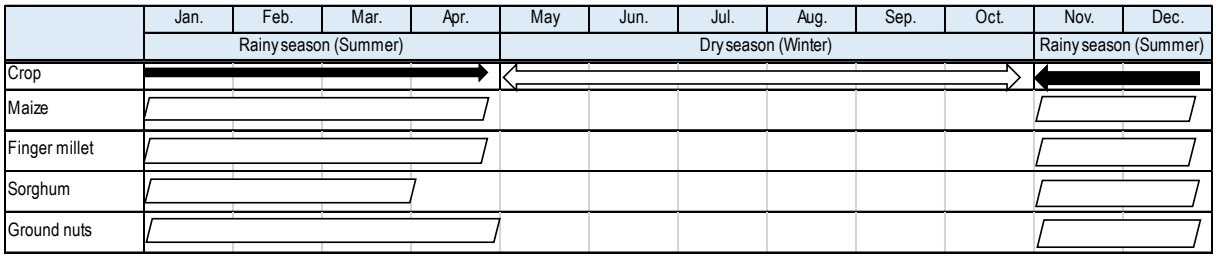


Figure 5.3.71 Typical Crop Planting Period (Munjanganja Dam: Non-Irrigated Area)

The yield of maize is 0.3-1.3 ton/ha, finger millet is 0.3-1.3 ton/ha, sorghum is 0.3 ton/ha and ground-nuts is 2-3 ton/ha. The yield of maize is only about 1/17 to 1/4 from yield of the irrigated area. The most of products are for self-consumption and there is not enough for surplus to sell. Since most of the crops is consumed for self-sufficiency, the farmers get income from the sale of livestock (goats, ducks, rabbits, pigs) and part time labour such as brick making.

If the irrigation water would be supplied, farmers in the non-irrigated area wish to plant maize, wheat and sugar beans. The expected crop planting period is the same as the irrigated area shown as Figure 5.3.70.

The estimated changes in the farmland use ratio before and after irrigation is shown in Table 5.3.34. It is estimated that the farmers will plant mainly maize as staple food, wheat and sugar beans are for selling if there is surplus. The farmers will try to plant as crop rotation with maize, wheat and sugar beans same as irrigated area above.

Table 5.3.34 Estimating Changes in Farmland Use Ratio before and after Irrigation (Munjanganja Dam)

Crop	Cultivated Area before Irrigation (ha)	Cultivated Area after Irrigation (ha)	Increased Farmland Use Ratio (%)
Maize	2.0	3.0	-
Finger millet	0.5	0.0	-
Sorghum	0.5	0.0	-
Ground nuts	0.1	0.0	-
Pulse	0.1	0.0	-
Wheat	0.0	2.0	-
Sugar beans	0.0	2.0	-
Others (fallow farm, etc)	1.8	0.0	-
Total	5.0	7.0	140

When irrigation becomes possible, the farmers can plant crops through the year. It means that the farmland utilization rate after irrigation will increase about 1.4 times compared to before irrigation because the farmland can be used through the year.

(2) Evaluation of each Deteriorations/Damages on the Facilities

1) Embankment

i) Confirmed situations and those factor(s)

[Upstream and downstream slope] Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees (see Figure 5.3.72)

Under the riprap, there may be erosion due to rainfall, and the eroded portions are filled with riprap materials. In addition, the disturbance of the riprap and dam body exposure may be caused by the intrusion of people and livestock. Further, the overgrowth of plants implies the insufficient regular maintenance.

Figure 5.3.72 Upstream and Downstream Slope

ii) Evaluation of deteriorations/damages

Table 5.3.35 Evaluation Results of Deteriorations/Damages (Munjanganja Dam: Embankment)

Confirmed Situations	Evaluation	Reason for Evaluation
[Upstream and downstream slope] Disturbance of riprap, gully erosion under riprap, dam body exposure, and trees.	B	**Impact on facilities at the present time** - Confirmed deteriorations/damages are not significant deformations, cracks, steps, sinking, etc., which are the main signal of the initial stage of embankment collapse. Additionally, even under high water level (FWL-0.3m), there is no seepage on the downstream slope surface. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of the dam. - There is no drop-off of dam body due to fallen trees, and no seepage through roots of plants is observed. Therefore, it is judged that the confirmed deteriorations/damages do not affect the stability of embankment and water storage function of dam. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are the intrusion of people and livestock, rainfall, and insufficient maintenance which are difficult to control. The progress of erosion may cause the reduction of the embankment cross section and affect the stability of embankment and water storage function of dam. Therefore, it is judged that some measures are required in the long term.

2) Spillway

i) Confirmed situations and those factor(s)

[Weir] Leakage from downstream slope (see Figure 5.3.73)

Leakage may be caused by insufficient mortar filling between the gravels during construction.

[Apron] Open and damaged joints (see Figure 5.3.74)

Open and damage of the joints may be caused by damage and detachment of the joint material by flood.

Figure 5.3.73 Leakage from Downstream Slope

Figure 5.3.74 Joints of the Apron

ii) Evaluation of deteriorations/damages

Table 5.3.36 Evaluation Results of Deteriorations/Damages (Munjanganja Dam: Spillway)

Confirmed Situations	Evaluation	Reason for Evaluation
[Weir] Leakage from downstream slope	B	**Impact on facilities at the present time** - The amount of leakage is slight and it is judged that confirmed deteriorations/damages do not affect the water storage function of dam. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factor is insufficient concrete filling, which is difficult to control. The progress of situation may cause the increase of leakage and decrease the water storage capacity of dam. Additionally, it may affect the stability of the weir. Therefore, it is judged that some measures are required in the long term.
[Apron] Open and damaged joints	B	**Impact on facilities at the present time** - Since the damage is slight and it is judged that confirmed deteriorations/damages do not affect the water storage function of dam. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factors are the time-related deterioration and flood, which are difficult to control. As the damage expands, it becomes a weak point during floods, which may cause further damage and affect the stability of the facility. In addition, the leakage from the open joints may affect the water storage capacity of dam. Therefore, it is judged that some measures are required in the long term.

3) Spillway channel

i) Confirmed situations and those factor(s)

[Retaining wall] Cracks at the top of walls (see Figure 5.3.75)

The cracks are parallel to the flow direction of the canal, and the factor of the cracks is unknown at this time.

Figure 5.3.75 Cracks at the Top of Retaining Walls

[Bed Protection] Spilling out of basket mat on the right bank side (see Figure 5.3.76)

The remaining area of the basket mat has rock foundation, while a depression with no rocks seen at the foundation of the spilled area. The factor of this may be that the foundation of the gabion at right bank side was relatively soft and easily eroded.

Figure 5.3.76 Spilling Out of Basket Mat at the Right Bank Side

[Other] Crossing road across the channel (see Figure 5.3.76)

The reason why people pass the channel may be that there are no bridges that can safely cross the channel.

ii) Evaluation of deteriorations/damages

Table 5.3.37 Evaluation Results of Deteriorations/Damages (Munjanganja Dam: Spillway Channel)

Confirmed Situations	Evaluation	Reason for Evaluation
[Retaining wall] Cracks at the top of walls	B	Impact on facilities at the present time - Since the damage is slight, it is judged that confirmed deteriorations/damages do not affect the stability of the facility. Possibility of affecting facilities in the future - There is a possibility that the damage would expand and walls deteriorate due to rainwater infiltration for long time use. Deterioration and collapse of the walls may affect the discharge function of spillway. Therefore, it is judged that some measures are required in the long term.

Confirmed Situations	Evaluation	Reason for Evaluation
[Bed protection] Spilling out of basket mat on the right bank side	B	**Impact on facilities at the present time** - Since there is no collapse in the surrounding area, it is judged that confirmed deteriorations/damages do not affect the discharge function. **Possibility of affecting facilities in the future** - The scale of confirmed deteriorations/damages would expand in the future because its factor is flood, which is difficult to control. If the spill expand, 1) flow at this point would be disturbed, 2) this may cause the collapse of the surrounding area, and 3) affect the discharge function of spillway. Therefore, it is judged that some measures are required in the long term.
[Other] Crossing road across channel	B	**Impact on facilities at the present time** - Since there have been no reports of accidents, it is judged that the neighbours have taken adequate precautions when they cross. **Possibility of affecting facilities in the future** - Passing the channel, especially during the rainy season, can cause accidents, so it is judged that some measures are required in the long term.

4) Connection canal

i) Confirmed situations and those factor(s)

[Left bank side wall] Collapse of side walls at the end of the spillway channel (see Figure 5.3.77)

Here is the section where the material of the canal changes from concrete to basket mat and basket mat to soil, and it is assumed that erosion has occurred due to the disturbance of flow at this point.

Figure 5.3.77 Collapse of Left Side Bank

ii) Evaluation of deteriorations/damages

Table 5.3.38 Evaluation Results of Deteriorations/Damages (Munjanganja Dam: Connection Canal)

Confirmed Situations	Evaluation	Reason for Evaluation
[Left banks side wall] Collapse of side walls at the end of the spillway channel	B	**Impact on facilities at the present time** - There are no important structures such as houses, farmland, or embankments around the collapse points. Therefore, it is judged that confirmed deteriorations/damages do not affect the stability of embankment and the surrounding area. **Possibility of affecting facilities in the future** - Considering the cracks on the walls and the condition of the sediment in the canal, it is estimated that the progress of the collapse has slowed down. However, rainfall and flooding may cause further collapse and affect the stability of gabions in future. Therefore, it is judged that some measures are required in the long term.

5) Intake

i) Confirmed situations and those factor(s)

[Inlet] Missing of the wires (see Figure 5.3.78)

The wires may have been removed due to time-related deterioration or stolen. The intake gate is open at all times and water can be taken.

Figure 5.3.78 Winch on the Crest

ii) Evaluation of deteriorations/damages

Table 5.3.39 Evaluation Results of Deteriorations/Damages (Munjanganja Dam: Intake)

Confirmed Situations	Evaluation	Reason for Evaluation
[Inlet] Missing of the wires	B	Impact on facilities at the present time - The intake gate is open all the time and the intake volume is controlled by the discharge valve. Therefore, it is judged that the confirmed deteriorations/damages do not affect the water intake function. Possibility of affecting facilities in the future - When the discharge valve fails, it is necessary to close the intake gate, stop the water intake, and repair the valve. The immediate repairing is required when a valve fails, or the irrigation water supply may be delayed. Therefore, it is judged that some measures are required in the long term.

6) On-farm facilities

i) Confirmed situations and those factor(s)

[Diversion] Broken of sluice gate (see Figure 5.3.79)

The sluice gate may have been broken due to time-related deterioration or un-repairing for 30 years after installation.

Figure 5.3.79 Broken Sluice Gate

ii) Evaluation of deteriorations/damages

Table 5.3.40 Evaluation Results of Deteriorations/Damages (Munjanganja Dam: On-Farm Facilities)

Confirmed Situations	Evaluation	Reason for Evaluation
[Diversion] Broken of sluice gate	B	Impact on facilities at the present time - There is another similar diversion work on the downstream, and it is possible to adjust the flow rate and water level to some extent by this diversion. Additionally, sandbags can be used instead of broken gate in case of emergency. Therefore, it is judged that the confirmed deteriorations/damages do not affect the operation (irrigation water supply). Possibility of affecting facilities in the future - If the damage will have been left unsolved, it may not be possible to distribute water as planned. In this case, there may be fields with excess / undersupply of water than the planned amount, which may become to a decrease in the irrigated area. Therefore, it is judged that some measures are required in the long term.

5.4 EMERGENCY REPAIRING PLAN

5.4.1 Target Deteriorations/Damages

The emergency repairing plan is formulated for deteriorations/damages evaluated as "A" (urgent measures are required). According to the survey results shown in 5.3, the target deteriorations/damages are 1) Two large scale collapses on the right bank side wall of the connection canal, and 2) Exposure of siphon lining concrete on the connection canal bed.

5.4.2 Basic Policy

Since immediate implementation of emergency repairing measures is required, GoZ is the expected implementation agency, which may implement earlier than the Japanese aid scheme, such as Grant Aid Project. Therefore, the specification of the repairing measures shall be simple enough so that Zimbabwean contractor can construct. On the other hand, assuming that GoZ cannot secure the budget, the possibility of implementation by a development partner is assessed.

Finally, taking into account the results of above study/investigation, specification of emergency repairing measures, target area and implementation agency are selected.

5.4.3 Objective, Specification and Scale of the Emergency Repairing Measures

(1) Target: Two Large Scale Collapses on the Right Bank Side Wall of the Connection Canal

1) Occurrence factor

Impact by the flood which flow direction was changed due to a ditch across the connection canal

2) Objectives of the emergency repairing measures and required measures

[Objective-1] Avoiding the impact by flood by changing flood direction to downstream

[Measure 1-1] Backfilling the ditch across the connection canal, which is a main factor of change in flow direction, by wet masonry

[Measure 1-2] Construction of retaining wall by wet masonry along the right bank side wall and backfilling the erosion on the canal bed to make flow direction to downstream

[Objective-2] Suppress the progress of the current collapses

[Measure 2] Backfilling the area from retaining wall (to be constructed as measure 1-2) to the collapse surface with earthen materials and wet masonry

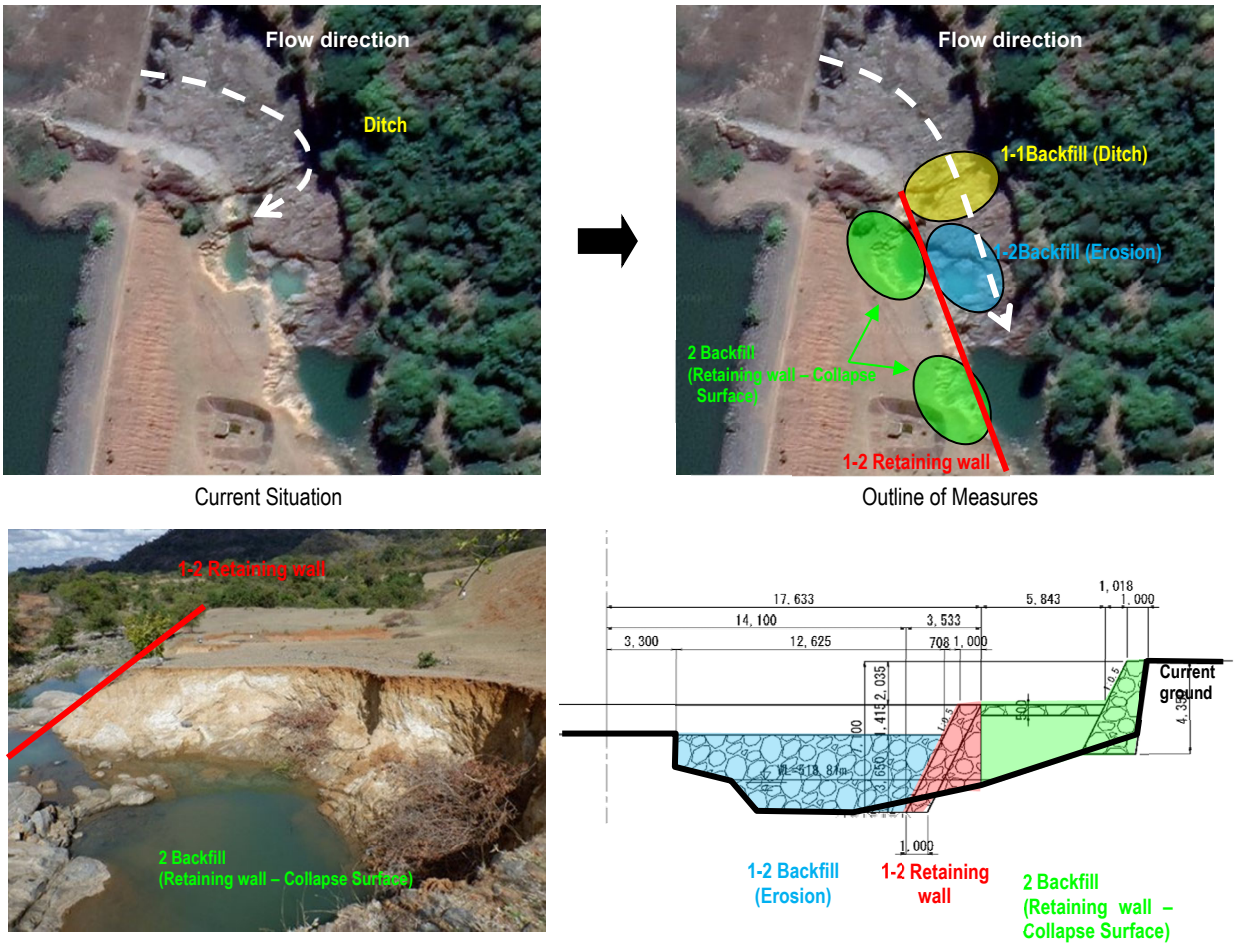


Figure 5.4.1 Outline of Emergency Repairing Measure for Two Large-Scale Collapses on the Right Bank Side Wall of the Connection Canal

3) Scale of emergency repairing measures

The scale of the emergency repairing measures is the one which any damages will not happen even if Cyclone Idai in 2019 comes again. The target flood discharge is 160 m^3/s calculated by rational formula utilizing daily rainfall at the time of the Cyclone Idai, and measures are designed according to the conditions below. The numbers below are consistent with the numbers shown in Figure 5.4.2.

(i) Retaining wall height: The critical water depth in each cross section during the target flow discharge rate

NOTE: Since canal bed slope in the target section is steep, about 1/6 to 1/9, it is considered that the flow conditions at the time of flood are supercritical in all cross sections. Since the supercritical flow depth is less than the critical water depth, the critical water depth in each cross section is adopted in consideration of the safety side.

(ii) Minimum thickness of retaining wall: 1.0 m in consideration of workability

(iii) Front slope of retaining wall: 1: 0.5 in consideration of workability

(iv) Front protection of retaining wall: Perform rooting work with a thickness of 1.0 m or more

(v) Retaining wall back: Backfill with wet masonry or earthen material

(vi) Area above the retaining wall: The front of the collapsed surface is covered with wet masonry work with a top width of 1.0 m and a front slope of 1: 0.5.

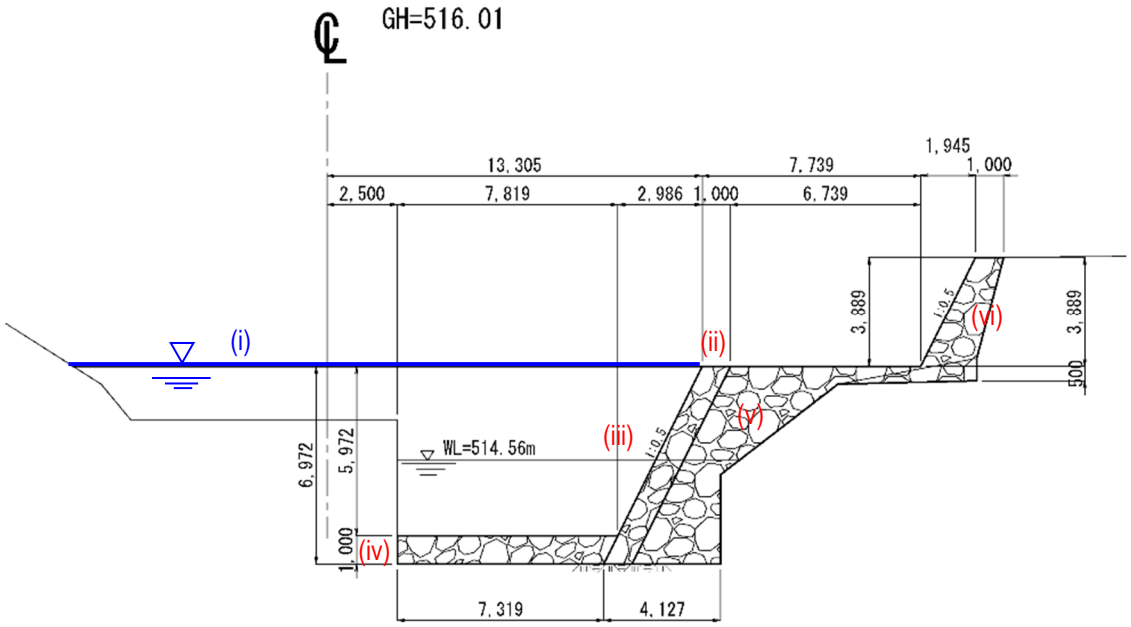


Figure 5.4.2 Scale of Emergency Repairing Measures for Two Large Scale Collapses on the Right Bank Side Wall of the Connection Canal

(2) Target: Exposure of Siphon Lining Concrete on the Connection Canal Bed

1) Occurrence factor

Erosion caused by flood

2) Objectives of the emergency repairing measures and required measures

[Objective] Preventing erosion caused by flood flow

[Measure] Covering the exposed siphon lining concrete by wet masonry

3) Scale of emergency repairing measures

0.5 m covering thickness in consideration of workability

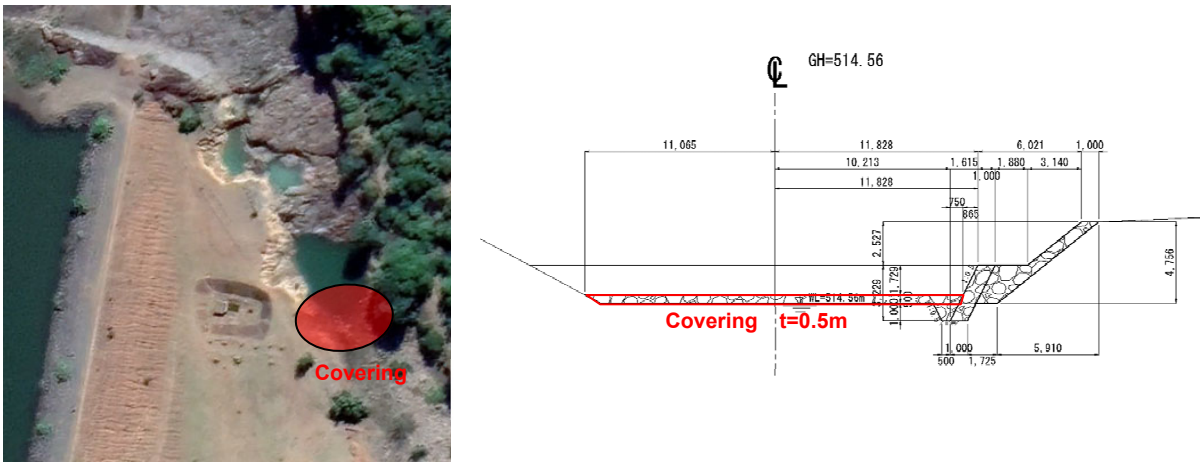


Figure 5.4.3 Outline of Emergency Repairing Measure for Exposure of Siphon Lining Concrete on the Connection Canal Bed

5.4.4 Basic Design Drawings of Emergency Repairing Measures

(Refer to Appendix-2 for all basic drawings)

Figure 5.4.4 Basic Design Drawng of Emargency Reparing Measures (Plan View)

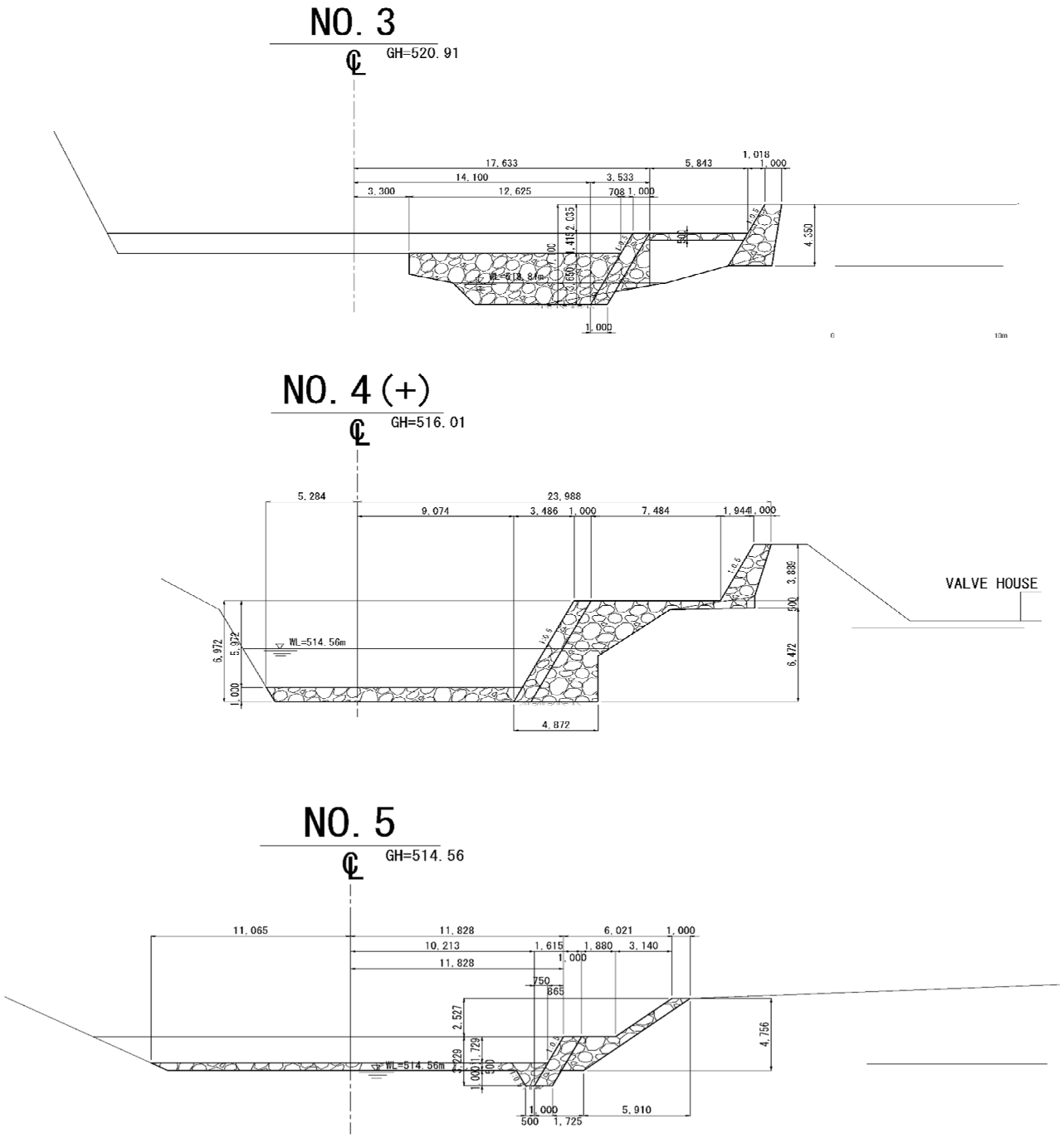


Figure 5.4.5 Basic Design Drawings of Emargency Reparing Measures (Representative Cross Sections)

5.4.5 Implementation Priority

Although it is expected that all the emergency repairing measures for both 1) Two large scale collapses on right bank side wall of the connection canal and 2) exposure of siphon lining concrete on the connection canal bed, are implemented immediately and at once. On the other hand, in consideration of the damage which may happen when the target structure collapses, and the contribution of the repairing measures to the deteriorations/damages extension control, the emergency repairing measures are divided into five construction packages (PKGs) according to the priority.

Table 5.4.1 Construction Package Division of Emergency Repairing Measures

PKG	Target Area	Main target	Priority	Remarks
PKG-1	No. 1 - No.1+7.15	A collapse progressing to a point 6.0m from the embankment * If this collapse extends, it could lead to the collapse of the embankment and loss of life.	1	Backfilling of the ditch across the connection canal which is the main cause of the collapse
PKG-2	No. 1 - No.3+9.95		2	Construction of the retaining wall and backfilling of the back of the wall to control the progression of the collapse
PKG-3	No.4+20.84 - No.6	Exposed siphon protection works * If the siphon pipe is damaged, the irrigation water supply will be interrupted. This may result in impoverishment, but not loss of life.	3	Surface covering to prevent damage on siphon protection works
PKG-4	No.3+9.95 - No.5+6.59	A collapse progressing to a point 1.5m from discharge valve house slope protection works * Even if the slope protection works are damaged, the valve can be operated for a while by removing the earth and sand manually.	4	Construction of the retaining wall and backfilling of the back of the wall to control the progression of the collapse
PKG-5	No.1+7.15 - No.4+20.84	Unevenness on throughout the connection canal bed	5	Backfilling of connection canal bed unevenness (mainly recesses)

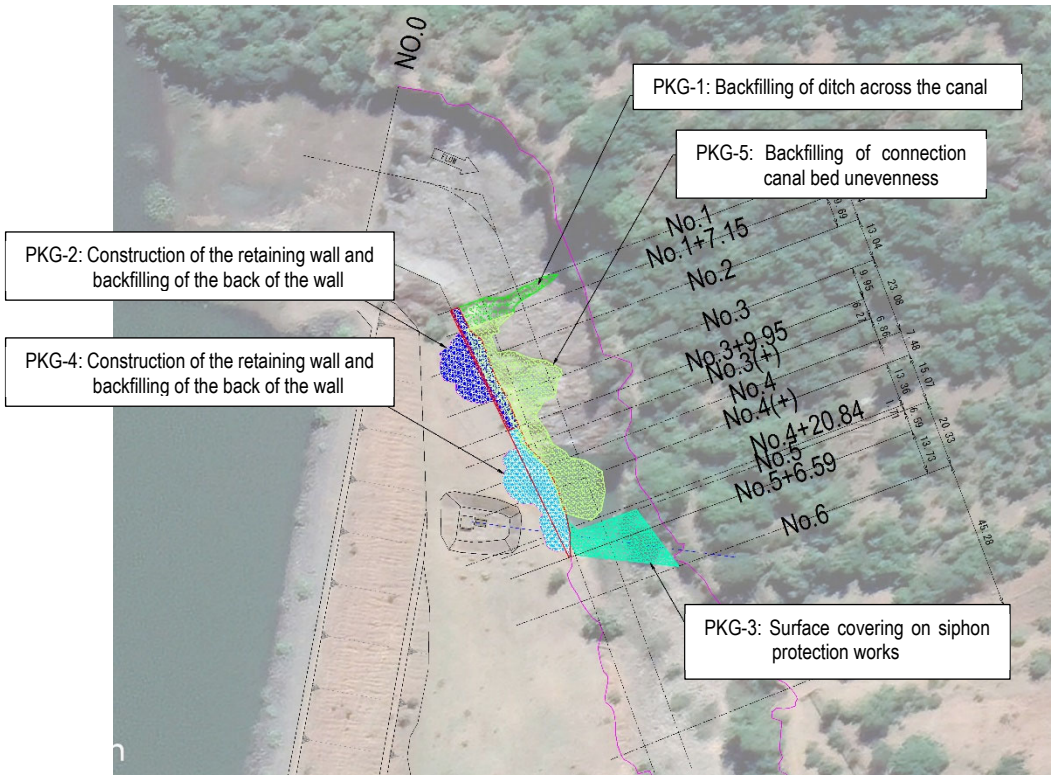


Figure 5.4.6 Construction Package Division of Emergency Repairing Measures

5.4.6 Project Cost

Table 5.4.2 shows the construction costs by construction PKGs. These costs are calculated based on the quotation submitted by Zimbabwean contractors (Refer to Appendix-2 for all the submitted quotations).

Table 5.4.2 Project Cost of Emergency Repairing Measures by PKGs

Contractors	Construction costs (thousand USD)					
	PKG-1	PKG-2	PKG-3	PKG-4	PKG-5	Total
	Backfilling of connection canal crossing trenches	Backfilling of retaining walls and the back of retaining walls (Upstream)	Surface coating of siphon protection works	Backfilling of retaining walls and the back of retaining walls (Downstream)	Backfilling of uneven floor of connection canal	
Company A	55	240	51	281	331	958
Company B	72	309	66	364	435	1,246
Company C	59	265	54	298	357	1,033
Average	**62**	**271**	**57**	**314**	**375**	**1,079**

5.4.7 Capacity of Zimbabwean Contractors

The capacity of Zimbabwean contractors is assessed through 1) questionnaire survey and 2) inspection of the construction site. Based on the assessment, the feasibility to implement the emergency repairing measures by the Zimbabwean contractor is verified.

(1) Questionnaire Survey

The Survey team requested DOI to introduce four contractors in Zimbabwe who have a track record of dam construction and irrigation schemes. The Survey team distributed the questionnaire to the Zimbabwean contractors and requested to answer. The questions consisted of 1) financial status, 2) construction experiences for the last five years, and 3) the number of engineers and construction machineries.

Three out of four contractors submitted the answers (Refer to Appendix-2 for all the submitted answers). The summary of the answers is shown in Table 5.4.3. All the three contractors have annual sales from 250,000 USD to 12 million USD in last five years, and all contractors are continuously involved in the dam construction. Additionally, all the contractors have implemented a series of dam construction such as embankments, spillways, pipelines, and irrigation facilities. Further, all of them have enough number of engineers and construction machineries, also have suppliers who can supply sufficient amount of construction materials such as cement, earth & sand, and steel bars.

Table 5.4.3 Summary of Answers from Zimbabwean Contractors

Contractor Name		E.G. Construction	J R Goddard Contracting (Pvt) Ltd	Multiforce Contractors
Office		Masvingo	Bulawayo, Gweru, Harare	Harare
Financial Condition (1,000USD)	Capital Fund	5,000	17,800	N/A
	Total Debt	250	N/A	N/A
Annual Sales of last 5 years (1,000USD)		250 - 12,000	700 - 6,400 (Dam project only)	1,000 - 3,000
Engineers	1~5years	3	16	4
	5~10years	6	10	10
	10years~	2	6	5
Construction Machineries	Excavator	5	28	5
	Bulldozer	2	14	2
	Dump truck	16	67	7

(2) Inspection of the Construction Site

The Survey team inspected Chivu Dam construction site being carried out by one of the Zimbabwean contractors who answered to the questionnaire survey requested by the Survey team.

Table 5.4.4 Summary of Chivu Dam Specification

Client	Contractor	Dam Type	Height	Crest Length	Embankment Volume	Storage Capacity	Water Surface Area
ZINWA	E.G. Construction KW Blasting Specialists	Zone type Earth dam	28.2 m	346 m	400,000 m^3	2.6 million m^3	420 ha

At the time of the inspection, main works carried out were curtain grouting, backfilling of core zone, backfilling of shell zone, and spillway foundation excavation. (see Figure 5.4.7)

Figure 5.4.7 Construction Site of Chivu Dam

The construction site was well organized, and especially for safety measures, 1) a gate with a gatekeeper was installed at the entrance of the construction site so that no one other than the people concerned was allowed to enter (see Figure 5.4.8), 2) all of workers wore helmets and safety shoes, and 3) "Tool Box Meeting" (confirmation of dangerous places in the work of the day) had been held every morning before starting of works.

In addition, the site manager had a very good understanding of the construction method, quality control (frequency, method, etc.) for each construction type, and environmental & social considerations as well. The workers were employees of the company, and they were dispatched to the site after some training.

Figure 5.4.8 Gate at the Entrance of the Site

(3) Capacity to Implement the Emergency Repairing Measures

According to the answers for the questionnaire, all of them have 1) stable sales and good financial conditions, 2) enough engineers with sufficient years of experience, 3) enough construction machineries, and 4) construction material suppliers. Additionally, it can be said through site inspection that a contractor has enough construction capacity and management capacity. Thus, it is judged that there is a Zimbabwean contractor who may be able to carry out the planned emergency repairing measures.

In addition, the Survey team interviewed one of the three contractors who answered to the questionnaire survey and found that a company was involved in the construction of six dams under the “Project on Medium Size Dams in Masvingo Province” which was completed 30 years ago under Japanese Grant Aid Project. Therefore, it is judged that there is a contractor who knows required quality and safety measures for the project by the development partners.

5.4.8 Implementation Agency of the Emergency Repairing Measures

As already discussed, Zimbabwean side is the expected implementation agency of the emergency repairing measures. On the other hand, assuming that GoZ cannot secure the budget. Therefore, the possibility of implementation by the Zimbabwean side and each development partner are assessed.

(1) Zimbabwean Side (ZINWA)

ZINWA understands the emergency situation of the Magudu Dam and is willing implement a measure in the next financial year (2022 FY) budget. A letter to this effect has been issued to the JICA Zimbabwe Office. However, the project cost, which is in excess of 1.0 million USD, is not a small amount for ZINWA and is difficult to secure. Therefore, ZINWA is planning to carry out only PKG-1, back filling the ditch across the canal, which is the main cause of collapse. In the aforementioned letter, it is stated that ZINWA requested to JICA to implement other PKGs.

(2) Development Partners

Questionnaire on the conditions for the use of their funds (scale of project cost, target sectors, need for co-financing, etc.) are distributed to FAO, IFAD, WB, African Development Bank (AfDB), and World Food Program (WFP), all of which provide support to the agricultural sector in Zimbabwe. As a result, all the agencies did not have a scheme to fund only the construction of facilities.

(3) Japanese Schemes

1) JICA (Grant Aid Project)

The total cost of the emergency repairing measures is just over 100 million JPY, which is too small to be a Grant Aid Project. In addition, the technical difficulty of the project is not high and it can be carried out by Zimbabwean contractors. Taking into account these factors, it is judged to be difficult to implement the emergency repairing measures under this scheme. On the other hand, if the project is implemented not as a stand-alone emergency repairing work, but in combination with the dam improvement plan or new irrigation development as described below, the total cost would be larger and that combined project may be able to be a Grant Aid Project.

2) Embassy of Japan in Zimbabwe (Grant Assistance for Grass-Roots Human Security Projects)

The project cost under this scheme is basically capped at 10 million JPY but the project cost of the repairing measures exceeds 100 million yen. Although some PKGs have a project cost of less than 10 million JPY, but effect on damage is limited if only individual PKGs are implemented. Therefore, it is judged to be difficult to implement the emergency repairing measures under this scheme.

3) Japan (Supplementary budget)

Projects with humanitarian purposes and urgency could be funded through the Japanese supplementary budget. The scale of eligible projects is about 100 million JPY. Recently, number of selected projects for Zimbabwe is about 3 or 4 projects per year and the main target of the selected projects is food aid for drought areas in Zimbabwe. Also, the budget is for projects carried out by development partner(s). However, as the deadline for requests is at the end of August. Since the deadline for requests for next year's budget has passed, it is judged to be difficult to implement the emergency repairing measures under this scheme.

5.5 DAM IMPROVEMENT PLAN

5.5.1 Categorization of Deteriorations/Damages

As described in 5.3, deteriorations/damages evaluated as "B" need to be rehabilitated. However, some of these damages can be handled by GoZ through regular O&M works. Therefore, the deteriorations/damages evaluated as “B” are further classified into three categories as below.

(1) To be Implemented by Japanese Grant Aid Project

Target deteriorations/damages are ones which do not require urgent measures at present but are considered to require large scale measures in the future because the degree of deteriorations/damage is large or is expected to become large in the future.

(2) To be Monitored and Implemented by Zimbabwe if Necessary.

Target deteriorations/damages are ones which does not require urgent measures at present, and for which it is unclear whether it is progressive, or for which the impact on other facilities and the surrounding environment cannot be measured at present even if it is progressive. These Target deteriorations/damages are to be monitored regularly by Zimbabwean side to determine whether countermeasures are necessary, and if they are, the Zimbabwean side will implement them.

(3) To be Implemented by Zimbabwe

Target deteriorations/damages are ones which can be treated by the regular O&M works carried out by Zimbabwean side.

The deteriorations/damages found are classified into the above categories as shown in Table 5.5.1.

Table 5.5.1 Classification of Deteriorations/Damage on each Facility

Facility	Deteriorations/Damage	Scheme		
		By Japan Grand Aid Project	By Zimbabwean Side	
			Monitoring	Regular O&M
Embankment	-Disturbance of riprap -Dam body exposure, and erosion -Trees on and around embankment - Seepage and erosion at slope edge	✓		
Spillway	-Surface concrete peeling and lack of stones - A slight plant - Leakage from downstream slope - Open and damaged joints on the apron			✓
Spillway canal	- Cracks at the top of walls		✓	
	- Spilling out of basket mat - Crossing road across the canal (basket mat)	✓		
Connection canal	- Collapses on the sidewall - Washed away of a bridge - Crossing road across canal	✓	✓*	
Intake	- Disappearance of the gate operation facilities - Rusting all over - Insufficient supply volume	✓		
On-farm facilities	- Broken of sluice gate (night storage) - Spilling out of backside soil (canal) - Missing parts (sluice valve) - Water leakage from pipeline (air valve) - Broken of the discharge gate (diversion)			✓

* In respect for the erosion and collapse of the sidewalls found in the connection canal of the Musaverema Dam, as the impact on other facilities and the surrounding environment cannot be measured at this time even if it progresses, the Zimbabwean side will conduct continuous monitoring to determine whether or not countermeasures are necessary.

Figure 5.5.1 Deteriorations/Damages on the Spillway to be Treated by Zimbabwean Side

Figure 5.5.2 Deteriorations/Damages on the Spillway Canal to be Treated by Zimbabwean Side

Figure 5.5.3 Deteriorations/Damages on the Connection Canal to be Treated by Zimbabwean Side

Figure 5.5.4 Deteriorations/Damages on the On-Farm Facilities to be Treated by Zimbabwean Side

5.5.2 Rehabilitation Policies

(1) Embankment

1) Policy for rehabilitation of deteriorations/damages on the embankment

The Table 5.5.2 shows deteriorations/damages found on the embankment for each dam.

Table 5.5.2 Deteriorations/Damages Found on the Embankment

Deteriorations/Damages	Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja
i) Disturbance of riprap	✓	✓	✓	✓	✓	✓
ii) Dam body exposure, and erosion	✓	✓	✓	✓	✓	✓
iii) Trees on and around embankment		✓	✓	✓	✓	✓
iv) Seepage and erosion at slope edge			✓		✓	

Of the above, i) Disturbance of riprap, ii) Dam body exposure, erosion, and iii) Trees on and around the embankment are considered to be caused by thinning of the surface riprap due to weathering and

livestock invasion on the embankment slope. In order to repair the embankment and to prevent similar problems in the future, the surface layer (including trees) is removed, and the embankment replaced with new material and riprap is placed on both upstream and downstream sides. Since riprap has not been installed downstream of the Magudu and Musaverema Dams, new riprap layer is installed. In addition, Geotextile is placed between dam body and the riprap to prevent the runoff of dam body.

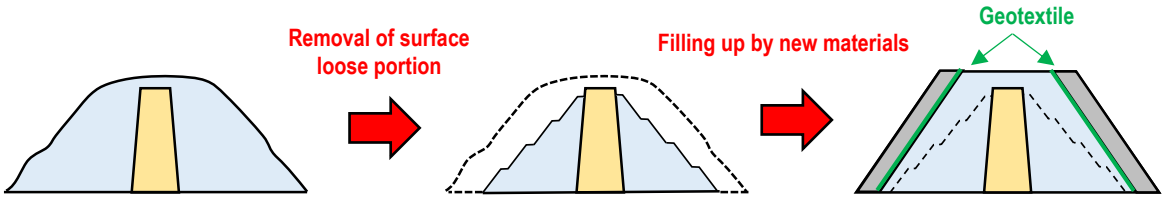


Figure 5.5.5 Model of Embankment Rehabilitation Work

iv) Seepage and erosion at slope edge are assumed to be caused by the absence of a drainage canal at the embankment slope edge where surface water arising from rainfall tends to be collected. Therefore, a drainage canal is installed at the edge of the embankment to quickly remove the surface water and prevent erosion (see Figure 5.5.6). Since this damage may occur in all dams in the long term, measures should be taken in all dams together with the above-mentioned repair of embankments.

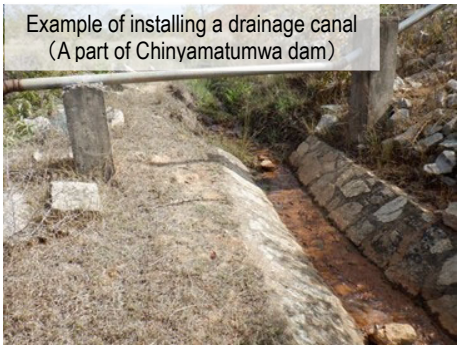


Figure 5.5.6 Present of Slope Edge and Example of Installing a Drainage Canal

A typical cross-section and plan drawings of the embankment rehabilitation are shown in Figure 5.5.7 and Figure 5.5.8. The surface excavation depth is at least 1m for root removal. In order to increase the boundary area between the excavated surface and the new material, and to ensure accurate compaction at the boundary, the excavated surface of the existing embankment is shaped like steps (1.5 m high, slope 1:0.5), and the compaction width is to be at least 4 m for workability. In addition, the thickness of the newly installed riprap is 1 m.

It should be noted that this rehabilitation causes the boundary of the embankment slope to expand in the upstream and downstream directions.

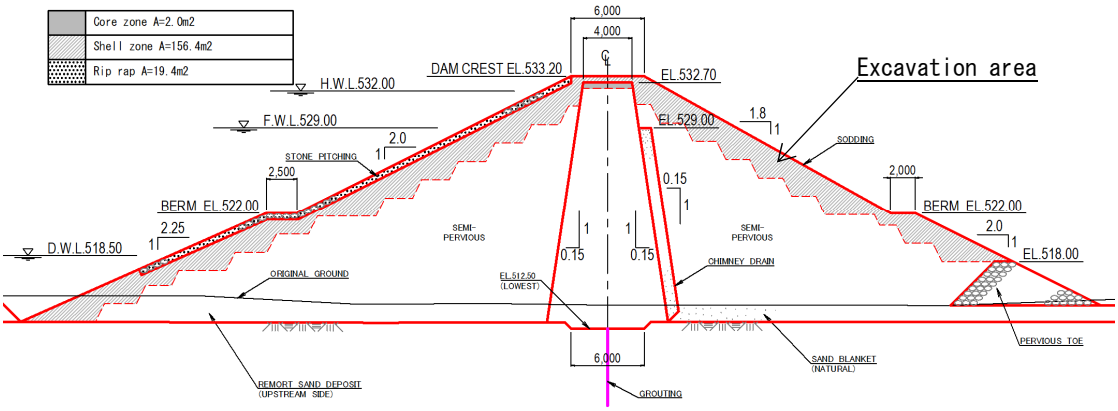


Figure 5.5.7 The Typical Cross-Section of Excavation for Rehabilitation (Magudu Dam)

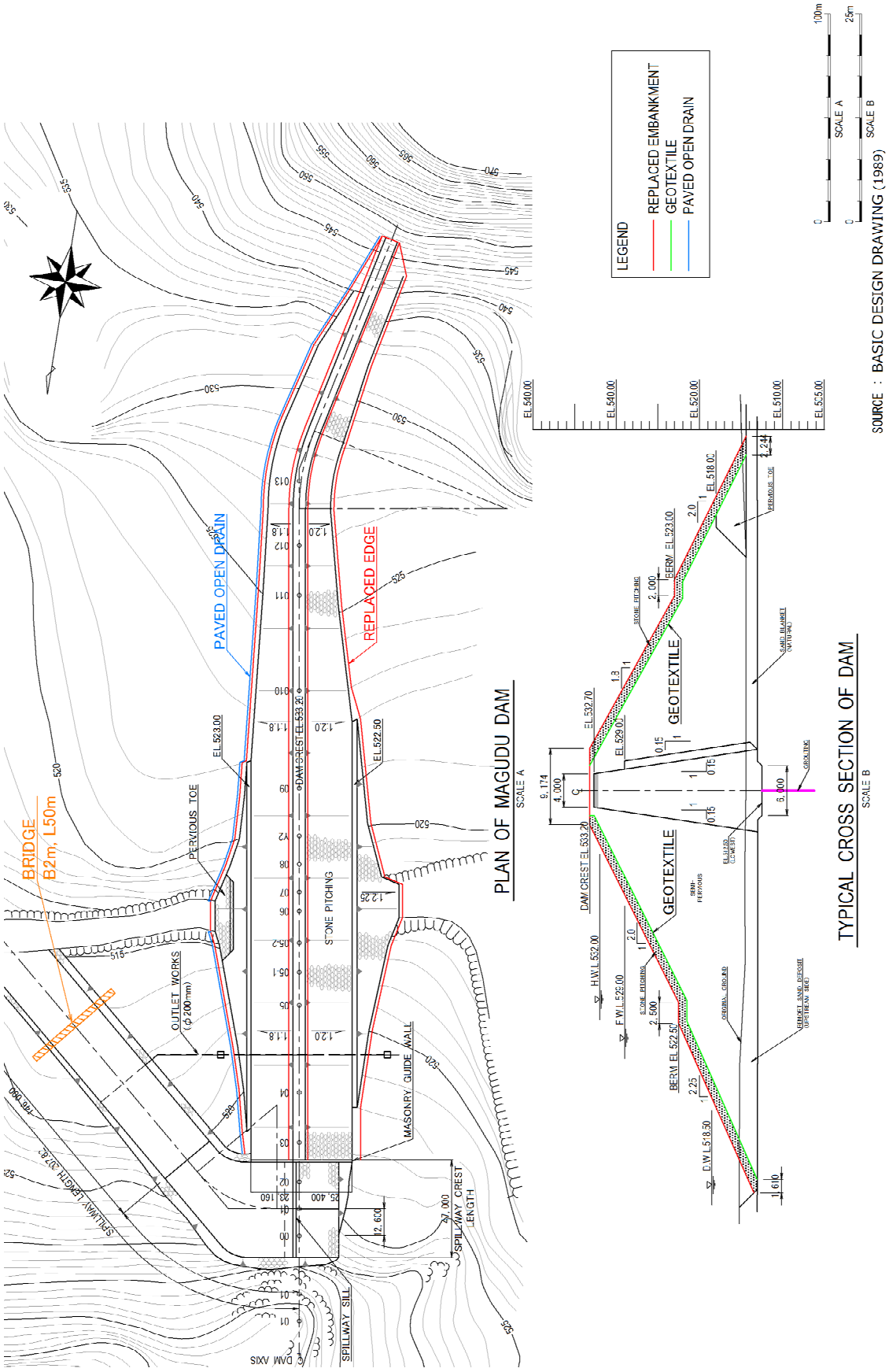


Figure 5.5.8 The Typical Cross-Section and Plan of the Embankment Rehabilitation (Magudu Dam)

2) Policy against the climate change

Since the six dams were all designed around 1990, it is suspected that the flood volume at the dam sites may have changed from the time of design due to recent climate change. Therefore, it should be verified if the existing facilities have the capacity to safely discharge floodwaters calculated from recent rainfall. If some dams don't have enough capacity, countermeasures are considered.

The flood volume of each dam was designed for a 2000-year or 500-year probability flood based on the Zimbabwean national design standards at the time of design. However, since the design flood volume is a 100-year probability under the current Zimbabwean design standard (for the size around target 6 dams) and is around 200-year probability under the Japanese design standard, the design flood volume at the time of design is considered to be excessive. Therefore, the design discharge calculated under the present Zimbabwean standards, a 100-year probability of occurrence, is used to verify the capacity of existing facilities

The verification is done by the following procedure.

i) Calculation of target daily rainfall (100-year probability rainfall)
ii) Calculation of revised flood volume by the rational formula
iii) Calculation of overflow depth of revised flood volume and comparison with the original design HWL

i) Calculation of target daily rainfall (100-year probability rainfall)

The flood volume is reviewed using the actual daily rainfall for the past 10 years at meteorological observation station points near each dam. Since there are multiple station points near and around each dam, the amount of rainfall within the dam basin is estimated by the Thiessen method. The maximum daily rainfall and the 100-year probability daily rainfall for the study period in each dam catchment are shown in Table 5.5.3 and Table 5.5.4.

Table 5.5.3 Maximum Daily Rainfall in the Latest 10 Years (mm/day)

Year	Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja
2011	69	44	60	66	66	73
2012	40	29	70	56	56	45
2013	56	110	84	61	61	64
2014	69	56	70	91	91	44
2015	59	68	76	59	59	61
2016	79	69	79	135	135	70
2017	86	85	169	149	149	114
2018	76	77	95	112	112	67
2019	126	59	204	78	78	153
2020	61	60	105	82	82	69
Max	126	110	204	149	149	153
Min	40	29	60	56	56	44
Ave	72	66	101	89	89	76

> 100mm/d (Examples of years with heavy rainfall)

< 50mm/d (Examples of years with low rainfall)

Table 5.5.4 Rainfall Intensity for each Return Period (mm/day)

Return period	Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja
2	68.5	63.5	88.0	80.9	80.9	67.4
5	88.8	83.6	124.8	111.0	111.0	95.7
10	102.2	95.6	155.5	133.8	133.8	118.3
20	114.9	106.3	189.6	157.9	157.9	142.8
50	131.4	119.4	240.7	191.9	191.9	178.5
100	143.9	128.8	284.6	219.8	219.8	208.5
200	156.4	137.9	333.4	249.6	249.6	241.2
500	173.1	149.5	405.9	292.1	292.1	289.0
1000	186.0	158.1	467.4	327.0	327.0	328.8

ii) Calculation of revised flood volume by the rational formula

The calculation conditions and results of the revised flood discharge are shown in Table 5.5.5. In the case of the Chinyamatumwa, Mashoko, Mabvute, and Munjanganja Dams, the revised flood discharge exceeded the original design discharge.

Table 5.5.5 Conditions and Results of Calculation for Revised Discharge

Item	Unit	Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja
Area	km^2	41.9	131.6	16.4	27.2	31.1	52.8
Rainfall (1/100)	mm/d	144	129	285	220	220	209
Length of flow	m	7,833	18,287	4,339	7,154	5,605	8,161
Difference of height	m	57	69	76	107	115	129
Incline of flow		1/136	1/267	1/57	1/67	1/49	1/63
Quantity of revised discharge Q	**m^3/s**	**310**	**499**	**311**	**342**	**423**	**600**
Quantity of planed discharge Qp	**m^3/s**	**415**	**835**	**163**	**228**	**343**	**349**
Return period	*year*	*2000*	*2000*	*500*	*500*	*2000*	*500*

Red: Q > Qp

iii) Calculation of overflow depth of revised flood volume and comparison with the original design HWL

The water levels when the revised flood discharge is applied are shown in Table 5.5.6.

Table 5.5.6 Water Level of Overflow by the Revised Flood Volume

Item	Unit	Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja	Remarks
Quantity of discharge Q	m^3/s	310	499	311	342	423	600	1/100 flood (revised one)
Length of weir B	m	47	125	53	73	39	206	Designed length
Water level of overflow H	EL.m	530.92	681.46	752.80	665.59	646.51	1150.22	As of 1/100 flood
HWL	EL.m	532.00	682.50	752.50	665.50	647.00	1150.00	Designed level
Elevation of crest	EL.m	533.20	683.70	753.70	666.70	648.20	1151.10	
Difference HWL-H	m	1.08	1.04	-0.30	-0.09	0.49	-0.22	
Evaluation		**OK**	**OK**	**NG**	**NG**	**OK**	**NG**	**H＜HWL: OK**

As shown in the table above, the water levels of the Chinyamatumwa, Mashoko, and Munjanganja Dams exceed the designed HWL at the time of the revised flood discharge. However, since the excess water level is within the freeboard (below the crest elevation), it is judged that revised flood volume could be discharged by the existing spillways and overtopping of the embankment would not happen. On the other hand, even if revised flood volume could be discharged, the elevation of core zone which work to shut off the water and the freeboard is insufficient. Therefore, a countermeasure to keep sufficient free boar against flooding is necessary. To secure the freeboard and height of the core, the embankment is raised as shown in Figure 5.5.9.

The height of raise up for each dam (the elevation of the crest of the dam and top of core)

Chinyamatumwa dam :30cm
Mashoko dam :10cm
Munjanganja dam :30cm

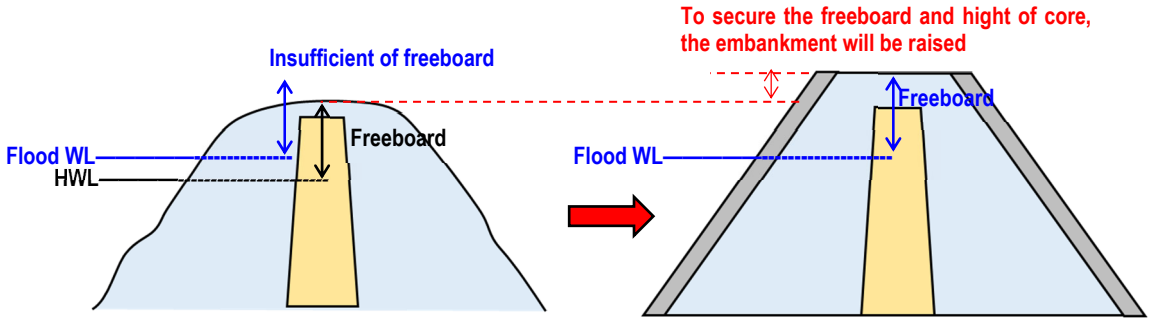


Figure 5.5.9 Drawing of Raising of Embankment

Although there are some cases in Zimbabwe where retaining walls (parapets) are laid on the crest to secure a freeboard, in this Survey, raising the embankment is adopted because it can be implemented together with the above-mentioned deteriorations/damages rehabilitation.

Figure 5.5.11 in the following page shows an example of a typical cross-sectional and plan view of the raised embankment. It should be noted that the boundary of the embankment wall extends in both upstream and downstream directions due to the increase in the crest elevation.

Figure 5.5.10 Example of Parapets (Mundi Mataga Dam)

On the other hand, due to the increased flood volume, it might be necessary to raise the sidewalls of spillway channels and connection canals. As for the spillway channels, the risk of overflow is low due to the large difference in elevation between the bottom and the top of the canal. Also, because spillway channels have retaining walls (wet masonry), the possibility of it affecting the embankment like the Magudu Dam is considered to be small even if the water level rises.

As for the connection canal, the risk of overflow is low due to the wide width of the canal bed, and there are no houses or other facilities to be protected in the surrounding area. Therefore, the priority of measures such as the construction of protection walls is considered to be low at present.

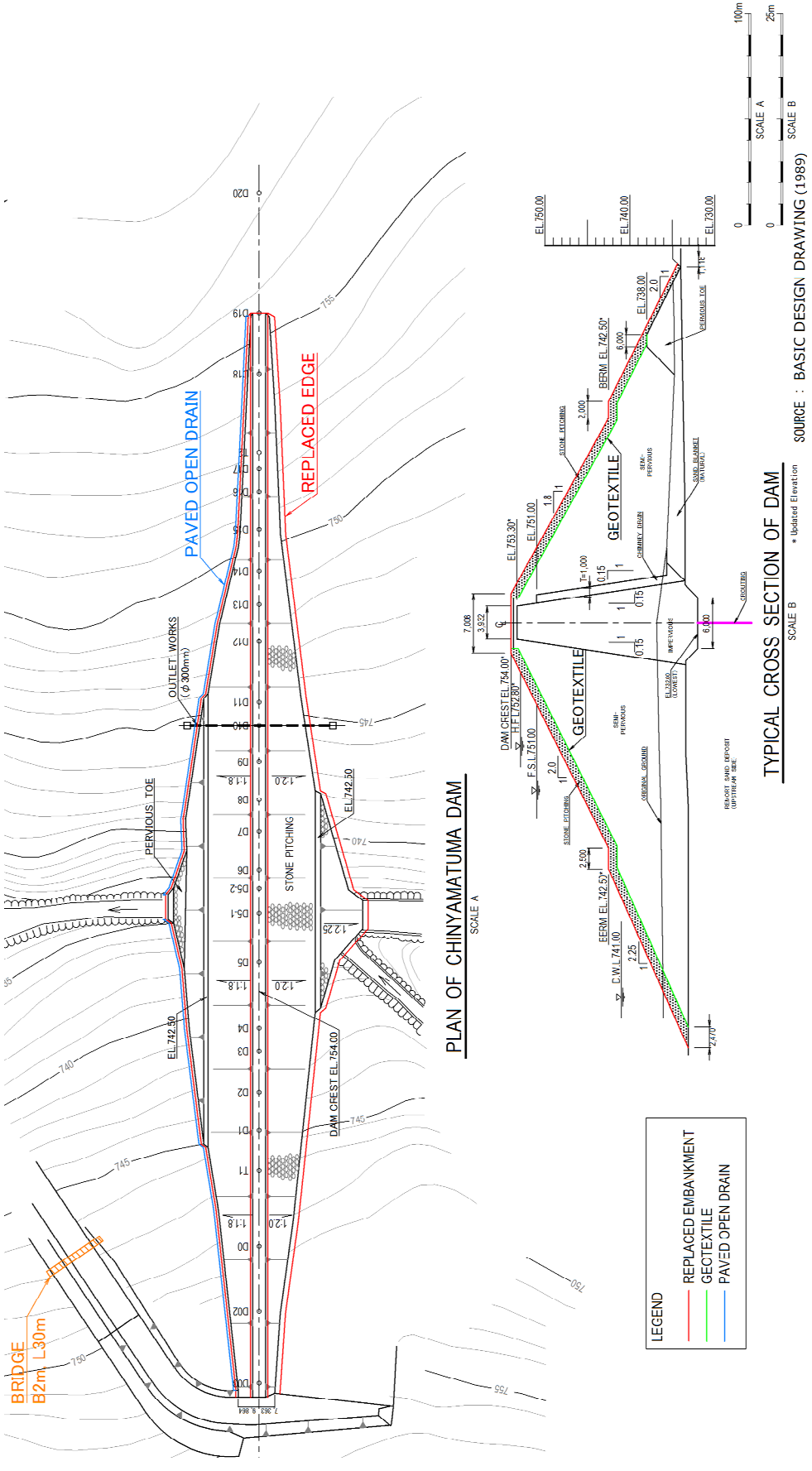


Figure 5.5.11 A Typical Cross-Section and Plan of the Embankment (Chinyamatumwa Dam)

3) Policy to increase the irrigable area

As a result of interviews with beneficiary farmers and facility operators etc., there was a request to increase the water storage capacity by raising the embankment. They expect to be able to expand the irrigated area by increasing the water storage capacity of the dam.

One of the essential conditions for embankment raising is that the topography around the embankment and reservoir is capable of being raised. Since embankment height raising requires a large amount of cost, it is desirable to be able to raise the embankment as high as possible in order to increase its effectiveness. Therefore, in this Survey, the condition for raising the embankment is that the elevation around the embankment and reservoir must be at least 1 m higher than the crest of the existing embankment. The results of verifying the topography around each dam's embankment are shown in Table 5.5.7 and Table 5.5.8

Table 5.5.7 Topography around each Dam (1)

	Magudu	Musaverema	Chinyamatumwa
The topography around the embankment Right side Left side	 	 	 
Status by visual inspection	Right side abutment: The ground is high hills. Left side abutment: The abutment is flat (about 1 m of elevation difference).	Both side abutment: There is no significant difference in elevation between the ground and the crest of the embankment.	Both side abutment: There is a small elevation difference (like a hill) at the abutment.
Possibility of raising	Right side: over 2m Left side: around 1m	Right side: under 1m Left side: under 1m	Right side: under 1m Left side: under 1m
Evaluation for raising	Possible but to be avoided by another concerns (see next page)	Impossible	Impossible

Table 5.5.8 Topography around each Dam (2)

	Mashoko	Mabvute	Munjanganja
The topography around the embankment Right side			
Left side			
Status by visual inspection	Right side abutment: The ground is about 2 meters higher than the retaining wall of the spillway. Left side abutment: The topography is a 2 to 3 meter higher hill.	Right side abutment: There is no significant difference in elevation between the ground and the crest of the embankment. Left side abutment: The outside of the spillway is about one meter higher, and the topography is flat.	Both side abutment: There is no significant difference in elevation between the ground and the crest of the embankment.
Possibility of raising	Right side: around 2m Left side: around 2m	Right side: under 1m Left side: under 1m	Right side: under 1m Left side: under 1m
Evaluation for raising	**Possible**	Impossible	Impossible

From the above table, the Magudu and Mashoko Dams meet the conditions for raising the embankments.
*It should be noted that it is possible to raise the embankment by about 30 cm to secure the freeboard, which is necessary for flood management as discussed.

However, for the Magudu Dam, it is desirable to avoid using the right bank side of connection canal (embankment side) as the foundation of the embankment to be expanded because the ground there may be loose due to the collapse. In addition, the water level in the embankment may rise due to the rising FWL caused by the embankment raising, and this may have a negative impact on the stability of the canal and the embankment with the loose basement even if the retaining walls are built in the future. Therefore, the Magudu Dam is excluded from the target of embankment hight raising.

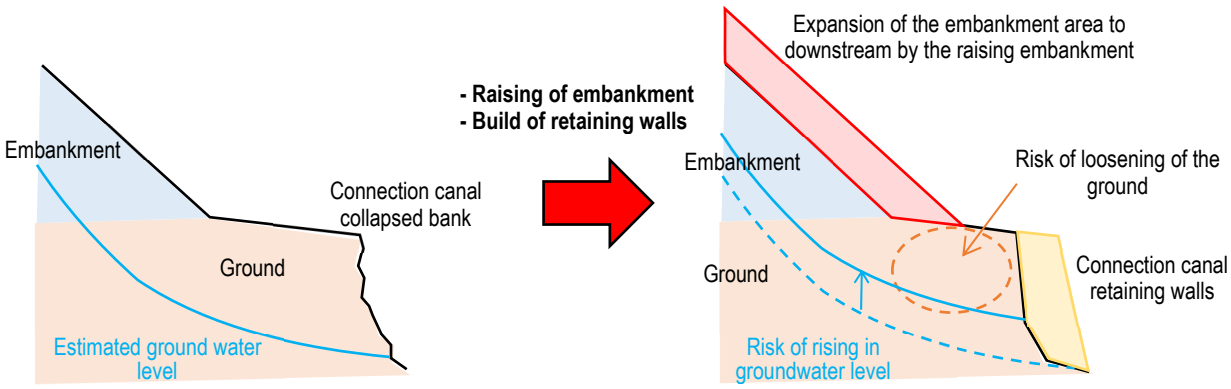


Figure 5.5.12 Drawing of Downstream Situation of Magudu dam

As a result, embankment raising can be done for Mashoko Dam only. The typical cross-section and plan view of the Mashoko dam with raised embankment is shown in Table 5.5.13.
*It should be noted that the boundary of the embankment widens in both upstream and downstream directions as the top elevation increases.

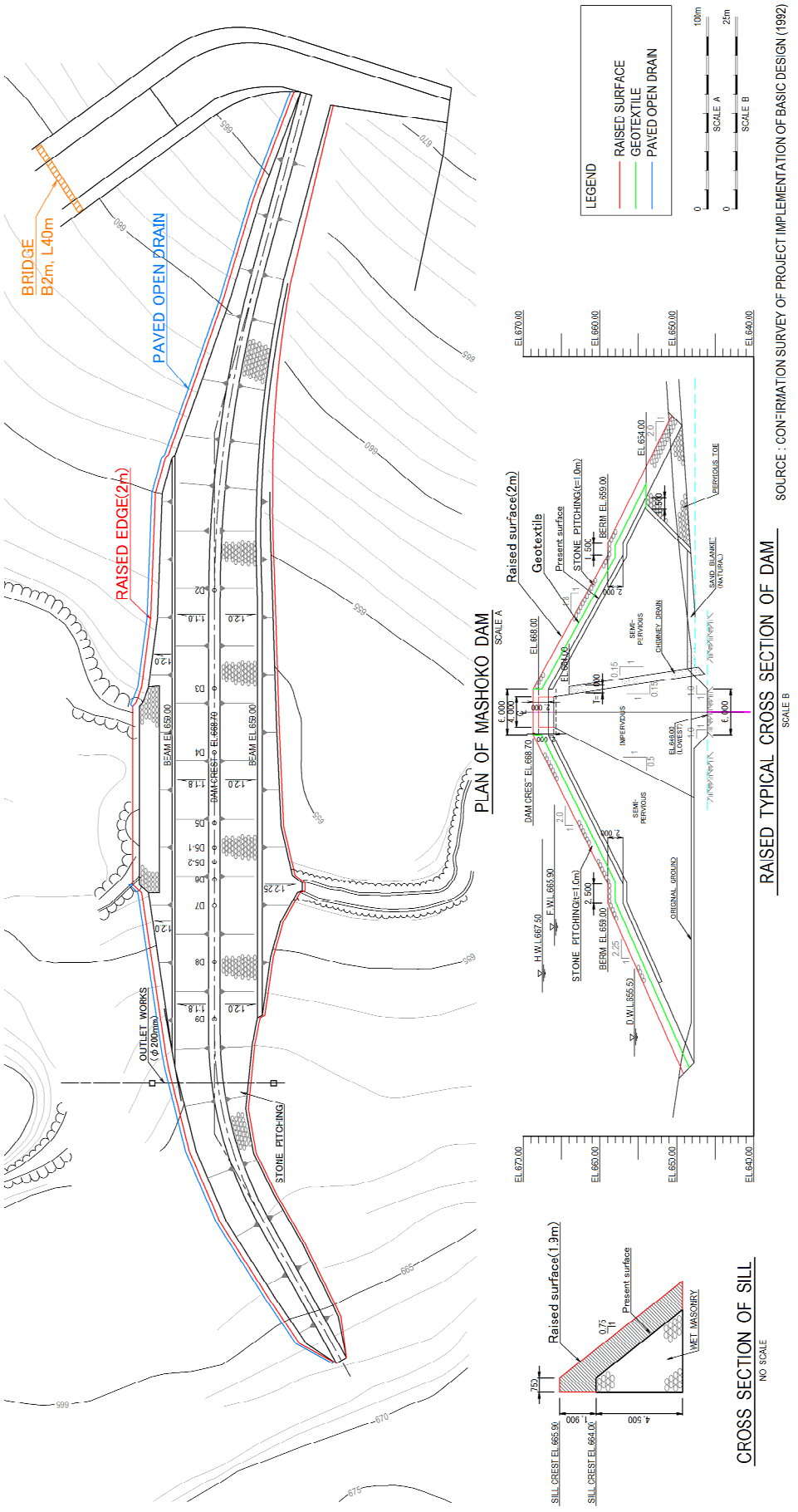


Figure 5.5.13 The Typical Cross-Section and Plan of the Raised Dam (Mashoko Dam)

As for the raising of the embankment, a more detailed investigation is required for the implementation of the project because of the following concerns.

i) It is necessary to determine whether it is possible to secure enough inflow every year to fulfil the increased storage capacity through a multi-year reservoir water balance analysis, which is an analysis based on inflow data calculated from rainfall, and data on water intake and demand in the beneficiary area.

ii) The increase of water storage capacity leads not only increase the irrigated area in the beneficiary area, but also submarginal of some farmlands around the reservoir. Therefore, it is necessary to examine the submerged area and consider the compensation for these submerged areas.

iii) The capacity of facilities for water conveyance and night storage may also need to be revised due to the increase of required water volume caused by the expansion of the irrigated area.

(2) Spillway Channel

Table 5.5.9 shows deteriorations/damages found on the spillway channel for each dam.

Table 5.5.9 Deteriorations/Damages Found on the Spillway Channel

Deteriorations/Damages	Magudu	Musaverema	Chinyam atumwa	Mashoko	Mabvute	Munjanganja
i) Spilling out of basket mat						✓
ii) Crossing road across the canal (gabions)				✓		✓

The basket mat at the end of the spillway channel of the Munjanganja dam is assumed to have deteriorated during its use of more than 30 years. Since it is difficult to prevent deteriorations caused by long-term use, the basket mat is reinstated with the same structure as at the time of construction. As for the washed-away part of the basement, it is re-formed by wet masonry.

Figure 5.5.14 Model of Rehabilitation of Basket Mat（Left: Present, Right: Rehabilitated）

It is thought that the reason why the inside of the channel is used as a road is that there is no crossing bridge nearby. Since the crossing into the spillway channel, especially during the rainy season, is very dangerous and must be definitely prevented, a bridge for the crossing is installed at an appropriate point in the section between the spillway channel and the connection canal.

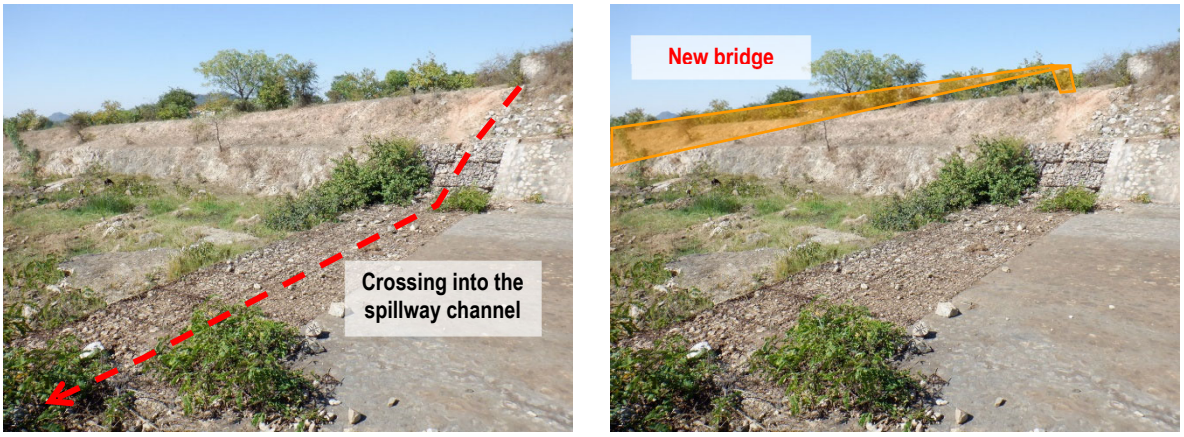


Figure 5.5.15 Model of Installing of New Bridge（Left: Present, Right: Installed）

(3) Connection Canal

Table 5.5.10 shows deteriorations/damages found on the connection canal for each dam.

Table 5.5.10 Deteriorations/Damages Found on the Connection Canal

Deteriorations/Damages	Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja
i) Collapses on the sidewall			✓		✓	✓
ii) Washed away of a bridge	✓					
iii) Crossing road across canal		✓	✓		✓	

Significant erosion and collapse of the side walls are found at the boundary with the spillway channel, which could be caused by flow disturbance due to changes in canal structure and canal elevation. In the present state, the downstream of the spillway canal is an earth bank, and since there are significant erosions and collapses in this section, protection walls with wet masonry are installed. The typical cross-section and plan view of the protection walls are shown in Figure 5.5.17.

Figure 5.5.16 Model of Construction of the Protection Wall（Left: Present, Right: Constructed）

The washed-away bridge at Magudu Dam is thought to be due to the impact by flood flow. The bridge needs to be rebuilt because it is difficult to get to the valve house when there is flow in the canal and to operate it in an emergency. For the crossings in the canal found in the three dams (Musaverema, Chinyamatumwa, and Mabvute), it is necessary to prevent entering the canal surely, especially in the rainy season. Bridges for crossings are to be installed at appropriate points in the section from the spillway canal to the connection canal.

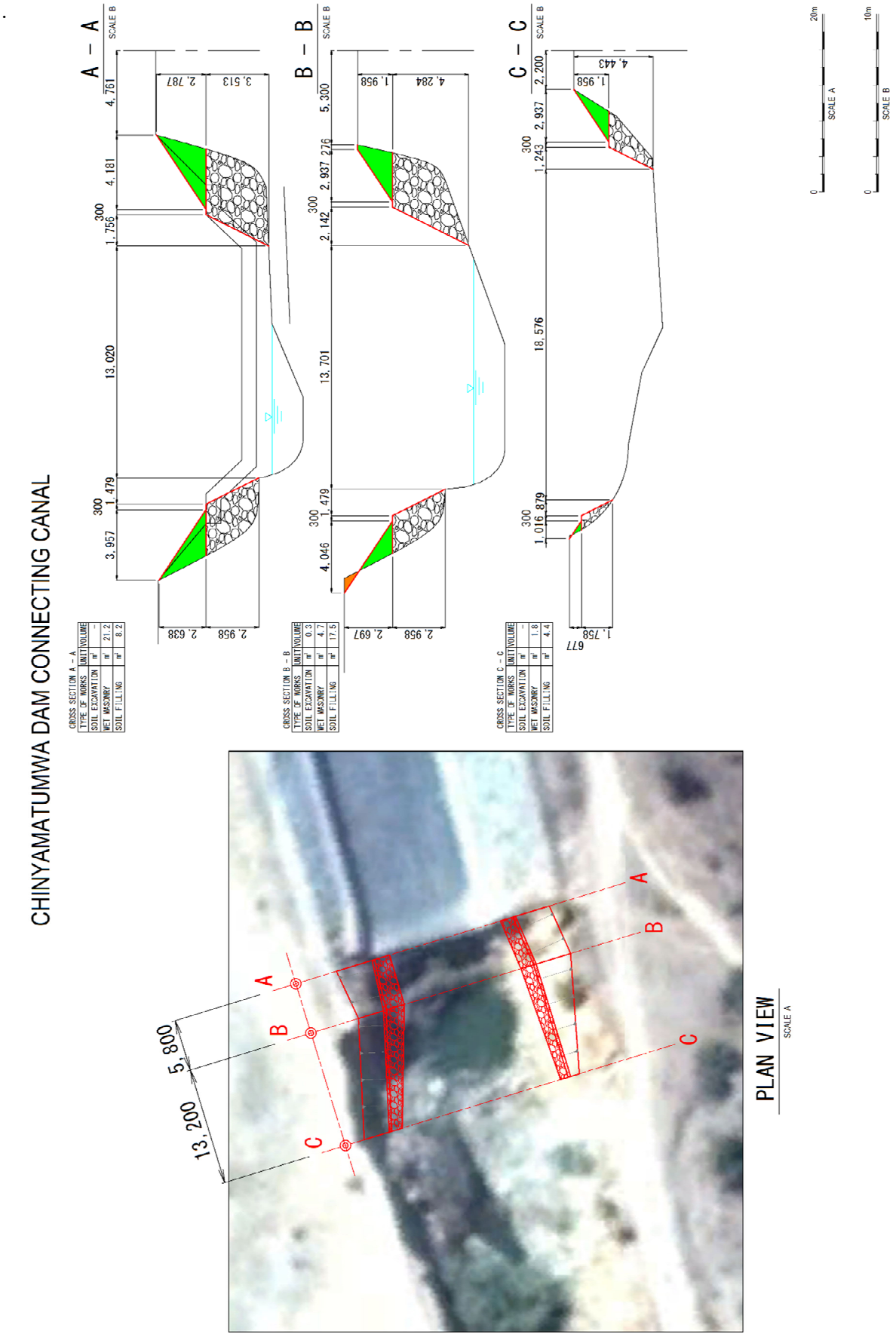


Figure 5.5.17 The Typical Cross-Section and Plan View of the Connection Canal with Protection Walls (Chinyamatumwa Dam)

(4) Intake

Table 5.5.11 shows deteriorations/damages found on intake for each dam.

Table 5.5.11 Deteriorations/Damages Found on the Intake

Deteriorations/Damages	Magudu	Musaverema	Chinyamatu mwa	Mashoko	Mabvute	Munjanganja
i) Disappearance of the gate operation facilities	✓	✓*	✓	✓*		✓*
ii) Rusting all over		✓		✓		
iii) Insufficient supply volume			✓			

* Disappearance of the wire

The intake gate winch had lost its function due to the disappearance of its body or wires. In addition, some of them have deteriorated greatly due to rusting. The suspected reasons are theft and insufficient maintenance works.

In order to restore the gate operation function and to prevent a similar problem in the future, an operation house is built at the crest and a new winch is installed in it. In addition, the steel wires leading to the intake gate are arranged in the protection pipe set under the riprap at the upstream side to prevent theft and deteriorations.

Figure 5.5.18 Status of Intake Structures

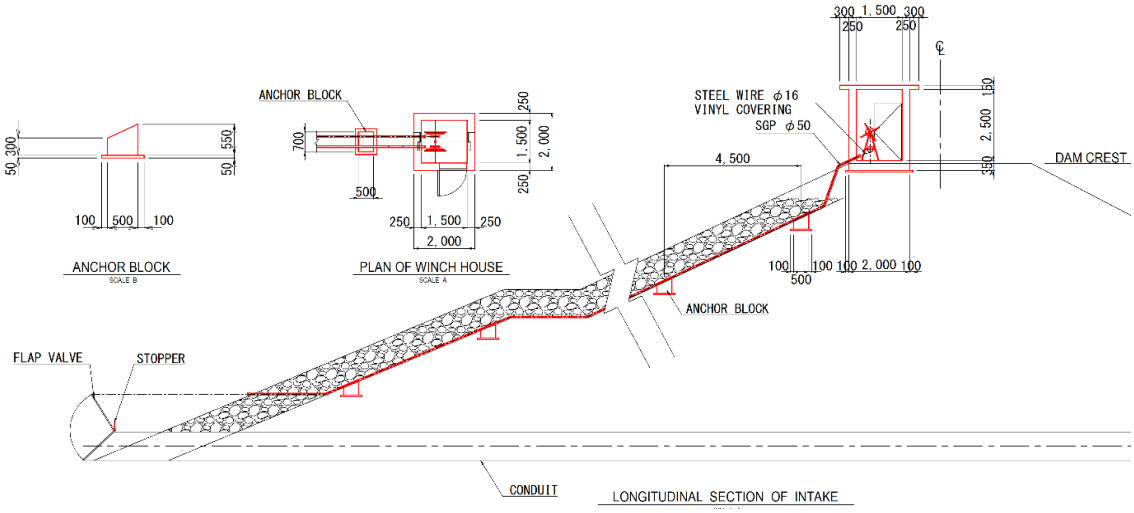


Figure 5.5.19 Layout of the Intake Improvement Plan

Insufficient supply volume found on the pumps at Chinyamatumwa Dam might be caused by insufficient electricity current volume since the transformer is about 500 m away from the pump facility and the required amount of current cannot be supplied due to transmission loss. To cope with this problem, the transformer is replaced.

Figure 5.5.20 Status of the Pump Facility (Chinyamatumwa Dam)

5.5.3 Environmental and Social Consideration

This section describes the result of preliminary evaluation on the environmental and social impact by the dam improvement plan. Explanation of the legal institutional framework for the environmental and social consideration is referred to 3.5, 3.6 and 4.5.

(1) Project Component

Purpose of the dam improvement plan is to rehabilitate six medium scale agricultural dams that were constructed in the early 1990s under the Japanese Grant Aid Project. Therefore, the project component is limited to the rehabilitation of existing agricultural dams. Table 5.5.12 summarises the project component.

Table 5.5.12 Outline of the Expected Project Component

Rehabilitation Dams	Contents of Works
Existing six (6) agricultural dams (Magudu, Musaverema, Chinyamatumwa, Mashoko, Mabvute and Munjanganja)	● Rehabilitation of the surface of dam embankments ● Rehabilitation of spillway channel and connection canals (including protection wall installation for canals, installation of access bridge, etc.) ● Rehabilitation of intake facilities (including gate operation facility replacement, etc.)

(2) Project Location

The existing six dams and those beneficiary areas are located in Masvingo Province (see Figure 5.1.1). The land category of all sites is Communal Lands. Figure 5.5.13 summarise the information about the location of project Area.

Table 5.5.13 Location of the Project Areas

Rehabilitation Dams	Beneficial Area*1		Location of the Dams and Beneficial Areas			
	Beneficiaries	Land Size (ha)	Province	District	Land Category	Communal Land Name
Magudu	2,800	70	Masvingo	Masvingo	Communal Lands	Nuajena
Musaverema	2,590	44		Mwenezi		Matibi No.1
Chinyamatumwa	1,610	50		Bikita		Bikita
Mashoko	570	21		Bikita		Matsai
Mabvute	3,930	100		Zaka		Ndanga
Munjanganja	1,710	51		Gutu		Mutra

(3) Environmental and Social Conditions in the Project Areas

An overview of the natural and social condition of Zimbabwe is given in 2.1.1 and 2.1.2, and an overview of the natural and social condition of Masvingo Province where the six dams located is given in 2.2.1 and 2.2.2. Other features of environmental and social conditions in project area are described as below.

1) Natural environment

- **Meteorology and Hydrology**

The annual rainfall is around 600 mm and most of rainfall is concentrated in summer season from November to March. The project areas are located in Zone IV (Semi-Extensive Farming Region, with annual rainfall: 450 – 650mm) and/or Zone V (Extensive Farming Region, with annual rainfall: less than 450mm) classified by the agro-ecological zones. Therefore, the necessity for irrigation is high in the project areas.

The rivers that flow into the dam reservoirs of the six existing dams are all seasonal rivers. The dams store river water during rainy season and discharge for irrigation during dry season.

- **Eco-system and Habitats**

The project areas of existing six dams (including catchment area and downstream area) and those beneficiary areas are not located in the important ecological habitats such as national parks, Ramsar wetlands and IBAs. Since the main contents of dam improvement plan is restoring of original functions of dams through rehabilitation, the way of dam operation is not changed from existing one. Therefore, it is assumed there will be not significant changes from existing ecological condition of surrounding area of existing dams.

- **Erosion and Forestry**

Soil deteriorations due to gully erosion in farmland and forest lands is common problem in and around the project areas. Gully erosion distribution map in Masvingo Province is shown in Figure 5.5.21. The gully erosion leads sedimentation on dam reservoirs. As the countermeasures for the protection from gully erosion, efforts have been made to construct drainage canal in the farmland, to place trees on counter line, to preserve forest and to control illegal tree cutting, generally.

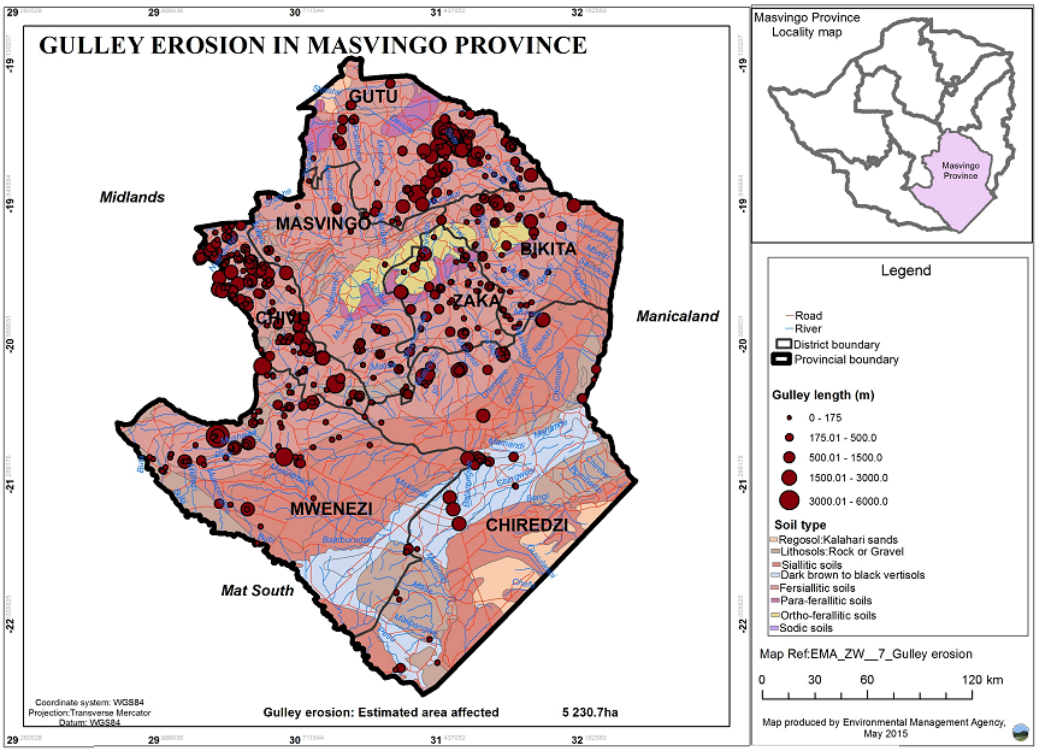


Figure 5.5.21 Gully Erosion Distribution Map in Masvingo Province

Source: EMA

- **Vegetation**

Growing of Lantana Camara, which is one of the invasive species, is common problem of farmland in the project areas. Distribution map of Lantana Camara in Masvingo Province is shown in Figure 5.5.22. On the other hand, growing of Water Hyacinth in dam reservoir is one of problems causing deterioration of water quality due to obstruction of water flow and reduction of dissolved oxygen.

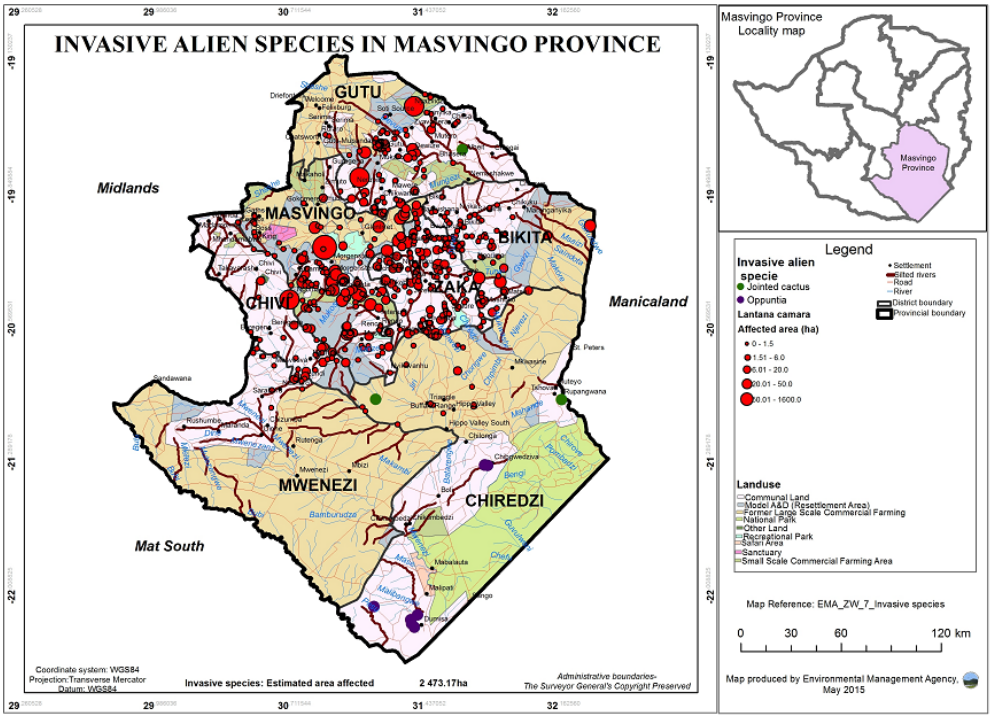


Figure 5.5.22 Lantana Camara Distribution Map in Masvingo Province

Source: EMA

2) Social environment

- **People**

Ethnic group living in the project areas is Shona people. Although official language is English, Shona language is also used as local language popularly. There are no tribal conflicts in the project areas.

- **Livelihood**

According to the statistical data of Zimbabwe[1], average household size living in the Communal Lands is 5 persons/households while the proportion of woman headed household is around 36%. 98% of people living in Communal Lands are engaged in agriculture and their livelihoods are heavily dependent on it. In general, most of the farmers in Communal Lands are smallholder and average farmland size is about 1.4 ha/households.

- **Decision Making System by Traditional Custom**

The traditional leadership locality called as Traditional Leaders (composed of local chiefs, headmen and village leaders) is functioned and legally recognized in Communal Lands. Traditional Leaders substantially make a role of managing land use and dispute resolution of the community (see 3.6.1 for detail).

[1] ZIMSTAT, Zimbabwe Smallholder Agricultural Productivity Survey 2017 Report, March 2019

(4) Scoping

As a preliminary assessment for the environmental and social consideration of the project, the scoping is examined. The result of the scoping is shown in Figure 5.5.14.

Table 5.5.14 Scoping Result for Dam Improvement Plan

Category	No.	Environmental Item	Scoping Result		Reason
			Construction Stage	Operation Stage	
Pollution	1	Air Quality	B-	D	**Construction stage:** Exhausts from the construction machineries and vehicles can be the causes of air pollution in the neighboring area of construction work, temporarily. **Operation stage:** Air pollution by the operation of facilities is not anticipated.
	2	Water Quality	B-	C	**Construction stage:** Drainage of construction work and sewerage from workers camp can be the causes of water pollution in the neighboring area. **Operation stage:** In case the water hyacinth glows in large area of dam reservoirs, water quality of reservoirs will be deteriorated. Regular maintenance will be required to mitigate.
	3	Waste/ Garbage	B-	D	**Construction stage:** Generation of the construction wastes by the removal work of existing structures, removal of soil material by the excavation work, and garbage from workers camp and so on., are anticipated. **Operation stage:** Impacts are not anticipated.
	4	Soil Contamination	B-	D	**Construction stage:** Leakage of the oils from construction machinery can be the cause of soil contamination. **Operation stage:** Impacts are not anticipated.
	5	Noise and Vibration	D	D	**Construction stage:** Since the surrounding areas of the project areas are located in farmlands, impacts of noise and vibration during construction works are not significant. **Operation stage:** Impacts are not anticipated.
	6	Subsidence	D	D	The works affecting to land subsidence are not anticipated.
	7	Odor	D	C	**Construction stage:** Odors during construction works are not anticipated. **Operation stage:** In case the water hyacinth glows in large area of dam reservoirs, there is the possibility to generate odor from rotten plants. Regular maintenance shall be required to mitigate.
	8	Sediment	D	D	Since the works inside of reservoirs are not planned, it is not anticipated the construction works affect sediment.
Natural environment	9	Protected Areas	D	D	There are no protected areas for habitats such as national protection areas, Ramsar convention wetlands, IBAs in the project area.
	10	Ecosystem	C	D	**Construction stage:** There are no protected areas for habitats such as national protection areas, Ramsar convention wetlands, IBAs in the project area. Since direct construction activities are not planned inside of the dam reservoirs, impacts on existing aquatic biodiversity in the reservoirs will be limited. **Operation stage:** Since the project is rehabilitation of existing dam and does not change existing dam operation, the impacts on biodiversity of surrounding area will be limited.
	11	Hydrology	D	D	Since the existing dam operation will be not changed after the rehabilitation of dams, the impacts on existing hydrology around area will be limited.

Category	No.	Environmental Item	Scoping Result		Reason
			Construction Stage	Operation Stage	
	12	Topography and Geology	B^-	D	**Construction stage:** Surface works on the embankment slope of dams require large amount of earth fill (clay and sand) and riprap (rock). For the extraction of these construction materials, appropriate sand extraction site should be selected, and permission should be obtained from EMA through application form. **Operation stage:** Impacts are not anticipated.
Social environment	13	Resettlement	C	C	**Construction and Operation stage**: Relocation of houses are not anticipated, basically. If in case the project component includes the raising of dam embankments, embankment area and submerged area of reservoir may be expanded. In this case, land acquisition of farmlands or bush lands around embankments and reservoirs will be required.
	14	The poor	B^+	B^+	**Construction stage:** Positive impacts are expected since the project may create job opportunities for construction works. **Operation stage:** Positive impacts are expected since the project contributes to the income generation of beneficiaries including poor people through the irrigation infrastructure rehabilitation in the area.
	15	Ethnic Minorities and Indigenous Peoples	D	D	There are no ethnic minorities and indigenous people in the project area.
	16	Livelihood/ local economy	B^+	B^+	**Construction stage:** Positive impacts are expected since the project may create job opportunities for construction works. **Operation stage:** Positive impacts are expected since the project contributes to the income generation of beneficiary farmers including poor people through the irrigation infrastructure rehabilitation in the area.
	17	Land use and local resource utilization	B^-	B^+	**Construction stage:** Appropriate sand extraction site should be selected, and permission should be obtained from EMA through application form. **Operation stage:** Positive impacts are expected on local resources in the area through the improvement of awareness among beneficial people for protecting watershed area of dams in terms of gully erosion protection and forestation.
	18	Water Usage or Water Rights and Rights of Common	B^-	B^+	**Construction stage:** The construction work may affect to the existing water usage in the area during construction period. Mitigation measures are necessary such as implementation of the construction activity avoiding periods when changes in water use affect agriculture. **Operation stage:** Positive impacts are expected since the irrigational condition among beneficiary farmers will be stable by the contribution of the project.
	19	Existing social infrastructures and services	B^-	B^+	**Construction stage:** Due to the increasing of construction vehicles, local transportation around construction area may be affected. And, the construction work may affect to the existing usage of the existing irrigation facilities. **Operation stage:** Positive impacts are expected on local transportation in the project site at which the bridge will be constructed, especially during rainy season.

Category	No.	Environmental Item	Scoping Result		Reason
			Construction Stage	Operation Stage	
	20	Social institutions	C	B^+	**Construction stage:** In case the project component includes the raising of dam embankments, land acquisitions of agricultural lands or bush lands around embankments and reservoirs are required. Coordination with local traditional leaders will be necessary during land acquisition process. **Operation stage:** Positive impacts are expected since existing IMC will be enhanced through the rehabilitation of existing dams.
	21	Misdistribution of benefit and damage	D	D	No impacts are expected during both construction and operation stages.
	22	Conflict	D	D	No impacts are expected during both construction and operation stages.
	23	Cultural heritage	D	D	There are no cultural heritages around project area.
	24	Land scape	D	D	Since the project is rehabilitation of existing structures, the project does not affect to the landscape.
	25	Gender	D	D	No impacts are expected during both construction and operation stages.
	26	Rights of the Child	D	D	No impacts are expected during both construction and operation stages.
	27	Hazards (Risk), Infectious diseases such as HIV/AIDS	B^-	D	**Construction stage:** There are risks of spreading infection diseases such as HIV due to the entering of construction workers into the area. **Operation stage:** Impacts are not anticipated.
	28	Work environment (including safety)	B^-	D	**Construction stage:** Safety and health of construction workers shall be considered during construction work. **Operation stage:** Impacts are not anticipated.
Others	29	Accident	B^-	D	**Construction stage:** There are risks of accidents by operating construction machineries, vehicles and so on, during construction work. **Operation stage:** Impacts are not anticipated.
	30	Transboundary impact, climate change	D	A^+	**Construction stage:** Impacts are not anticipated. **Operation stage:** Positive impacts are expected significantly since the project contributes the stability of dams into the future and reduces the risks of climate change (e.g. flood damage by cyclones).

A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. D: No impact is expected.

(5) Mitigation Measures and Monitoring

According to the scoping result shown in above table, most of the major negative impacts on environmental and social aspects are anticipated during construction works, such as water pollution, wastes, and so on. It is necessary to develop an EMP of the project and implement appropriate mitigation measures and monitoring by construction contractor and implementation agency (DOI or ZINWA).

(6) Evaluation of the Environmental Category (Proposed)

The scope of the project is limited to rehabilitation works of the existing agricultural dams and the current dam operation will not be hanged after the rehabilitation works. Significant negative impacts on the surrounding natural environment and social environment by the project implementation are not anticipated. The project sites are not located in sensitive areas such as national protected areas and other important biodiversity areas. And, the large scale involuntary resettlement and/or land acquisition are not anticipated. In these reasons, it is assumed that the project will fall under Category B in the category classification of JICA environmental and social consideration guideline.

5.5.4 Rehabilitation Project Cost

Table 5.5.15 shows the estimation of the project cost for the deteriorations/damage to be rehabilitated under Japanese Grant Aid Project. The unit cost and rate of indirect cost are based on the hearing from the local contractors.

Table 5.5.15 Estimated Rehabilitation Cost

Cost	Item			Magudu	Musaverema	Chinyamatumwa	Mashoko	Mabvute	Munjanganja
Direct cost	(1) Embankment	-Surface replacement (including raising*1) -Drainage canal		2.43	4.45	2.55	2.97	3.12	3.40
	(2) Spillway channel	-Basket mat							0.03
		-Bridge					0.22		0.19
	(3) Connection canal	-Protection wall				0.02		0.04	0.04
		-Bridge		0.26	0.31	0.19		0.26	
	(4) Intake	-Winch and house		0.01	0.01	0.01	0.01		0.01
		-Transformer relocation				0.01			
	Subtotal (A)			2.70	4.77	2.78	3.20	3.42	3.67
(B) Indirect cost (=(A)x0.58)				1.57	2.77	1.61	1.86	1.98	2.13
(C) Total (=(A)+(B))*2				4.27	7.54	4.39	5.06	5.40	5.80
Total cost implemented by Japanese Grant Aid Project	(D)Total (=(C)x1.5)		(million USD)	6.40	11.30	6.59	7.58	8.11	8.70
			(million JPY*3)	734	1,296	756	869	930	998
	(E)Consultant Service (=(D)x0.08)		(million JPY)	59	104	60	70	74	80
	(F)Soft component (=(D)x0.02)		(million JPY)	15	26	15	17	19	20
	(G)Sub total (=(D)+(E)+(F))		(million JPY)	808	1,426	831	956	1,023	1,098
	(H)Contingency (=(G)x0.05)		(million JPY)	40	71	42	48	51	55
	Total (=(G)+(H))		**(million JPY)**	**848**	**1,497**	**873**	**1,004**	**1,074**	**1,153**

*1 Raising to cope with increased flood volume (target: Chinyamatumwa, Mashoko and Munjanganja Dams only)
*2 The construction cost implemented by the Zimbabwean contractor
*3 *Exchange rate: 114.674 JPY/USD（By JICA, Jan 2022）