REPUBLIC OF MOZAMBIQUE

MINISTRY OF AGRICULTURE AND FOOD SECURITY

NATIONAL IRRIGATION INSTITUTE

SMALLHOLDERS IRRIGATED AGRICULTURE AND ACCESS MARKET PROJECT (IRRIGA)

PEST MANAGEMENT PLAN

REPORT

April 2018

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ABBREVIATIONS AND ACRONYMS

DNGRH	National Directorate of Water Resources Management
DPASA	Provincial Directorate of Agriculture and Food Security
DPS	Provincial Directorate of Health
DPOPHRH	Provincial Directorate of Public Works, Housing and Water Resources
DSV	Plant Protection Services
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ERRP	Emergency Resilient Recovery Project
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
FAO	Food and Agriculture Organization
GAP	Good Agricultures Practices
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GoM	Government of Mozambique
INGC	National Disaster Management Institute
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan
IRRIGA	Smallholders Irrigated Agriculture and Access Market Project
MASA	Ministry of Agriculture and Food Security
MIMAIP	Ministry of the Sea, Inland Waters and Fisheries
MISAU	Ministry of Health
MITADER	Ministry of Land, Environment and Rural Development
MOPHRH	Ministry of Public Works, Housing and Water Resources
MSDS	Materials Safety Data Sheet
NGO	Non-Governmental Organization
PARPA	Action Plan for the Reduction of Absolute Poverty
PEDSA	Strategic Plan for Agricultural Development
PMP	Pest Management Plan
PNI	National Irrigation Program
PROIRRI	Sustainable Irrigation Project
RPF	Resettlement Policy Framework
SDAE	District Services of Economic Activities
SDSMAS	District Services of Health, Women and Social Affairs
USAID	United States Agency for International Development
WUAs	Water User Associations
WB	World Bank
WHO	World Health Organization

EXECUTIVE SUMMARY

The Pest Management Plan (PMP) is the generic designation for the Integrated Pest Management Plan (IPMP), which is designed to set out the overall approach for minimizing potential adverse impacts on human and environmental health through promotion of Good Agricultures Practices and rational use of pesticides, insecticides and herbicides, as well as training and supervision for the safe use and disposal of pesticides.

The proposed project is designed to focus on smallholder irrigated agriculture development and market access and is expected to provide improved irrigation services and market linkages to smallholders' farmers in 5,000 hectares of irrigated land cultivated by around 12,000 smallholder farmers in all target Provinces. The four project target provinces (Manica, Nampula, Sofala and Zambezia) were identified and selected because they were particularly adversely affected by the impacts of natural disasters of 2014 and 2015 and considering the need for reconstruction and rehabilitation of infrastructures because of these disasters.

Mozambique has legislation on plant protection and pesticides, which complies with the International Plant Protection Convention. Phytosanitary measures include all relevant laws, decrees, regulations, requirements and procedures taken by a state to protect plant health and prevent the spread of pests. The Ministry of Agriculture and Food Security is the main institution responsible for pest management. This integrated pest management is included in the existent strategic and action plans as the Poverty Reduction Action Plan and the Strategic Plan for Agricultural Development.

The success of implementation of a Pest Management Plan is the use of Integrated Pest Management Approach for development and sustainable institutional and human capacity. The training of actors involved in pests and pesticides management will be implemented at District Services of Economic Activities with field action by farmer groups, which will receive training and advisory services from Farmer Field School Facilitators/Trainers, appropriate NGOs, and community leaders who would have graduated from Training of Trainers sessions.

Mozambique has Phytosanitary Measures that include all relevant laws, decrees, regulations, requirements and procedures taken by a state to ensure that all processes that involve working with or handling pesticides are executed without prejudice to public, animal and environmental health (Decreto 54/2015 de 31 de Dezembro). As a member of the WHO, this Regulation is complied with the international standards within the WTO framework, and World Bank operational policy on pest management OP 4.09.

The Ministry of Agriculture and Food Security is the main institution responsible for pest management. The Plant Protection Services is responsible for preparation of a response strategy and operational action plan and defining the charter of responsibilities for the action plan and its implementation of approved field intervention sites and the PMP activities monitoring coordination in collaboration with Health Services, Water Resources Institution, Farmer Organizations, relevant NGOs and Stakeholders.

At present pest and plant disease control in Mozambique is limited by a combination of lack of knowledge, equipment, supplies and finance. Pesticides and fertilizers are only used by a small proportion of rural households due to the deficient supply network and unfordable cost. However, there are several scattered experiences of Integrated Pest Management within the country, including in the majority of target conservation areas, which are implemented by

NGOs and the Ministry of Agriculture, through the IIAM and the extension network of the Provincial Agriculture and Food Security Directorates.

The IPMP is meant to (i) review the proposed aims and activities of the Project; (ii) highlight the anticipated pest and pest management problems in the areas targeted by the Project; (iii) review national policies and regulations for dealing with these pests; (iv) review the country's pest management practices including its experiences with integrated pest management (IPM); (v) outline a Work Plan for applying IPM to improve the effectiveness and safety of pest management under the proposed Project (i.e. to be specified in a specific Integrated Pest Management Plan IPMP); and (vi) setting out an overview monitoring and evaluation plan to be detailed within the IPMP.

The preparation of this IPMP which will serve the entire project is a key tool for the promotion use of environmentally friendly practices (hygienic, cultural, biological or natural control mechanisms and the judicious use of chemicals) in pest control. The IPMPs will ensure the compliance with regional standards laws and regulations, with World Bank safeguard policy OP 4.09, requirements on pest management.

There is a need of additional and continuous capacity building in target areas to build up existing farmers' inclination of implementing IPM techniques, keeping chemical use at a minimum. Community associations whenever possible should visit other IPM programs in the region. Therefore, there should be an articulation with other actors with IPM programs, as the Provincial Directorates for Agriculture and other partners.

The training of actors involved in pests and pesticides management in IPM/Farmer Field School (FFS) will be implemented at the DPASA/SDAE with field action by farmer groups, which will receive training and advisory services from FFS Facilitators/Trainers, appropriate NGOs, and community leaders who would have graduated from Training of Trainers (TOT) sessions. Training at all levels will be based on participatory learning modules for capacity building in IPM information delivery. The training modules will concern the risks associated with pesticide handling, sound management methods, adequate behaviors and good environmental practices, facilities and equipment maintenance, protective measures and measures to be adopted in case of intoxication.

Awareness-raising programs and training on IPM techniques and safe use of pesticides shall be inclusive for women and vulnerable groups, since experience show that these are the most impacted persons by pest and pesticides use and storage.

The proposed budget for PMP implementation amounts to **396,000 USD**.

1. INTRODUCTION

With the World Bank (WB) support, the Ministry of Agriculture and Food Security of Mozambique (MASA) will be implementing the Smallholder Irrigated Agriculture and Market Access Project, aka IRRIGA, during the period 2018 and 2024. The project is expected to play a crucial role in the consolidation of the developments initiated by the Sustainable Irrigation Development Project (PROIRRI), which will phase out in December 2018 after close to seven years of implementation. PROIRRI is and was the most relevant undertaking in irrigation development in Mozambique since the country embraced the market economy from the mid-1980s and enjoyed peace and democratic pluralism from 1992 onwards.

IRRIGA will support the rehabilitation of irrigation schemes and improvement of the cropping intensity, productivity, production, competitiveness and market access of around 12,000 smallholder farmers cultivating 8,000 ha of irrigated land in the project area in the central provinces of Manica, Sofala and Zambezia and the northern province of Nampula.

Agricultural intensification was under PROIRRI and is also expected under the new project to trigger an increase in pest populations and subsequently a raise in pesticide usage to control them, as well as an increase in the use of chemical fertilizers across the agricultural cycle. Any increase in pest populations may be detrimental to agricultural productivity or human/animal health, which in turn will increase the dependency on pesticides. Any subsequent increase in the use of chemicals has the potential of causing harm to users, the public and the environment. Evidence shows that although developing countries like Mozambique lag far behind developed countries in the use of pesticides they experience the highest number of pesticide poisoning due to poor regulatory, health and education systems.

Under this project, a pest may be defined as any organism whose presence causes economic loss or otherwise detracts from human wellbeing and safety in general. The term covers a broad range of organisms (plants, animals and microorganisms) that reduce productivity of agriculture

Several pests attack agriculture crops and can cause huge damage. Failure to effectively manage them, can greatly lead to reduced yield and product quality (FAO 2007, Schelling 2014). However, many pest management problems arise from relying entirely on pesticides for control. The control of pests is generally based on a calendar spraying which can lead to repeated pesticide application and consequently pest resistance to insecticides. This has the potential of affecting negatively the population density of natural enemies, increasing the cost of production and environmental problems (Thomas 1999, Radcliffe et al 2009, Gurr et al 2017). In addition, Public health concerns from water-borne and water-related diseases such as malaria and bilharzia cases under irrigation projects can trigger the use of pesticides in controlling their vectors.

This document forms Pest Management Plan (PMP), which under the contect is the generic designation for the Integrated Pest Management Plan (IPMP). The IPMP is designed to set out the overall approach for minimizing potential adverse impacts on human and environmental health through promotion of Good Agricultural Practices

(GAP) and rational use of pesticides, insecticides and herbicides, as well as training and supervision for their safe adoption, use and disposal.

The World Bank Safeguard Policy OP 4.09 on Pest Management stipulates that "in assisting borrowers to manage pests that affect either agriculture or public health, the Bank supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides". Further, "in appraising a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the project components a Work Plan to strengthen this capacity".

In line with these objectives, the IPMP:

a) Reviews the proposed aims and activities of the Project;
b) Highlights the anticipated pest and pest management problems in the areas targeted by the Project;
c) Reviews national policies and regulations for dealing with these pests;
d) Reviews the country's pest management practices including its experiences with integrated pest management (IPM);
e) Outlines a Work Plan for applying IPM to improve the effectiveness and safety of pest management under the proposed Project (i.e. to be specified in a specific Integrated Pest Management Plan IPMP);
f) Sets out an overview monitoring and evaluation plan to be detailed within the IPMP.

The preparation of this IPMP involved literature review, consultations with relevant government departments, and consultation with farm communities. It also involved consultation with regional and district officials in the targeted areas of Manica, Sofala, Zambézia and Nampula Provinces to review the project plans and pest management challenges. An inventory of common pest problems in the project sites, and the practices commonly used by farmers to control these pests was undertaken, discussed and compared with adoption data available in the literature. PROIRRI's experience was extensively examined as way of drawing lessons that will have to be applied under IRRIGA as a way of enhancing its ability to translate IPM principles into added value for the project.

In addition to this introduction the document comprises the following main chapters: (i) project description; (ii) project targeted areas; (iii) policy and institutional framework; (iv) pest management approach; (v) towards the active adoption of the IPM; (vi) institutional strengthening, training and capacity building; (vii) proposed budget.

2. PROJECT DESCRIPTION

The proposed project is designed to focus on the development of irrigation schemes for smallholder farmers as well as market access to inputs and outputs to and from irrigated agriculture. The irrigation schemes to be financed will be on already existing traditional ones, in order to rehabilitate and expand them; The project will not finance the construction of new irrigation schemes. Also, water gravity-fed schemes will be prioritized as opposed to pumping ones, due to lower maintenance and operational costs. Typical IRRIGA physical interventions in irrigation per se will be in the form of (a) upgrading the areas around the water intakes and the main canals; (b) construction of water collection structures and/or rehabilitation of damaged embankments; (c) installation of control structures like water gates; (d) upgrading the main canals and, where necessary, lining critical stretches of the distribution system; and (e) use of local plants/grasses (like vetiver grass) to control canal erosion;; associated investments such as rehabilitation of rural roads ("last mile") or connecting power lines (in case of pumping-fed schemes) may also take place[1]. The intensification of irrigated agriculture will also facilitate investments in (i) storehouses; (ii) a processing unit at a pilot level; (iii) basic access to irrigation areas, etc.

The three main pillars of the project are:

1) Capacity development of the irrigation institutions to provide the National Irrigation Institute (INIR) with the necessary capacity to design and technically supervise the construction and operation of new irrigation schemes under the National Irrigation Program (PNI), strengthening Water Users Associations (WUAs[2]) to adequately undertake on-farm water management and operations and maintenance (O&M) of irrigation schemes;
2) Irrigation development for smallholders by linking them with existing or emerging private agri-business companies in the country by using the concept of out-growers or contract farmers for companies in the project area; and
3) Promote agriculture intensification, enhance agriculture productivity and strengthen market access for smallholders on the irrigation schemes that have already been completed under the PROIRRI irrigation project in Zambezia, Sofala and Manica provinces.

The project also aims to provide INIR with adequate skills and resources to manage environmental and social risks or impacts of its investments (since planning stage to monitoring and auditing).

As indicated the proposed project (IRRIGA) will be geographically focused on the central and northern provinces of Manica, Sofala, Zambezia and Nampula. The project is expected to provide improved irrigation services and market linkages to smallholder farmers in 5,000 hectares of irrigated land cultivated by near 12,000 smallholder farmers in the targeted Provinces. Additionally, the project will provide agricultural

[1] In order to explore synergies with other WB projects, such as SUSTENTA or Feeder Roads, sub-project rural roads will likely be financed by these other projects.

[2] The law and regulation governing the establishment and operation of these organizations was developed under PROIRRI.

intensification and improved market linkages to the new 5,000 ha to be developed plus 3,000 ha of land that will have been developed under PROIRRI. IRRIGA subprojects will be concentrated on six (6) main river basins flow/runoff in Lurio, Meluli, Licungo, Zambeze, Pungwe, and Buzi. It is estimated that the future cumulative water demand associated with IRRIGA ranges from 0.16% to 4.1 %, which is considered to be minimal and in line with the nature of small and medium scale embraced by the project.

The project will have five main components:

a. Capacity Development of the Irrigation and Agriculture Institutions;
b. Development of Irrigation Systems;
c. Agriculture Intensification and Market Linkages;
d. Project Management, Monitoring and Evaluation; and
e. Contingency and Emergency Response.

The scope and contents of these components and allocation of funds are detailed below.

Component 1 - Institutional Capacity Building (US$8 million of IDA grant). This component is designed to improve the enabling policy environment, support the regulatory framework, improve investment strategy and technical oversight, strengthen institutions and enhance beneficiaries' capacity for sustainable development and management of irrigated agriculture. In response to a request from the Ministry of Agriculture and Food Security, the project will also support the development of investment planning and management capacity (including environmental and social management) for coordinating all donor funding for the development of irrigation sector in the country. This component will finance three activities: (i) establishing the Agriculture Investment and Management Unit (AIMU); (ii) strengthening the capacity of irrigation institutions; and (iii) strengthening the capacity of agricultural institutions and market information systems. It will have the following subcomponents:

- **Sub-component 1.1. Agriculture Investment and Management Unit**. This sub-component will support the establishment of AIMU, to serve as the implementation agency of for MASA program. This Unit will consist of qualified staff hired competitively and will be operationally responsible to plan and implement the agriculture program in the country funded by international partners. Initially the Unit will manage only IRRIGA Project and gradually will evolve and include other investment operations funded by international partners at MASA. Under the IRRIGA Project, the Unit will be responsible for assurance of technical quality (including environmental and social management) in all phases of the development of the irrigation schemes and INIR will be responsible for policy and regulatory framework issues;
- **Sub-component 1.2. Strengthening Irrigation Institutional Capacity**. This sub-component will support the development of regulatory tools for irrigation services, review of the existing institutional structures, and the development of required guidelines, norms and systems for promoting efficient delivery of irrigation services. Specifically, this subcomponent will support the following activities: (i) provide technical assistance to INIR to continue irrigation institutional reforms initiated under PROIRRI; and (ii) strengthen technical and operational capacity of INIR. The regulatory tools and processes were broadly identified as part of the PNI and will be further refined and implemented with

support from this project. This includes: (a) preparation and adoption of the public private partnership (PPP) regulations; (b) a review of the INIR's mandates for enhancing its financial and patrimonial autonomy; (c) the development of relevant regulatory tools and contract models for partnerships in irrigation, as defined in the PNI; (d) the development of the regulations and tools for licensing irrigation development in the country; and (e) partnerships with formal education systems in the country (e.g. University Eduardo Mondlane, Universidade Politecnica de Manica among others), including provision of at least 10 internships for irrigation engineering and irrigation economics graduates for up to 12 months of field work.

- **Sub-component 1.3. Strengthening Agriculture Institutional Capacity and Market Linkages**. Increase in crop productivity, cropping intensity, and overall agriculture production is an important objective of this project by gradually transforming the traditional smallholder subsistence agriculture into more productive commercial agriculture. In this context, this sub-component is designed to finance capacity building activities of institutions involved in the development of irrigated agriculture at the national and decentralized provincial/local levels to provide appropriate technical and market information as well as complementary services needed for improved farm level investments. In this sub-component, the focus will be on the following activities: (i) applied agriculture research and development; and (iii) agriculture technology development, transfer and use. This will require effective coordination of actions at the central, provincial and local levels, and preparation of MOUs to implement specific actions to fully utilize the irrigated area developed under this project. This sub-component will promote (i) an increase in crop productivity and cropping intensity; (ii) strategic agriculture specialization; (iii) climate smart agriculture; and (iv) appropriate diversification at the farm level to reduce risk, increase product demand for the market and improve profitability and at the same time promote production and consumption of nutritious food for farmer households and the rural community.
- This sub-component will also pilot the development of a digital platform to use the available tools that could collect, process and disseminate relevant market and price information for decision making related to agriculture production and marketing. The project will also use available agrometeorological information (agricultural observatory) to generate reports for decision making for relevant institutions involved in the agriculture development. The output could be used to facilitate inter-ministerial meetings, meeting with agro-dealers, inputs suppliers and involve research. These activities will be implemented by relevant departments at MASA, including agricultural research and extension, MITADER, Ministry of Public Works and the Ministry of Trade and Industry, including input suppliers, traders and private agribusiness operators.

Component 2: Smallholder Irrigation Development (US$46 IDA grant). This component will finance the development of 5,000 ha of irrigated land in the project area that will facilitate increased cropping intensity and agricultural productivity and enhanced climate resilience. This will include engineering studies, construction works, and equipment required to fully equip 5,000 ha of irrigated land; of which around 1,300 ha for medium/large rice irrigation schemes, 3,000 ha for small/medium horticulture crops (vegetables) and 700 ha for value chain specific out-grower crops (e.g. sugarcane, bananas, litchi, avocados and other fruits, and high value vegetables). These crops were

selected based on the Government strategies for agriculture development, market needs and existing agro-climatic conditions in the project area.

The construction of the irrigation systems will be tendered to qualified and experienced private sector contractors and the irrigation infrastructure development (rehabilitation and expansion of existing traditional irrigation schemes) is expected to consist of: (a) upgrading the area around the water intake and the main canal; (b) construction of water collection structures and/or rehabilitation of damaged embankments; (c) installation of control structures like water gates; (d) upgrading the main canals and, where necessary, lining critical stretches of the distribution system; and (e) use of local plants/grasses (like vetiver grass) to control canal erosion; associate investments such as rehabilitation of rural roads ("last mile") or connecting power lines (in case of pumping schemes) may also be considered.

The AIMU, will be responsible for technical oversight and quality control of the irrigation infrastructures falling under this component. Priority will be given to gravity-fed canal irrigation systems, as they are relatively simple to operate and maintain, and are less costly compared to the piped systems. Pumping will be considered, if at all, only for high value crops and under exceptional cases.

Component 3: Agriculture Intensification and Market Linkages (Total US$22 million: US$20 million IDA grant and US$2 million from beneficiaries). This component is designed to improve the cropping intensity, productivity, production, competitiveness and market access of near 12,000 smallholder farmers cultivating 8,000 ha of irrigated land in the project area. This component will finance (i) capacity building through training for the establishment and operation of farmers groups and water user associations as well as local level staff; and (ii) farmers investments, using matching grants and market linkages, to enhance agricultural production and value addition. It will have the following subcomponents.

i. ***Sub-component 3.1. Capacity building for farmers associations and local level staff.*** Under this sub-component, farmer groups and associations, including WUAs, will be trained using the Farmers' Field Schools (FFSs) and the Integrated Program for the Transfer of Agricultural Technologies (PITTA-*Programa Integrado de Transferência de Tecnologias Agrárias*) methodologies. In addition, staff from the local government institutions and service providers, including local NGOs, will be trained to provide appropriate assistance to the project's smallholder farmer beneficiaries. Specifically, the project will support capacity building for the technical, institutional, managerial, and marketing skills of smallholder beneficiaries as well as local level staff. After appropriate training, qualified smallholder beneficiaries are expected to apply for investment support through the matching grants to introduce new and improved agriculture technologies to enhance cropping intensity, productivity, production and value chain linkages.

ii. ***Sub-component 3.2 Investment support to enhance agricultural production and value chain linkages.*** This sub-component will provide demand-based matching grants to eligible smallholder farmers, farmers' groups and organizations to introduce new and improved agriculture technologies to enhance cropping intensity, productivity, production, and value addition to increase market access. The project will support three categories of sub-projects: (i) production matching grants for the acquisition of improved inputs (such as seeds, fertilizer, draft animals, and farm

equipment) aimed at increasing agricultural productivity and production as well as support for emerging commercial farmers for innovative activities to increase the area under irrigation and/or increase water storage capacity for irrigation; (ii) value chain matching grants for post-harvest activities, including value addition, equipment, tractors/trucks, storage and marketing facilities to improve value chain linkages and market access; and (iii) at least one pilot partnership arrangement with private sector agri-business operators for the construction of horticulture processing plant in Manica province that is equipped for cleaning, sorting, grading, washing, weighing, packaging and storage of fresh vegetables.

The eligibility criteria for the matching grants consist of the level of the farmer's organization, including the availability of a business/investment plan, agronomic skills, and alignment with project supported value-chains. The implementation arrangements and grant delivery structure will be further developed as part of the Project Implementation Manual (PIM), maximizing the existing capacity at the local and provincial level, with technical support from a central project implementation unit at MASA. Considering that other Bank-funded projects also provide matching grants, the approach to be used in the three categories under IRRIGA will be harmonized with the approach under the ongoing SUSTENTA or MozBio or MozFIP.

Component 4: Project Management, Monitoring and Evaluation (US$6 million from IDA grant). The objective of this component is to safeguard project management efficiency and efficacy, by ensuring the use of resources in accordance with the project's objectives, procedures, and fiduciary guidelines; and monitoring and evaluation (M&E) of the project implementation status and performance, and the achievement of project indicators and development objective. Specifically, the project will finance (i) incremental operating costs for the IRRIGA Project Implementation at the national level led by AIMU and the provincial levels led by Provincial Project implementation Units (PPIUs), related to financial management and procurement, environmental and social safeguard compliance, audits, and reporting; (ii) technical assistance and incremental operating costs for irrigation systems planning, design, construction supervision and training; and (ii) the establishment of a Management Information System (MIS) for irrigated agriculture, and the project monitoring and evaluation (M&E) system.

Component 5: Contingency and Emergency Response (US$0). This component will provide immediate response in the event of an eligible crisis or emergency. This component is a "zero-dollar" Contingency and Emergency Response Component. In the case of an adverse event that causes a major disaster, the Government of Mozambique may request the Bank to channel some financial resources from this component to address the emergency. If agreed by the World Bank, part of the project resources will be re-allocated to this component to finance any critical emergency activities under this component.

The **project total budget is estimated at US$ 82.0 million**, at this stage. The funds will be mobilized from (i) WB/IDA US$80 million (as a grant), and (ii) in-kind contribution from beneficiaries of US$2 million.

The project will build synergies and seek harmonization with other initiatives with the potential of facilitating the fulfilment of the above-mentioned objectives and targets.

Important initiatives include SUSTENTA, MozFIP[3] and its MozDGM[4] and MozBIO, under the Ministry of Environment, Land and Rural Development (MITADER) or the Feeder Roads[5] project, as these projects also aim to invest on agriculture intensification, irrigation, market access or other related infrastructure. The country's strong reliance on agriculture, turns this sector into the main driver of general economic development and rural development. In the past (e.g. in the 1990s), rural development was under the Ministry of Agriculture and since 2015 it has been under the Ministry of Environment and Land. MITADER is conducting several initiatives to promote rural development.

In addition to small and medium size irrigation schemes, which will be the core area for SUSTENTA (under implementation[6] in the provinces of Nampula and Zambezia) will also fund the development of (i) feeder road upgrade and maintenance; (ii) rural bridges construction and upgrading; (iii) storage facilities; (iv) other types of priority infrastructure; and (v) land delimitation and individual land tenure titling. While falling outside its direct scope all these are crucial for IRRIGA and will occur in the same geographical areas. On the ground and at higher levels coordination will be promoted to ensure maximization of the resources and to avoid duplications.

[3] Mozambique Forest Investment Program

[4] Mozambique Dedicated Grand Mechanism

[5] Integrated Feeder Roads Development Project

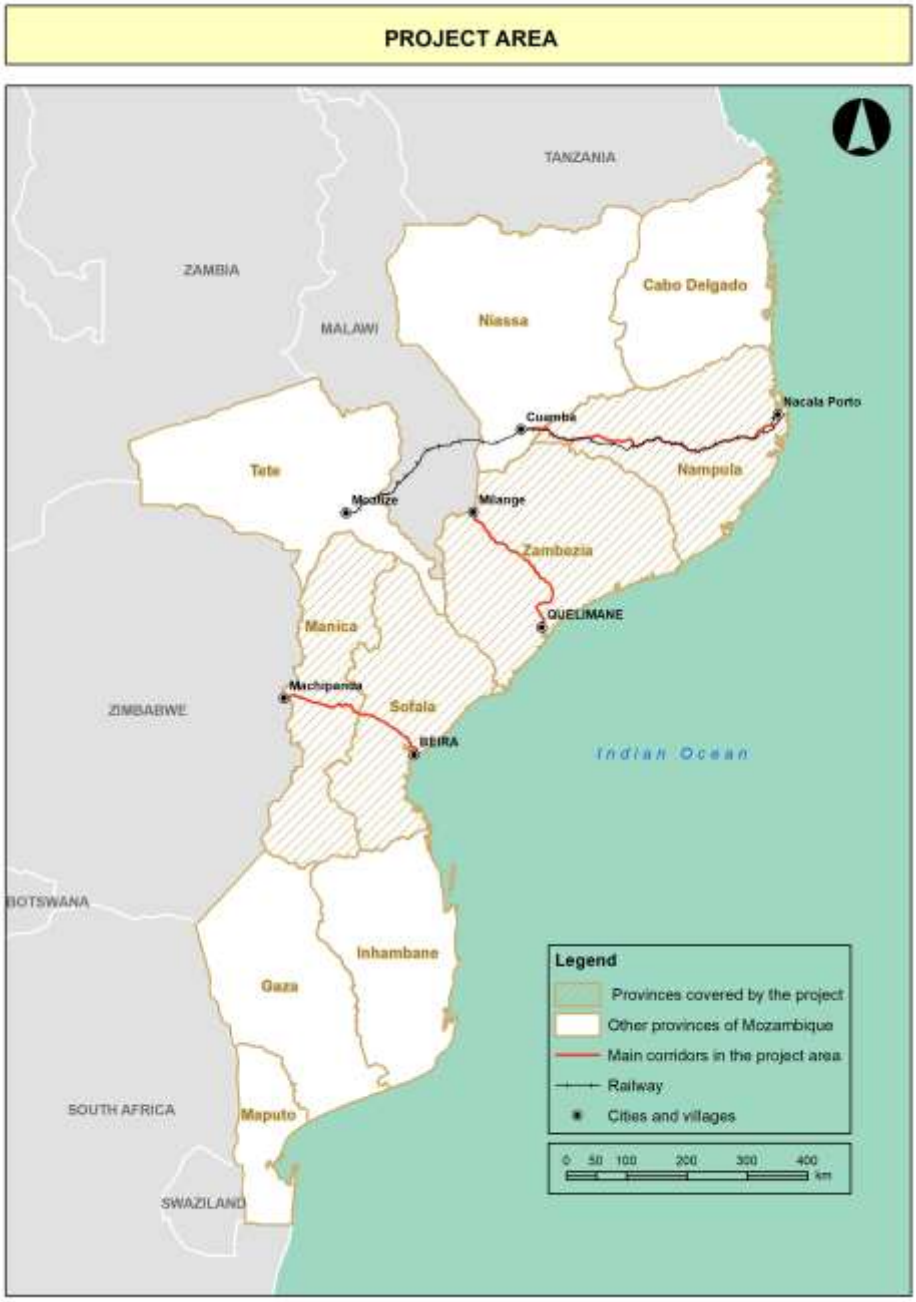
[6] SUSTENTA actual implementation started in 2017.

3. PROJECT TARGET AREAS

The project targeted areas are described in detailed at the Environmental and Social Management Framework (ESMF) chapter 4. As the ESMF is a safeguard tool that also entails provision from the present document (PMP), and these two documents interconnect, to avoid replication of information of project area overview and project development context this information shall be found in ESMF chapter 4. The main elements of such description cover the aspects outlined in the following paragraphs.

As shown in Figure 3-1 IRRIGA project will be implemented in four provinces, i.e. Sofala, Manica, Zambézia and Nampula. The first three were also part of PRIORRI, of which IRRIGA will be a natural continuation and from which it will inherit 3,000 ha of irrigated areas to then develop additional 5,000 ha across these four provinces to reach a total area of 8,000 ha that are IRRIGA's target.

Figure 3-1: The four provinces in the project area



3.1. Mozambique in General

With 49% of the country's total wealth being made of natural capital, as opposed to an average of 24% in the other sub-Saharan African countries, Mozambique is one of the most endowed countries in Africa in terms of natural resources (AFD, 2009)[7]. However, despite this privileged position, according to the 2015 Human Development Index, from

[7] 49% of the country's total wealth is natural capital, as opposed to an average of 24% in the other sub-Saharan African countries.

the United Nations Development Program (UNDP), Mozambique ranks 180 out of a total of 187 countries. More than 50% of its population lives under poverty.

There are also regional imbalances in development with the southern provinces of the country (except for Gaza province[8]) representing about 48% of the national GDP, while Maputo City itself, which covers only 5% of the total population, represents 18% of the total GDP. The central (29%) and northern (23%) regions come in the second and third positions, respectively. Yet these two regions are the most populated and endowed with natural resources.

Nevertheless, the country's economic performance was remarkable between 1995 and 2013-2015. The Gross Domestic Product (GDP) growth rate has been in the region of 7.4 in the period, which was informed mainly by a few large-scale capital investment projects, sound financial management, political stability and significant donor support. As with growth in some other developing countries in the SADC region (e.g. South Africa, Angola, etc.), the benefits of economic growth have not been enjoyed by all citizens and the link between economic growth and poverty reduction has been weak. Benefits from large scale capital investment projects tend to accrue to those who are already economically better-off (i.e. mostly minority groups residing in urban areas), as opposed to much poorer people who form the bulk of the population and particularly those living in rural areas. Urban poverty has also been showing a growing trend in the last two decades.

Political tension during the period 2013-2016, the discovery of hidden debts (2015/2016) and the decline/fluctuations of the prices of the commodities that Mozambique was starting and/or promising to export (mainly coal and gas) in the same period, have been accompanied by deacceleration of economic growth, reduced injection of foreign capital, and aid from donors. This was accompanied by high inflation and elevated depreciation of the national currency. After tight monetary policy reforms to control currency depreciation and fiscal deterioration inflation has decreased from close to 27% in October 2016 to 18% in March 2018 (BM, 2018), but the financial situation remains difficult and marked by uncertainties. Micro Small and Medium Size Enterprises (MSMEs), which are the dominant business entities in the country are the most affected by this complex context as they struggle to have access to finance and other forms of facilitation.

The effects of climate change, which tend to affect poorest countries with low resilience and lesser adaptive capacity, have further exacerbated the national economic challenges.

3.1.1. Physical Environment

As shown in **Error! Reference source not found.**, from the geomorphological point of view Mozambique is divided into two topographical regions: (i) to the north of the Zambezi river, there is a narrow coastline and bordering plateau slope upward into hills and a series of rugged highlands punctuated by scattered mountains; (ii) south of the Zambezi River, the lowlands are much wider with scattered hills and mountains along its borders with South Africa, Swaziland and Zambia.

[8] It represents close to 6% of the population and just under 5% of the GDP.

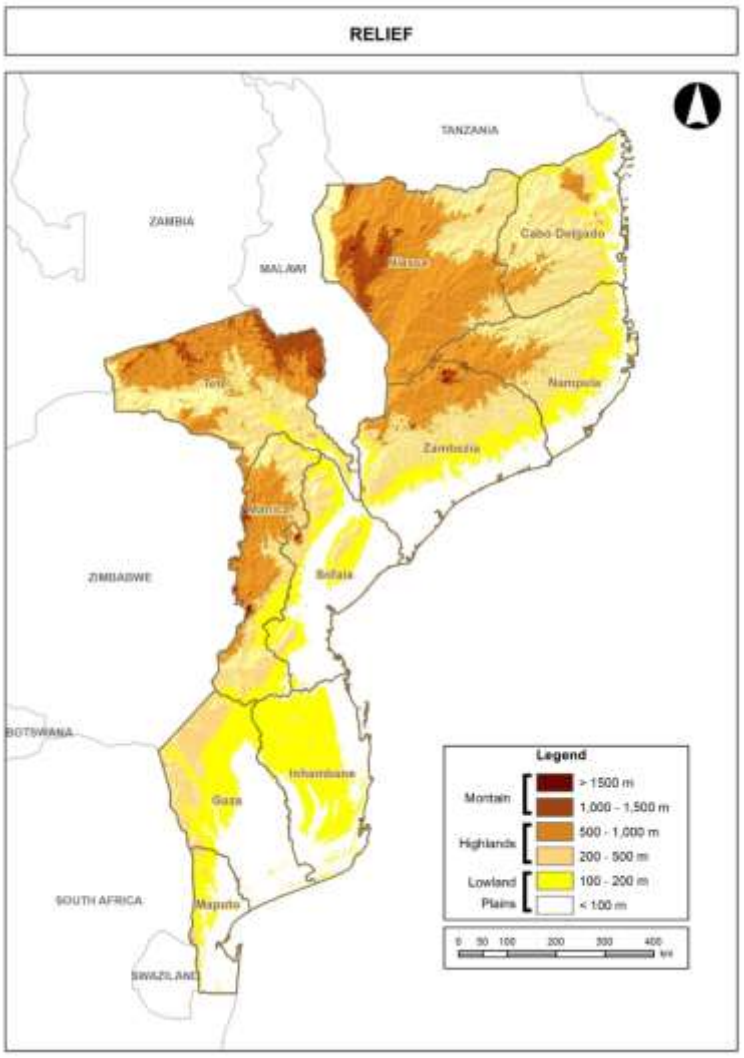


Figure 3-2: Mozambique physiography

The southern coastal areas have low water levels and extensive swamps, which make them prone to severe inundations in times of heavy rains. Monte Binga (in Manica province), peaking at 2,435 m, is the highest point of Mozambique; the Indian Ocean (0 m) is the lowest.

The country is drained by several important rivers, nine of which are international[9]. The Zambezi is the largest and most important river, the fourth-longest in Africa, and the largest flowing into the Indian Ocean from Africa. Lake Niassa (also Malawi), which is part of the Zambezi River basin, is the country's major lake. Cahora Bassa dam, along the Zambezi River, is Africa's fourth-largest artificial lake. A small slice of Lake Chiuta is found in Mozambique. The river is subdivided into 27 sub basins, spread over five provinces (**Manica**, **Sofala**, **Zambezia**, Tete and Niassa), which includes three of the IRRIGA targeted provinces (DNGRH, 2017). A large swathe of the Zambezi River Delta contains clearly visible evidence of center-pivot irrigation meaning that there already extensive irrigated agriculture taking place in the Delta. It therefore makes sense that the

[9] Maputo, Incomati, Umbeluzi, Limpopo, Save, Buzi, Pungwe, Zambezi, and Rovuma.

fertile soils of the Zambezi Delta are incorporated in the smallholder irrigated agriculture and market access project as this can be considered a mecca for agriculture. There is an agency responsible for the management of the Zambezi River Valley (ADVZ[10]) and a Special Land Use Plan (PEOT[11]) for the Valley was formulated in 2015. Since 2016 the Strategic Plan for the Utilization and Development of Zambezi River Basin has been under formulation. Together with the PNI, formulated under PROIRRI, these are important sources of information and facts related with the strategic plan to use Zambezi River Basin resources, including the development of small and medium size irrigation schemes.

The other important rivers in Mozambique are Limpopo, Incomati, Save, Pungwe, Buzi, Lurio and Rovuma. Save, Pungwe, Buzi and Lurio are in the project area. Lurio (associated with Nampula province, in this case) is an important river in Mozambique with the advantage of being confined within the country's boundaries. The other four major rivers are shared with other neighboring countries and this comes with specific requirements in the management of their water courses. The Strategic Plan for the Utilization and Development of Lurio River Basin was formulated in 2017, and should also be used to devise the best ways of developing IRRIGA subprojects where these will fall under it.

The country has a tropical climate with two seasons, a wet season from October to March and a dry season from April to September. Climatic conditions vary depending on altitude. Rainfall is heavy along the coast and decreases in the north and south. Annual precipitation varies from 500 to 900 mm (19.7 to 35.4 in), depending on the region, with an average of 590 mm. The east and the south have a more erratic rainfall while the north and west exhibit significant regularity. Cyclones are also common during the wet season.

3.1.2. Biological Environment

The biological environment is primarily shaped by the climate, altitude and by the soil types and textures throughout the provinces and districts. An additional factor, which strongly influences the state of the environment is the human use of biological resources (e.g. deforestation for timber, fuelwood/charcoal, construction, and subsistence such as hunting and fishing).

Mozambique has about 5,500 species of plants (including macroalgae) distributed in five Phyto-geographical regions and organized in communities with miombo, mopane, undifferentiated woodlands and coastal mosaic being the most common. The country's vegetation can also be divided into groups of land use and cover. Two centres of endemism (CE) have been identified in Mozambique namely Maputoland (in the south) and Chimanimani Nyanga (in the central region). Additional sub-centres are being proposed for the coastal forests (northern Mozambique) and inselbergs (in central and northern Mozambique).

[10] Agência do Desenvolvimento do Vale do Zambeze.

[11] Plano Especial do Ordenamento Territorial do Vale do Zambeze.

About 4,271 species of terrestrial wildlife were recorded with 72% insects, 17% birds, 5% mammals and 4% reptiles. The terrestrial fauna has undergone significant change in the last 40 years due to population increase, development and the political instability that ended in 1992, which confined most of the large mammals to existing conservation areas. It is estimated that eight (8) mammals are either extinct or in danger of extinction and these also include the black rhino and giraffe. The man-animal conflict is a significant main problem in the conservation areas. 735 species of birds, most of them migratory, occur in almost all habitats of Mozambique; with emphasis to the complex of Marromeu, which supports many species of waterfowl. Many of the identified endemic species, rare and threatened habitats are associated with isolated mountain, as are the cases of inselbergs, Chiperone and Namuli hills, Mecula and Gorongosa Mountains and Chimanimani massive. About 17 species of birds make up the country's red list. Threats to birds are mostly from anthropogenic activities such as deforestation forest degradation associated with a series of socioeconomic activities (MICOA, 2009[12]).

3.1.3. Social environment: Population and the Economy

Out of the country's eleven provinces the last population census (INE, August 2017) indicates that Mozambique is inhabited by 28,861,863 people. Nampula (6,102,867) and Zambezia (5,110,787) provinces represent close to 39% of the total, while the four provinces in the project area combined represent 53% of the total population (Manica and Sofala have 1911237 and 2221803, respectively. Close to 51% of the country's population are women.

People tend to concentrate along the main rivers, water courses and bodies and along the main development corridors made of roads, railways and other infrastructures.

A vicious cycle made of natural conditions, lack of capital, inadequate financial services, archaic production technologies and poor services responsible for development and dissemination of such technologies, poor marketing systems and other factors that define the environment in which local economic activities are carried out, explain the prevalence of the subsistence economy. The economy is based on direct and integrated exploitation of natural resources, with very little transformation. Plant and animal production, forests and fisheries are integrated in a single economic system of multiple relationships. These are combined to guarantee the survival of the individuals, the families and the communities.

Some of the aspects that define the practice of agriculture in Mozambique and the project the area, which are typical of the so-called "family sector"/subsistence economy are:

- Cultivation of very limited areas: slightly close to 2 ha and below 7 ha is the common size of most of the farms[13].

[12] The National Report on Implementation of the Convention on Biological Diversity in Mozambique.

[13] The informal character of agriculture and animal production, which are dominant economic activities, explains the present land use and land tenure patterns. Ancestral laws establish the distribution and use of land by existing families. Lineage plays a crucial role in the process. Each family and groups of families do their best to secure enough land and to have direct access to areas for housing, fauna, forests, pastures, fertile grounds and water.

- Use of farming technologies that are rudimentary: cultivation is primarily undertaken using hoes and virtually no external inputs, such as improved seed, fertilizers and chemicals are used[14].
- Over the years the family sector farmers have developed livelihood strategies oriented towards minimizing risk through crop diversification, which takes place in a variety of ways including:
    - Growing several crops and the dominance of intercropping;
    - Preferring to grow two or more consecutive crops rather than one of a longer cycle, even if the potential total yield is higher for the latter, to obtain advantage of moisture availability during the short rainy season; and
    - Growing crops in as many diverse environments (topography/relief/soil) as possible, e.g., in sandy flat areas, in medium textured alluvial deposits of slopes (transition zones), in the fine textured dark colored soils of the river beds (*dambos*) and in open valleys and alluvial soils.

This results in a combination of plots on different soil types and in different crop preferences, each with different fallow and cropping patterns.

At the household level artisanal fisheries is the second most important economic activity practiced in the rivers, lakes and the long Indian Coast and the main source of animal protein in Mozambique.

The dominance of agriculture and fisheries as the main subsistence activities goes hand in hand with other activities including the emerging commercial sector of agriculture made of small and medium size farmers, which although still in small numbers, are become increasingly important in Mozambique. Artisanal mining is also another important economic activity as is formal and informal employment in local cities and towns in the public and private sector and local services (banks, telecommunications, water supply and sanitation, etc.).

Both formal and informal Micro, Small and Medium Size Enterprises (MSMEs) represent about 98.6% of all business units, employing 43% of the workers and accounting for 76% of the total sales. Trade and service sectors form the bulk of business units, with commerce and retail businesses accounting for close to 60%, restaurants and accommodation 20% and manufacturing less than 10%. Most of these MSMEs tend to grow informally and as a reaction to immediate market deficiencies.

In what is relevant for the project, studies show that despite the MSMEs' importance in national economic development and poverty alleviation they lack growth perspectives, due in part to the entrepreneurs' and workers' poor education and training skills, cumbersome regulations, high cost of credit and poorly developed basic socioeconomic infrastructure[15]. Local entrepreneurs tend to diversify into many relatively small and uncompetitive businesses rather than growing promising small businesses into large ones

[14] Due to the monopolistic structure of the market for these products, they are rather very expensive in Mozambique.

[15] M. Krause and F. Kaufman, "*Industrial Policy in Mozambique*", 2011

that could reach out to more people and offer more income generation opportunities (job creation, gender mainstreaming, etc.).

The "Strategy for the Development of Small and Medium Size Enterprises in Mozambique" approved by the government in 2007 highlights the central role of MSMEs as drivers of employment, competitiveness, diversification and innovation, including mobilization of social resources. The strategy relies on three major pillars:

- Improve the business environment for SMEs
- Strengthen SMEs' technological and management capacities (capacity building)
- Give strategic support (e.g. to exporters and high-tech firms, etc.)

Priority is also given to the reduction of transaction costs for SMEs.

3.2.Agriculture and Irrigation

Close to 40% (36 million ha) of the 800,000 km² of Mozambique territory are arable land. At present only 10% of the total arable land is under cultivation of which only 1% is in the hands of commercial agriculture (i.e. medium and large enterprises that focus on cash crops[16]). The remaining 99% of the cultivated land is in the hands of subsistence farmers and are distributed by close to 4.0 million small farms of slightly above 1 ha and less than 10 ha in size.

Agriculture contributes 26% of total GDP and is the source of livelihood for 78% of the population. The sector has been displaying considerable growth averaging 6.8% over the period 1996 to 2015, which was less than the growth of the GDP of around 7% over the same period. The main negative contributing factor has been the high vulnerability of agriculture to natural disasters, mainly droughts and floods, particularly in the southern and central regions.

In 2011 the government approved the agricultural strategic plan (2011), i.e. PEDSA, with the aim of: (a) producing sectoral synergies to transform the agriculture sector from being predominantly one of subsistence farming into being more competitive; (b) embodying a vision that is shared by the sector´s key actors; and (c) dealing with the issues that affect investor confidence.

Due to the high dependence on hydrometeorological factors one important subsector in the development of agriculture is irrigation.

Historically, the total irrigated area fell from around 120,000 ha in the mid-1970s, after the country's independence, to close to 40,000 soon after the end of the civil conflict in 1992, and there is still a lot of work to be done to rehabilitate existing irrigation systems even before new ones are built. There are currently around 180,000 ha that have different forms of infrastructure for irrigation, of which only close to 50% are used mainly for sugarcane and increasingly some banana/fruit production. Only 8.8% of family sector farmers use some form of irrigation (TIA, 2008).

[16] Mainly sugar, tobacco, cotton, and more recently fruit (e.g. banana).

The country's irrigation strategy (EI, 2011) gives an orientation on how to establish the irrigation schemes and the property rights of the infrastructure. With the WB support a growing recognition of the importance of irrigation in the development of the country's agriculture led, among other developments, to the formulation and implementation of the Sustainable Irrigation Development Project (PROIRRI – 2011-2018), to which IRRIGA will be a form of continuation and consolidation.

After decades of stagnation PROIRRI has been an attempt of revitalizing the subsector. It focused on increased market led agricultural production and increased productivity in the development of new or improved irrigation schemes in central Mozambique. The project targeted the provinces of Manica, Sofala and Zambezia and it is expected to make available 3,000 ha of operational irrigation schemes, which will precisely be inherited by IRRIGA.

During PROIRRI implementation the National Institute of Irrigation (INIR) was established in 2012[17] and the National Irrigation Program (PNI) was formulated and approved in 2016.

INIR is the unit under the Ministry of Agriculture and Food Security (MASA) responsible for irrigation development. It works in close collaboration with the other MASA departments responsible for agrarian and extension services, such as the Department of Agriculture and Silviculture, the Department of Agrarian Extension; and the Agrarian Development Fund. It also collaborates with other relevant institutions for irrigation development, notably the National Directorate of Water Resources Management (DNGRH), from the Ministry of Public Works, Housing and Water Resources (MOPHRH), which is responsible for water resources planning and allocation, including the development and operation of major hydraulic works through the Regional Water Administrations (ARAs[18]). As shown in Figure 3-3, the country is subdivided into five regional water administrations (ARAs), i.e. Southern (Sul); Central (Centro), Zambezi (Zambeze), Central-North (Centro Norte) and North (Norte). There is also collaboration with the National Directorate of Land and Forestry in the Ministry of Land, Environment and Rural Development (MITADER), responsible for land allocation and titling.

Despite being defined as administratively and financially autonomous by its statutes INIR operates typically as any other national directorate within MASA and it is highly dependent on the government budgeting and funding systems and cycles. Among other aspects this means that it does not have the necessary revenue stream, financial autonomy and ultimately technical capacity to flexibly undertake initiatives in the development and management of irrigation schemes and the host of issues (human, technical, institutional, financial, etc.) around the sustainability of those schemes.

[17] Decree 09/2012, of May 11

[18] The country is subdivided into five regional water administrations (ARAs), i.e. Southern (Sul); Central (Centro), Zambezi (Zambeze), Central-North (Centro Norte) and North (Norte).

Figure 3-3: The five Regional Water Administrations in Mozambique (ARAs)

The PNI consists of a series of reforms and investments aimed at addressing critical irrigation development needs and medium-term food security targets for the country. The program considers three development scenarios, i.e. moderate, medium and high. Under the moderate scenario it is expected that close to US$ 1 billion will be invested to at least develop additional 125,500 ha (32,000 ha public and 90,500 ha private) of irrigated land by 2042. The initial phase of IRRIGA is focused on strengthening INIR's institutional capacity to plan for and manage irrigation infrastructure and services. Water Users Associations (WUAs) have also been identified as crucial in the system. They are expected to contribute to improve agriculture and on-farm water management, and operations and maintenance (O&M) of the irrigation schemes after receiving the

necessary capacity building. The law and regulation for the creation and operation of WUAs was formulated under the auspices of PROIRRI.

PNI implementation will require technical capacity and financial resources to significantly enhance the irrigation sub-sector to contribute to the critical strategic objectives of the agricultural sector of "increased production and agricultural productivity and the competitiveness of this sector to contribute to reducing food insecurity, increasing marketable surpluses and thus incomes from agriculture", as enshrined under PEDSA (MINAG, 2011). These are the issues that will be addressed by IRRIGA through the five components outlined above.

3.2.1. Water and Irrigation

Mozambique's vast water resources are well known. Figure 3-4 shows the main rivers in the project area. IRRIGA subprojects will be concentrated on six (6) main river basins flow/runoff of Luiro, Meluli, Licungo, Zambeze, Pungwe, and Buzi. It is estimated that the future cumulative water demand with IRRIGA will range from 0.16% to 4.1 %, which is minimal and in line with the nature of small and medium scale project represented by IRRIGA.

Figure 3-4: Main rivers in the project area

As stated above Zambezi, Lurio, Pungwe and Buzi are the dominant reivers complemented by a series of tributaries and other minor rivers and water courses and bodies.

3.3.The Provinces in the Project Area

3.3.1. Sofala Province

This subchapter provides and overview of these four provinces from the point of view of biophysical and socioeconomic environment. Potential project environmental and social impacts and related IPMP implications.

Based on 2000 data the Development Strategy for the Rice Sector in Mozambique (Ministry of Agriculture/GPSCA, 2005) placed Sofala in the third position (14%) in the national production of rice. Traditionally rice production is almost exclusively in the hands of the family sector/traditional farmers. The province is also known for hosting two of the four country's sugar cane farms and industries in operation at present, i.e. Marromeu and Mafambisse. The other operations are in Maputo province, in the south, i.e. Maragra and Xinanvane. Under IRRIGA the potential of transforming traditional rice production into a more commercial endeavor as well as the establishment of linkages (out growers) between existing large commercial farms and industries is particularly appealing. Under PROIRRI these aspects were tested and will be consolidated under IRRIGA. The use of pesticides by sugar cane out growers was significant during PROIRRI implementation and the levels of control of the use of pesticides and fertilizers was reported as problematic by the team that assessed the environmental and social management practices of the project.

3.3.2. Manica province

Manica has a long-standing tradition of small and medium size commercial farming with the use of irrigation (including that of pesticides and fertilizers) inherited from the colonial period focusing mainly on the production of horticulture and fruit. The use of ox power in agriculture also has some considerable tradition among local farmers. All these aspects combined, i.e. good soils, favorable topography (which makes the adoption of irrigation by gravity relatively easy), water abundance (regular rainfall and rivers), relative use of advanced farming technologies and tradition of producing for the market make this province particularly appealing to meet IRRIGA interests. There is room to revive all these elements (physical, socioeconomic and cultural) to build a thriving commercial sector led by small and medium size agricultural producers. PROIRRI has significantly demonstrated the veracity of this assumption, which it is expected that IRRIGA will consolidate. In the same way as Sofala province out growers under PROIRRI showed a substantial level of use of pesticides and fertilizers in a way that at times in not sound from the point pf view of environment and health management.

3.3.3. Zambézia Province

Based on 2000 data the Development Strategy for the Rice Sector in Mozambique (Ministry of Agriculture/GPSCA, 2005) placed Zambezia in the first position (close to 51%) in the national production of rice. According to the same study, all the districts in this province have natural favorable conditions to produce rice, but three of them represent close to 50% of the total production (Namacurra, Nicoadala, and Ile).

Rice production in this province is predominantly in the hands of the traditional and family sector farmers with irregular access to markets. This did not change substantially

under PROIRRI. Family farmers tend to have limited and irregular access to agrochemicals as these are very costly for their buying power.

3.3.4. Nampula Province

The Development Strategy for the Rice Sector in Mozambique (Ministry of Agriculture/GPSCA, 2005) placed Nampula in the second position (close to 15%) in the national production of rice. Cash crops (mainly involving cotton, cashew nuts and other) are widespread in Nampula province and subsequently a certain level of use of pesticides.

4. POLICY, REGULATORY AND INSTITUTIONAL FRAMEWORK FOR IMPLEMENTING THE (I)PMP

Under IRRIGA and in Mozambique in general an effective Integrated Pest Management (IPM) can only result from an adequate and creative combination of the Mozambique's policy and institutional framework and predominant practices with those of the World Bank.

This Chapter makes a review of the most significant elements of such a framework. It presents (i) Mozambique's main instruments and their applicability to the project; (ii) the WB policies and guidelines and their applicability to the project; and (iii) makes a brief comparison between the two sets of regulations and recommends the measures to be adopted by the project to bridge the gaps between the two systems.

4.1 Mozambique's Legal Framework

Mozambique's pesticide legislation is dispersed by a series of laws and regulations, which at times make it difficult to discern the main direction and critical aspects. There are times when the sum of the parcels does not necessarily result in a coherent direction, especially in social sciences. Among these two instruments take a central position: (i) ***Ministerial Diploma 153/2002 of 11 September 2002*** (Pesticides Regulation) and (ii) ***Decree 6/2009 of 31 March 2009*** (Pesticides Management Regulation). The table below makes a summary of the main contents of these instruments and of other that are relevant for the subject:

Table 4-1: Relevant Mozambican laws and regulations

Laws and regulations and brief description	Applicability to the project
Ministerial **Diploma 153/2002 of 11 September 2002** (**Pesticides Regulation**) This is a joint diploma issued by the Ministries of Agriculture, Health, and Environment for the management and use of pesticides in Mozambique. It requires that the use of pesticides be subject to their prior product registration with the Ministry of Agriculture. The Ministry of Health establishes permissible levels of pesticide residue in food stuffs based on FAO guidelines. Pesticides must be clearly labelled and identified and be color-coded depending on their level of toxicity. The use, storage, handling, sale and removal or destruction of pesticides may be subject to environment licensing	It is applicable as many of its provisions are in line with the WB guidelines on pest management including integrated pest management
Decree 6/2009 of 31 March 2009 (Pesticides Management Regulation) The objective of the Regulation is to ensure that all processes that involve working with or handling pesticides are not performed in detriment of the public, animal and environmental health It applies to the registration, production, donation, trading, importation, exportation, packing, storage, transport, handling, use and elimination of pesticides and adjuvants, by individual or collective persons, for agricultural, livestock, forestry, public health protection, domestic and other purposes Among other aspects the regulation identifies the institutions involved in pesticide management, identifies the bodies with responsibility of performing specific tasks in the area such as the (i) Technical Assessment Committee for Pesticides Registration; and the (ii) Technical Advisory Committee for Agrochemicals It also provides and updates regularly (annually) the list of pesticides products that can be used in Mozambique. These are classified according to their toxicity potential (Article 9). Out of the 188 registered pesticides, 109 are class III; 67 class II and only 12 class I (being Class I the most toxic ones)[19].	It is applicable for the same reasons as above

[19] Article Article 51, of the Regulation on Toxicological Classification, stipulates that the Ministers supervising the areas of agriculture, environment and health define the criteria for the toxicological classification of pesticides, which shall comply with the international standards defined by FAO and WHO.

Laws and regulations and brief description	Applicability to the project
The Regulation also stresses that companies or entities employing people for pesticide storage, trading, transport, application and elimination shall ensure continuing and updated training of their staff, including rules for combating fires, intoxication, first-aid, spills and other hazards. The companies are given the responsibility of training their staff with the government entities in the MASA being responsible for the preparation and administration of the courses. The Regulation also elaborates on the need for information dissemination and establishes limitations for pesticide advertisement	
Decree n. 18/2004 Regulation on Environmental Quality and Effluents' Emissions amended by **Decree No. 67/2010** (see below) The aim is to define environmental quality patterns for granting an effective control and management of pollutant concentration levels in environmental components. The annexed Regulation comprises 26 articles and 6 annexes divided into six Chapters. It defines air quality standards and emission requirements, water classification according to the uses and related quality control requirements with special regards to potable water. Moreover, it rules on soil quality and noise emissions. The Annexes provide technical requirements and standards **Decree No. 67/2010** amending the Regulation on Environmental Quality and Effluents' Emissions amends articles 23 and 24 and Annexes I and V of the Regulation on Environmental Quality and Effluents' Emissions, related to taxes for special authorizations and new fines and sanctions for illegal activities. Annexes IA and IB deal new standards of air quality, atmosphere polluting agents and parameters for carcinogenic Inorganic and Organic agents. Annex V lists potentially harmful chemical substances	Applicable. Although only addressing specific and partial aspects it is in line with crucial objectives of IPMP, as also espoused by the WB

4.2 World Bank Policies and Guidelines

The World Bank policies and guidelines on pest management are led by two main documents, namely World Bank OP 4.09 Pest Management and BP 4.01 Annex B – Application of EA to projects Involving Pest Management. The table below present a summary of each of these two documents and confirmation of application to the project.

Table 4-2: World Bank policies and guidelines

Policies and guidelines and brief description	Applicability to the project
World Bank OP 4.09 Pest Management It is meant to assist borrowers to manage pests that affect either agriculture or public health. It is in favor of a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. In Bank-financed projects, the borrower addresses pest management issues in the context of the project's environmental assessment In appraising a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the project components to strengthen such capacity. The Bank uses various means to assess pest management in the country and support integrated pest management (IPM) and the safe use of agricultural pesticides: economic and sector work, sectoral or project-specific environmental assessments, participatory IPM assessments, and investment projects and components aimed specifically at supporting the adoption and use of IPM. IPM takes central stage in the whole process such that in Bank-financed agriculture operations, pest populations are normally controlled through IPM approaches, notably biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest. The Bank may finance the purchase of pesticides when their use is justified under an IPM approach. The procurement of any pesticide in a Bank-financed project is contingent on an assessment of the nature and degree of associated risks, considering the proposed use and the intended users. The Bank refers to the World Health Organization's Recommended Classification of Pesticides by Hazard and Guidelines to Classification (Geneva: WHO 1994-95), which results in the following criteria being applied to the selection and use of pesticides in Bank-financed projects: (a) they must have negligible adverse human health effects; (b) they must be shown to be effective against the target species; (c) they must have minimal effect on non-target species and the natural environment. The methods, timing, and frequency of pesticide application are aimed at minimizing damage to	Applicable. IRRIGA was assessed to require the application of the set of measures set out in this regulation PROIRRI assessment, in particular, shows that integration of IPMP in environmental and social management was inadequate and this needs to be improved under IRRIGA

Policies and guidelines and brief description	Applicability to the project
natural enemies. Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them; (d) their use must consider the need to prevent the development of resistance in pests. The Bank requires that any pesticides it finances be manufactured, packaged, labeled, handled, stored, disposed of, and applied according to standards acceptable to the Bank. It does not finance formulated products that fall in WHO classes IA[20] and IB[21], or formulations of products in Class II, if (a) the country lacks restrictions on their distribution and use; or (b) they are likely to be used by, or be accessible to, lay personnel, farmers, or others without training, equipment, and facilities to handle, store, and apply these products properly	
BP 4.01, Annex B - Application of EA to Projects Involving Pest Management Annex B of BP 4.01, defined as the Umbrella Policy (see ESMF of the Project) sets out several principles to be adhered to in conducting project assessment, approval, implementation, monitoring and evaluation. It highlights the following: In the sector review the project task team (TT) ensures that any environmental assessment (EA) of the agriculture (or health sector) evaluates the country's capacity to manage the procurement, handling, application, and disposal of pest control products; to monitor the precision of pest control and the impact of pesticide use; and to develop and implement ecologically based pest management programs During project identification, the TT assesses whether the proposed project may raise potential pest management issues. Projects that include the manufacture, use, or disposal of environmentally significant quantities of pest control products are classified as Category A. Depending on the level of environmental risk, other projects involving pest management issues are classified as A, B, C, or FI. When substantial quantities of highly toxic pesticide materials for use under the project are transported or stored, a hazard assessment may be appropriate. Overall and also from the pesticide management point of view IRRIGA has been classified as Category B project due to the fact that it is not expected that its potential use of pesticides will raise highly complex issues and the issues it will raise are controllable using recommended IPM approaches The annex then endorses the IPM as the as the best approach for reducing environmental and health hazards associated with pest control and the use of pesticides and is structured to ensure that during all phases of the project the issues related with IPM need to be verified and corrective measures should be put in place to correct any nonconformities.	Applicable. It was in complying with this instrument that the project was found to requiring a PMP (this document) and assessed to falling into Category B, due to the low implications it has in bringing about environmental and social issues related with its various components and particularly control of plant and animal diseases.

[20] Classified under WHO system as Extremely hazardous

[21] Classified under WHO system as Highly hazardous

The following table makes a comparison between the country's laws and regulations and those of the WB as a crucial way of identifying conformities and gaps that will then be used to devise the best ways of using these two sets of regulations to fulfil the goal of "minimizing potential adverse impacts on human health and the environment and to advance ecologically based IPM".

Table 4-3: Comparison between the GOM regulations and the WB guidelines

Issues	Mozambican legislation	WB policies and guidelines	Assessment and Recommended Measures to Bridge the Gaps
Project assessment and identification and determination of the need for a PMP or an IPM for a project	Neither the EIA Regulations (e.g. **Decree 54/2015**) nor the pest management instruments (Ministerial **Diploma 153/2002** (**Pesticides Regulation**), Decree 6/2009 (Pesticides Management Regulation) and **Decree n. 18/2004 Regulation on Environmental Quality and Effluents' Emissions**) refer to the need of assessing a project in general to identify and determine if it needs a PMP or an IPM	The combination of both World Bank OP 4.09 Pest Management and BP 4.01, Annex B - Application of EA to Projects Involving Pest Management make it mandatory for an agricultural (or health) project to be assessed to identify and/or determine the need for a PMP or an IPM	The two sets of legislation differ. In compliance with the WB guidelines the project has been assessed and the need for both PMP and IPM has been ascertained. The implications of this will continue throughout the subsequent phases of the project
The financing and use of pesticides is only done when their use is justified under an IPM approach	Although Mozambican regulations (Ministerial **Diploma 153/2002** (**Pesticides Regulation**), Decree 6/2009 (Pesticides Management Regulation)) repeatedly refer to the value of using alternative ways of combating plant and animal diseases using more environmental friendly means they do not condition the financing and use of pesticide to an IPM that justifies pesticides	This is also a crucial aspect of both World Bank OP 4.09 Pest Management and BP 4.01, Annex B - Application of EA to Projects Involving Pest Management. IPM approach is central and the financing of pesticides is conditional to their use being justified under such an approach	This is a fundamental framework definition in which the two sets of regulation differ. The formulation of the PMP for this project and the subsequent actions are a confirmation of the fact that the WB guidelines prevailed and will prevail. This is specified in this document but also in the project's ESMF, prepared separately
Contingency of procurement of any pesticide to an assessment of the nature and degree of associated risks, considering the proposed use and the intended users	Although Mozambican regulations (Ministerial **Diploma 153/2002** (**Pesticides Regulation**), Decree 6/2009 (Pesticides Management Regulation)) set forth a series of measures to take precautions in the procurement and use of pesticides in line with the proposed use and potential users it does not make the process necessarily contingent to an assessment	This is one of the central provisions of the World Bank OP 4.09 Pest Management, i.e. that procurement of any pesticide in a Bank-financed project is contingent on an assessment of the nature and degree of associated risks, considering the proposed use and the intended users	There are significant differences in the general principles. The World Bank OP 4.09 Pest Management will be adhered to throughout the project life cycle.
Financed pesticides must be manufactured, packaged, labeled, handled, stored, disposed of, and	Both Mozambican regulations (Ministerial **Diploma 153/2002** (**Pesticides Regulation**), Decree 6/2009 (Pesticides Management Regulation)) and the latter make it mandatory for any operation involving	The Bank requires that any pesticides it finances be manufactured, packaged, labeled, handled, stored, disposed of, and	There are considerable similarities in the definition of standards and lists. In as far as the listing is concerned both sets of regulation can be used equally

Issues	Mozambican legislation	WB policies and guidelines	Assessment and Recommended Measures to Bridge the Gaps
applied according to clearly defined acceptable standards	pesticides to strictly restrict it to clearly defined acceptable pesticides standards. The list of acceptable pesticides exists and it is in conformity with the WHO standards.	applied according to standards acceptable to the Bank. The classification of pesticides exists and is in line with the WHO standards	

The essential differences between the GOM laws and regulations and the WB policies and guidelines highlight the lack of a framework by the former to deal with PM. The three regulations mentioned and particularly the two pertaining to the agricultural sector focus on operational matters in detriment of defining and regulating the overall context under which pesticides should be integrated, considered and possibly used. The country does not have any integrated pest management or any organic production strategy. Partial IPM related aspects are referred indirectly when encouragement for using other pest control methods (e.g. biological, physical, etc.) and other precautionary methods in dealing with pesticides are endorsed. However, IPM as such does not exist as a standalone policy and regulatory instrument. Under specific contexts, this situation also carries the potential to be an open door for farmers and other operators in the agro-chemicals value chain to embark on poorly thought and poorly controlled market, which could have unwanted consequences.

On the contrary, IPM is central to the WB approach. It can be defined as a mix of farmer-driven, ecologically based pest control practices that seek out to reduce reliance on synthetic chemical pesticides. It involves (a) managing pests (keeping them below economically damaging levels) rather than seeking to eradicate them; (b) relying, to the extent possible, on non-chemical measures to keep pest populations low; and (c) selecting and applying pesticides, when these must be used, in a way that minimizes adverse effects on beneficial organisms, humans, and the environment. The WB policy calls for assessment of the nature and degree of associated risks, considering the proposed use and the intended users for procurement of any pesticide in Bank-financed projects. The WB approach makes it mandatory that any pesticides that will be used, manufactured, packaged, labeled, handled, stored, disposed of, and applied be done according to standards acceptable to the World Bank. This will be applied throughout the project's life cycle.

Despite the existing limitations in the national legislation, the instruments in place involve a strong element of control over the whole cycle of pesticide use. Consequently, only pesticides registered with the then National Directorate of Agrarian Services (DNSA) now National Directorate of Agriculture and Silviculture/Forests (DINAS), under the current Ministry of Agriculture and Food Security (MASA), can be used in Mozambique. These include a list of pesticides products that are classified according to their toxic potential (Article 9). From the 188 registered pesticides, 109 are class III; 67 class II and only 12 class I (Class I are the most toxic ones). Composition and physical-chemical characteristics of the pesticides proposed for registration must conform to the specifications from the World Health Organization (WHO) and the United Nations Food and Agricultural Organization (FAO) and should appear on the label. The regulation also requires proper packaging and handling, which meet the necessary requirements of occupational health and safety.

Additional measures around the entire cycle of pesticides control foreseen under the Pesticides Management Regulation include:

- The use of Class I pesticides is subject to a 1-year renewable authorization to be issued by the CATERP (Technical Assessment Committee for Pesticides Registration), based on a formal request, with the following data attached: (i) curriculum vitae, (ii) health certificate confirming appropriate health for the

handling of pesticides and certificates confirming the technical training of the applicant.

- Pesticides can only be used by adults. The applicants for Class I pesticides shall have a basic level of schooling granted by institutions recognized by the DNSAS.
- The DNSAS can submit the applicant to a test to measure his/her technical capabilities.
- The use of pesticides is prohibited for pregnant or breastfeeding women and for minors (Art. 30)

These and other legal provisions in the entire pesticide cycle are control systems and procedures aimed at ensuring restrain in the use of pesticides. They are often offset by several institutional constraints and weaknesses including poor law enforcement capabilities, as can be seen below in the institutional analysis. These weaknesses are yet another reason that make the WB IPM relevant under IRRIGA and other similar projects.

The two main agricultural regulations are complemented by the Environmental Quality Standards and Effluents Emissions Regulation approved by the Council of Ministers in May 2004 (Decree 18/2004) and published in the government's gazette (*Boletim da República number 22 of 2 of June 2004*). It is aimed at controlling and maintaining the level of concentration of pollutants at an admissible level. The former Ministry for the Coordination of Environmental Affairs (MICOA) and current Ministry of Land, Environment and Rural Development (MITADER) is responsible for ensuring compliance with this Regulation, in close collaboration with the Ministry of Agriculture and Food Security (MASA).

4.3 Mozambique's Institutional Framework

4.3.1 THE INSTITUTIONAL FRAMEWORK

The core institutions in pesticide management in Mozambique are the Ministries of Agriculture and Food Security (MASA), Land, Environment and Rural Development (MITADER) and the Ministry of Health (MISAU). These are nominated by the Pesticides Regulation Ministerial Diploma 153/2002 as being ultimately responsible for ensuring the translation of the Regulation into the set of actions that will guarantee that pesticides are managed in a way that does not pose a threat to human, plant and animal health and to the overall health of the environmental components (water, soil and air).

The table below makes a summary of the roles and responsibilities of the above three main ministries/sectors and subsectors in what relates to pesticide management.

Table 4-4: Institutions, roles and responsibilities in PM

Sectors/Government Departments	Roles and Responsibilities
Agricultural Sector	
MASA is the central government department in PM. It is involved in the process through three main units and areas of operation: a) The DINAS and its respective units at the central and provincial (DPASA) and district (SDAE) levels that deal with plant and animal diseases b) The National Agrarian Research Institute (IIAM)[22] c) National Directorate of Agrarian Extension Services (DNEA)	In its capacity as the overall manager of plant and animal production and related services including health, MASA is the main institution responsible for pest management DINAS is the MASA's unity directly responsible for plant and animal production, which manages the subunits that deal with related health issues and pesticides IIAM[23] is the main research institution in the agrarian sector in Mozambique, focused on the improvement of crops production, seeds improvement, integrated pest management, capacity building and training. It concentrated at the central level with limited regional/provincial delegations, mainly specific subject matter units dealing with specific crops and other specific issues DNEA is MASA's entity responsible for training, communication and technical assistance and organization of producers, mainly small and medium size farmers including the subsistence family sector. The work is done mainly through extension workers, stationed at the district level.
Health Sector	
MISAU is the central entity responsible for public health. It fulfils its role through one national directorate, the National Directorate of Public Health (DNSP), which has a series of units including the Department of Environmental Health (DSA)	DSA fits within the framework of MISAU's organizational structure. The DSA is part of the National Directorate of Public Health and falls under the Deputy National Director for the "Prevention and Control of Diseases". At provincial level, the DSA is a unit under the Department of Community Health within the DPS and at the district level, the activities are undertaken by the Community Health Unit that is part of the SDMAS
Environmental Sector	
MITADER is the central entity responsible for the health of the environmental components such as water, soil, air, flora and fauna. It exercises its role through two main units: a) AQUA (environmental quality agency) b) DINAB, which is responsible for environmental licensing of activities through the Department of	In its capacity as the overall manager of environmental aspects and related services MITADER is the main institution responsible for controlling the potential implication of pesticide use in the quality of the environmental components AQUA is the leading institution in environmental quality management by, among other, establishing

[22] The Faculty of Agronomy from the main public university in Mozambique (UEM) also participates in research work hand in hand with IIAM.

[23] After many years of separation, it now (after approval of Decree 47/2004, of October 27, of the Cabinet) deals with the three subsectors, i.e. plant, forests and animal production in a single institution although with internal divisions of responsibilities to deal with specific issues around these subsectors.

Sectors/Government Departments	Roles and Responsibilities
Environmental Licensing (DLA) as well as Department Environmental Education (DEA)	environmental standards to be adhered to and defining ways and procedures to put them in place DINAB is responsible for the licensing of activities and well as for promoting environmental education

The Instituto Nacional de Normalização e Qualidade (INNOQ) should also be considered. It was established on 24 March 1993 by Law Decree 02/93 of the Council of Ministers, under the Ministry of Industry and Commerce (MIC). It is an autonomous body responsible for defining and implementing quality policy and for coordinating all standardization and quality activities at national level. INNOQ's main functions are: (i) the promotion of standardization and quality in the manufacturing of products and the performance of services; and (ii) cooperation with regional and international organizations working in the fields of standardization and quality. The aim is to improve the conditions of industry, protect consumers and the environment, increase and facilitate domestic and international trade to improve living standards and strengthening the overall economy.

All the institutions are, in different ways, represented at central, provincial and district levels.

To deal with the multidisciplinary character of the PM the above-mentioned institutions and other are organized in a series of collective management and technical bodies that deal with different aspects of PM. The most important, which are chaired by MASA and include the private sector, are:

- Registration: through the Agrochemicals Registration and Control Department (RRCA) and its technical arm the Technical Assessment Committee for Pesticides Registration
- Advisory: through the Technical Advisory Committee for Agrochemicals.

Outside the public sector main actors are (i) the large producers of sugar cane[24] and the emerging fruit sector (that has been focusing mainly on banana)[25] and rice[26] including the various share cropping, out growing (mostly adopted under IRRIGA's precursor PROIRRI) and off-take agreements, organized spot buying, etc. undertaken by large agricultural companies with local smallholder farmers around crops such as cotton[27],

[24] In the provinces of Maputo and Sofala

[25] In the provinces of Maputo (Boane) and Nampula (Matanuska) and Manica in general

[26] Gaza province (Weibao)

[27] By companies like OLAM, SANAM and JFS across the country but mainly in the Northern provinces including Nampula.

tobacco (MLT), cassava[28] and cashew nuts[29]; (ii) NGO, although the weight of this category of actors in agriculture and/or assistance to production has been diminishing since 1992 after the end of war. Main actors from this category in Nampula and Zambezia were World Vision, CARE; IBIS, etc. and (iii) the smallholder farmers themselves who focus on food crops (maize, beans, cassava, sweet potatoes and a variety of fruits) and cash crops (mainly cotton, cashew nuts, cassava[30]

4.3.2 Institutional Capacity and Strength

Below (Table 4-5) the ability of the above-mentioned institutions to carry out their mandates within PM is briefly assessed. The results are then used to outline the PMP and the IPM adopted under this document. The ESMF also made a more comprehensive assessment and should be used in conjunction with this assessment to get a better understanding of the prevailing strengths/weaknesses, opportunities/threats.

Table 4-5: Brief assessment of institutional capacity

Sectors/Government Departments	Capacity and Strength
Agricultural Sector	
MASA is the central government department in PM. It is involved in the process through three main units and areas of operation, namely: a) The DINAS and its respective units at the central and provincial (DPASA) and district (SDAE) levels that deal with plant and animal diseases b) The National Agrarian Research Institute (IIAM) c) Directorate of Agrarian Extension Services (DNEA)	**DINAS (agriculture)**: DINAS capacity to carry out routine activities such as pesticide registration, licensing of actors and periodic publication of authorized pesticides is assessed to be stable and strong. The dissemination to reach as many users as possible is assessed to be weak It is an understaffed institution to carry out inspection and other law enforcement functions. For a country of close to 800,000 km² and close to 4.0 million production units of which more than 90% are made of subsistence farmers it only has 6-7 technical staff members at the central level and only one in each province and no specialized technician at the district level It is also poorly equipped in terms of other facilities to carry out its activities such as vehicles, laboratories and other **IIAM (research)**: in the last 3-4 decades IIAM has shown considerable inconsistencies in undertaking research programs particularly adaptive programs capable of generating messages that could be used by extension workers/farmers to improve their work in crucial areas of the sector (e.g. improved varieties and seeds). The few exceptions, particularly in Nampula Province, have been for cassava, cashew nut trees and cotton, for which the

[28] In Nampula province the country brewery company (CDM) has been producing beer using cassava outsources from local farmers as the main primary product

[29] In Nampula province as well as in Cabo Delgado there are many cashew nut industrialists that procure the kernels from local smallholder producers.

[30] Particularly in Nampula (Ribaue and Malema) due to the presence CDM operation already mentioned.

Sectors/Government Departments	Capacity and Strength
	development of new and improved varieties adapted to local conditions (agro ecological and socio economic) has shown remarkable results. IIAM is markedly underfunded, under staffed and extremely dependent on external support, which tends to be of short term (3-5 years). This goes against the nature of research work that often requires long term commitment. The result has been that most research programs that have ever been started are usually not completed. Pesticide research has not been at the top of the agenda. IIAM is also centralized with only a few research stations across the country with the four target provinces having two of the four[31] regional units, i.e. Chimoio in Manica and Nampula in Nampula. These deal mainly with research around crops and very little on plant diseases **DNEA (Extension)**: although the government employs close to 70% of all agricultural extension workers[32] extension work in Mozambique is also highly dependent on specifically funded projects. The government invests relatively low in the establishment and maintenance of extension services. The payment of extension workers' salaries as well as of other facilities needed for the sub sector such as bicycles, motor bikes and field work kits, etc. have usually been under the responsibility of donor and development assistance agencies. Whenever the involvement of these agencies decreases so does the vitality of and the means assigned to extension services. Extension network is marked by low coverage with only between 2 to 5% of the farmers having occasional direct contact with these workers (Gemo, 2006). Although the level of formal education has increased in the last few years[33] extension workers have little or no links with research services that could provide them with updated messages. Even though acknowledging that several correct practices were witnessed, PROIRRI's environmental and social performance assessment report (Ribeiro; N. et al, 2017) describes inconsistencies in the way extension workers assisted farmers in the use of pesticides, mainly in Manica and Sofala.

[31] Lichinga, Nampula, Chimoio e Chókwè.

[32] 18% work for the private sector, 12% for NGOs (Gemo.2006).

[33] 48% of extension workers have completed vocational training at the medium level (pre-university), 29% basic education (junior secondary) and 20% higher education

Sectors/Government Departments	Capacity and Strength
	Training in PM has not been at the top of the agenda. Under PROIRRI (2011-2018) a massive training and capacity building program has been underway since 2013 with the aim of building capacity of agricultural training institutes as well as extension workers. Focus was mainly in irrigation.
Health Sector	
MISAU is the central entity responsible for public health. It fulfils its role through one national directorate, the National Directorate of Public Health (DNSP), which has a series of units including the Department of Environmental Health (DSA)	Environmental Health is assessed as facing limitations in trying to fulfil its role and in discharging its duties in a way that is compatible with its multisector mandate. Environmental Health should be positioned differently within institutions that manage health and environmental factors. It should focus on defining policies and norms, promotion and regulation/surveillance than on implementation (AFD, 2010)[34]. In general, de subsector is understaffed[35] and at the provincial and district levels it is faced with shortage of personnel and poor working conditions
Environmental Sector	
MITADER is the central entity responsible for the health of the environmental components such as water, soil, air, flora and fauna. It exercises its role through two main units: AQUA (environmental quality agency) DINAB, which is responsible for environmental licensing of activities through the Department of Environmental Licensing (DLA) as well as environmental education	**AQUA (environmental quality)**: AQUA is a unity that is in the process of being established. For many years the Ministry of Environment (then MICOA (1994-2015) fulfilled its role in the management of environmental components through the National Directory of Environmental Management (DGA). DNGA was assessed to be facing serious challenges to fulfil its role of cooperation and coordination with other environmental Ministries and civil society institutions, specifically to get its coordinating role defined and clarified. Its role in the definition of environmental standards was faced with many pre-conditions that the Ministry could not meet. Staff turnover is high, and some positions are not filled with adequate staff (DANIDA, 2012)[36]. AQUA came to replace the DNGA but it is not yet fully operational. **DINAB (environmental licensing)**: the licensing of specific activities through the environmental impact assessment regulation (Decree 54/2015) has been one of the most successful ways of exercising environmental management in Mozambique (DANIDA, 2012). Upstream the issuing of the license solid systems and procedures that bring together the different players (developers, engineers, consultants and the public including the public-sector representatives that are

[34] Sector Analysis Note on Environmental Health (AFD, 2010)

[35] Mozambique has less than 1,800 doctors for population of close to 25.0 million people (MISAU, 2015)

[36] Institutional Performance Study (DANIDA, 2012)

Sectors/Government Departments	Capacity and Strength
	relevant in each project) have been under consolidation. Law enforcement remains rather weak, especially after the issuing of the environmental license that is still in need of improvements. environmental and social performance assessment report further uncovers the need of bringing the ESIA process closer to specific issues as is the case of the use of pesticides

Despite continuous efforts being made by the various government-led agriculture projects, capacity for pesticide management remains relatively weak in Mozambique.

The subsector is marked by a series of institutional constraints in the form of (i) poor coordination; (ii) dependency on external funding; (iii) poor law enforcement; (iv) inconsistency and discontinuity in program implementation; (v) under-staffing; and (vi) poor allocation of resources; (vii) inconsistent and discontinuity in applied and adaptive research and capacity building. These are obstacles for a proper policy formulation, consistent implementation, monitoring and evaluation of IPM. A few examples include: (i) pesticide residues are not being monitored on export crops, nor on crops for the domestic market; poisoning statistics by pesticides are not available; (ii) medical staff at rural clinics is not trained to recognize and adequately treat pesticide poisoning; and (iii) antidotes are not systematically available in rural areas, and in certain remote provincial and district urban centers.

Provincial officers report that the few random inspections that are conducted uncover non-compliance by different kinds of operators including by large agricultural farmers in the form of:

- obsolete pesticides,
- inadequate labelling,
- use of pesticides without the adequate equipment.

These contribute to increasing the risk of contamination and use of empty pesticide's packages for domestic use, washed in rivers and posing water and soil contamination risks, etc. Health risks to people and animals are evident, which makes the WB approach to integrated pest management even more relevant.

All aspects combined make the adoption of IPM for IRRIGA mandatory. Local actors concede that the IPM strategy in itself will be a serious challenge as it will be necessary to keep a number of factors under control to ensure that IPM essential elements are adopted and put in place. This is yet another reason to justify a well thought plan of action that includes mobilization and capacity building of people, institutions and resources.

4.3.3 Monitoring and Reporting

PMP monitoring and reporting will be integrated at the ESMF monitoring and reporting resources and procedures while implementing the ESMF, Environmental and Social Management Plan (ESMP) and its Good Agricultural Practices - Hygiene and Safety

Environmentally and Socially Friendly Agricultural Farming Systems (Annex 9 of the ESMF); following the same procedures and reporting basis.

Annual reports and biennial external independent audits covering PMP implementation performance will also be integrated in the ESMF Annual reports and biennial external independent audits.

As per indicators of PMP implementation performance the following ones may be considered:

- Number of farmers (men and women) trained on pest management control
- Number of farmers (men and women) awarded with pesticide acquisition support
- Number of farmers (men and women) awarded with e-voucher (with PPE)
- Number of farmers of complaints due to water contamination with pesticides

5. PEST MANAGEMENT ISSUES IN MOZAMBIQUE

This section describes the current and anticipated pest management problems relevant to the Project, relevant IPM experience within the project area, assessment of proposed or current pest and pesticide management approaches and recommendations. The section considers the fact that the Project will have a strong agricultural development component, particularly under "Agriculture Intensification and Market Linkages". The latter has been the area in which the GOM's ability to diversify the economy and deepen inclusion has been significantly weak. The contribution of the agriculture sector to the country's GDP has been far below its real potential. Strategic and policy documents for the sector adopted lately such as PEDSA (Strategic Plan for Agricultural Development), PNISA (National Agriculture Investment Plan), PNI (National Irrigation Program), aim at reversing this phenomenon and IRRIGA embraces them.

5.1 Current and anticipated pest problems

The use of pesticides is likely to be associated with agricultural activities (plant production) for the control of pests, diseases, nematodes and weeds. Main crops targeted under IPMP in the project area and particularly the irrigated schemes to be established are likely to be **rice**, **maize**, **sugar cane**, a variety of **beans**, **horticultures** and **fruits**[37]. Other crops are likely to be adopted as their feasibility becomes apparent. These are associated with several plant diseases trypical of the Mozambican context. Different ways of combating such diseases are adopted by the three main categories farmers, namely (i) the family sector; (ii) the small and medium size operators; and (iii) large farmers and operators. The expected intensification involvind the two first categories of farmers under IRRIGA is likely to trigger the application of agrochemicals and inputs such as fertilizers, herbicides, insecticides, nematicides and fungicides. This has been happening under PROIRRI and it is expected to continue and if not controlled even to increase.

In the context of this text and in Mozambique in general pests affecting plants are subdivided into three main categories i.e. pests, diseases and infestants. **Error! Reference source not found.**, **Error! Reference source not found.**, and Table 5-3 successively present the most common pests, infestants and diseases and associated crops in the country. Infestants (weeds) tend to be associated with all kinds of crops and are widespread.

Table 5-1: List of major pests and associated crops in Mozambique

Common Name	Name of Pest or Vector	Crop
Insects		
Brocas do colmo	*Busseola fusca, Sesamia calamistis* (Lepidoptera: Noctuidae)	Maize, Rice & Sugar cane
	Chilo partellus (Lepidoptera: Crambidae)	Maize, Rice & Sugar cane
Brocas da espiga	*Mussidia nigrivenella* (Lepidoptera: Pyralidae)	Maize
Lagarta do funil do milho Fall armyworm	Spodoptera frugiperda (Lepidoptra: Noctuidae)	Maize

[37] Under PROIRRI except for green beans there was not enough consideration for this crop.

Common Name	Name of Pest or Vector	Crop
Lagarta das searras ou militar	Spodoptera exempta = *Laphygna exempta* (Lepidoptera: Noctuidae)	Maize
Pragas de armazenamento	*Sitotroga cerealella* (Lepidoptera: Gelechiidae)	Maize
	Sitopphilus orizae (Coleoptera: curculionidae)	Maize
Roscas (lagartas)	*Agrotis segetum, A. ypsilon* (Lepidoptera: Noctuidae)	Maize
Pássaros (pedizes, etc.)	*Rhynchotus rufenses*	Maize & Beans
Ratos, Toupeiras	*Talpidae*	Maize & Beans
Ácaros	*Tetranychus urticae*	Beans, Cowpea & Vegetable
Besouro da flor	*Mylabris* spp, *Coryna* spp. (Coleoptera: Meloidae)	Beans & Cowpea
Besouro da folhagem	*Ootheca mutabilis, O. bennigseni* (Coleoptera: Chrysomelidae)	Beans & Cowpea
Besouro listrado	*Alcidodoles leucogrammus* (Coleoptera: Curculionidae)	Beans & Cowpea
Cigarrinha verde	*Empoasca dolichi, E. lybica* (Hemiptera: Cicadellidae)	Beans & Cowpea
Gorgulhos	*Acanthoscelides obtecus & Zabrotes subfasciatus* (Coleoptera: Bricidae)	Beans & Cowpea
Lagarta caterpilar	*Spodoptera* spp. (Lepidoptera: Noctuidae)	Beans & Cowpea
Lagarta das cápsulas do algodoeiro	*Helicoverpa (Heliothis) armigera* (Lepidoptera: Noctuidae)	Beans & Cowpea
Lagarta-das-vagens	*Marura testulalis* (Lepidoptera: Pyraustidae)	Beans & Cowpea
Lagartas (roscas)	*Agrotis segetum & A. ypsilon* (Lepidoptera: Aleyrodidae)	Beans & Cowpea
Mosca branca	*Bemisia tabaci* (Hemiptera: Aleyrodidae)	Beans & Cowpea, vegetable
Mosca do fejoeiro	*Ophiomyia phaseoli, O. spencerella* (Diptera: Agromyzidae)	Beans & Cowpea
Pulgão preto	*Aphis fabae, A. cracivora Myzus persicae* (Hemiptera: Aphididae)	Beans, Cowpea & vegetable
Tripes	*Mgalurothrips sjostedti; Thrips tabaci* (Lindeman)	Beans, Cowpea & vegetable
Diamond back moth	*Plutella xylostella*	Brassicas
Traca do tomate	*Tuta absoluta*	Tomato
Mosca das frutas	*Bactrocera* spp	Tomato & other fruits
Lagarta Americana = Africana	*Helicoverpa zea* (Lepidoptera: Noctuidae)	Vegetable

Table 5-2: List of major weeds (infestants) in Mozambique

Family name	Scientífic name	Classifier
	Pteridophyta	
Acanthaceae	*Justiça sp*	
	Dicotyledoneae	
Amaranthaceae	*Amaranthus hibridus*	L.
Asteraceae	*Acanthospermum xanthioides*	DC.
Asteraceae	*Ageratum conyzoides*	L.
Asteraceae	*Bidens biternata*	(Lour.) Merr.&Scherff

Family name	Scientífic name	Classifier
Asteraceae	*Bidens pilosa*	L.
Asteraceae	*Bidens steppia*	(Steetz) Sherff
Asteraceae	*Blumea lacera*	(Burm.f) DC
Asteraceae	*Crassocephalum rubens*	(Juss. Ex Jacq.) S. Moore
Asteraceae	*Crassocephalum sarcobasis*	(DC) S. Moore
Asteraceae	*Conyza stricta*	Wild
Asteraceae	*Emilia coccínea*	(Sims) G. Dan
Asteraceae	*Feliaia muricata*	Thunb.
Asteraceae	*Galinsoga parviflora*	Cav.
Asteraceae	*Pseudognaphalim luteo-album*	(L.)
Asteraceae	*Tagete minuta*	L.
Asteraceae	*Vernonia petersii*	Oliv. & Hiern
Asteraceae	*Vernonia poskeana*	Vatke & Hildebrandt
Capparaceae	*Cleome iberidella*	Welw.
Capparaceae	*Cleome monophylla*	L.
Chenopodiaceae	*Chenopodium ambrosioides*	L.
Convolvulaceae	*Ipomea eriocarpa*	R. Br.
Curcubitaceae	*Zehneria racemosa*	Hook.f
Fabaceae	*Caesalpina sp.*	
Fabaceae	*Chamaecrista mimisoides*	L.
Fabaceae	*Crotolaria aculeata*	de Wild
Fabaceae	*Crotolaria anthyllopsis*	Welw.
Fabaceae	*Crotolaria comosa*	Baker
Fabaceae	*Indigastrum costatum*	(Guill. & Perr.)
Fabaceae	*Indigofera subulifera*	Welw.
Fabaceae	*Sesbania pachycarpa*	DC.
Fabaceae	*Tephrosia melanocalix*	Welw.
Fabaceae	*Vigna sp.*	
Lamiaceae	*Leucas martinicensis*	(Jacq.) R. Br.
Malvaceae	*Hibiscus canabinus*	L.
Malvaceae	*Sida cardifolia*	L.
Meniospermaceae	*Cissampelos mucronata*	A. Rich
Oxalidaceae	*Oxalis semiloba*	
Portulaceae	*Portulaca oleraceae*	L.
Rubiaceae	*Calanda rubricaulis*	K. Schum
Rubiaceae	*Oldenlandia herbácea*	(L.) Roxb.
Rubiaceae	*Richardia scabra*	L.
Scrophulariaceae	*Alectra sessiliflora*	(vahl) Kuntze
Solanaceae	*Datura stramonium*	L.
Solanaceae	*Nicandra physoloides*	(L.) Gaertn
Tiliaceae	*Corchorus tridens*	L.
Tiliaceae	*Lasiosiphon sp*	
Tiliaceae	*Triumfetta annua*	L.
Verbenaceae	*Lipia sp*	
Commelinaceae	*Commelina benghalensis*	L.

Family name	Scientífic name	Classifier
Commelinaceae	*Commelina purpurea*	C.B. Clarke
Cyperaceae	*Abilgaardia hispidula*	(Vahl) Lye
Cyperaceae	*Cyperus distans*	L.
Cyperaceae	*Cyperus esculentus*	L.
Cyperaceae	*Cyperus rotundus*	L.
Cyperaceae	*Killinga Odorata*	Vahal
Cyperaceae	*Mariscus alternifolius*	Vahal
Cyperaceae	*Mariscus umbellatus*	Vahal
Cyperaceae	*Mariscus cylindristachyus*	Steud
Poaceae	*Cynodon dactylon*	(L.) Pers.
Poaceae	*Digitaria spp*	
Poaceae	*Eleisine indica*	Gaertum
Poaceae	*Eragrotis annualata*	Rendle
Poaceae	*Eragrostis chapelieri*	Ness
Poaceae	*Eragrotis superba*	Peyr
Poaceae	*Hyparrhenia rufa*	(Nees) Stapf
Poaceae	*Melinis repens*	(Willd.) Zizka
Poaceae	*Setaria sphacelata*	(Shumach) Moss
Poaceae	*Sporobolus pyramidalis*	Beuv

Table 5-3: List of major dieases and pathogenic agents and associated crops in Mozambique

Crop	Disease	Pathogenic Agent
Tomato, Aubergine and Pepper	Seedling wilting	*Pythium,h Rhizoctonia, Sclerotium e Fusarium*
	Concentric spot	*Alternaria solani*
	Mildew	*Phytophtora infestans*
	Bacterial wilt	*Pseudomonas solanacearum*
	Bacterial wilt	*Xanthomonas vesicatoria*
	Canker	*Colletotrichum* sp.
	Mosaic and Leaf Winding	Vários vírus
Cabbage, kale/white cabbage, Turnip and Chinese Cabbage	Seedling Wilt	*Pythium, Rhizoctonia, Sclerotium e Fusarium*
	Mildew	*Peronospora parasitica*
	Black-rot	*Xanthomonas campestris*
	Motile Rot	*Erwinia carotovora*
Reindeer potato	Mildew	*Phytophtora infestans*
	Concentric spot	*Alternaria solani*
	Common scab	*Streptomyces scabies*
	Bacterial Wilt	*Pseudomonas solanacearum*
	Rhizoctonia (Cancer)	*Rhizoctonia solani*
	Leaf roll	Potato Leafroll Virus
Onion and garlic	Seedling wilting	*Pythium, Rhizoctonia, Sclerotium e Fusarium*
	Purple spot	*Alternaria porri*
	Mildew	*Peronospora destructor*
	Rust (garlic)	*Puccinia allii*
	Soft rot (onion)	*Botrytis* spp.
	White rot	*Sclerotium cepivorum*
Cucurbitaceas (melon; cucumber; watermelon; pumpkin - Alliaceae: onion and leek).	Seedling wilting	*Pythium, Rhizoctonia, Sclerotium e Fusarium*
	Mildew	*Pseudoperonospora cubensis*
	Oidium	Vírus (Maize Streak Vírus)
	Mosaic	*Fusarium*; *Diplodia*

Crop	Disease	Pathogenic Agent
Maize	Mildew	*Peronoclenospora* sp
	Striped foil	Vírus (Maize Streak Vírus)
	Cob rot	*Fusarium*; *Diplodia*
	Brown stein	*Helminthosporium* sp
Rice	Burnt	*Pyricularia oryzae*)
	Brown stein	*Drechslera Helminthosporium oryzae*
Beans	Mancha angula	*Phaeoisariopsis grisseola*
	Rust	*Uromyces appendiculatus*
	Foot and rot	*Rhizoctonia solani, Sclerotium rolfsii*
	Canker	*Colletotrichum* sp.
	Common mosaic	*Bean Common Mosaic Virus*
Sugar caner	Mildew	*Peronoclenospora* sp
	Striped foil	Vírus (Maize Streak Vírus)
	Brown stain	*Helminthosporium* sp

In general pest attack is low in the Project targeted areas, but there is a range of pests, diseases and weeds reported by farmers, officials and in the literature. The main factors informing mortality of these pests are (i) climate (cold and dry seasons tends to be better than the hot and wet); (ii) morphology (areas in higher altitude tend to enjoy colder temperatures and increased natural regulation of pests than the lower aeras). These factors work as an opportunity for farmers in general and in irrigated areas. It also follows that the higher areas of Nampula, Zambezia and Manica, which grow horticultures, maize, beans and fruits have more opportunities than the lower areas of Zambezia and Sofala that focus on rice and sugar cane. Farmers already know how to play with these factors and the project will reinforce existing strategies.

The current impact from these pests is not well unknown and/or mapped, except perhaps the red locust that attacks some of the areas. However, the expected pest incidence increases in the production of (i) agriculture-based (rice, maize, sugar cane); (ii) horticulture/fruits will likely reverse that situation and some pests may become a major economic and environmental problem, especially for medium-scale subprojects and, thus an increase in pest control measures and rational use of chemical fertilizers may be needed for this project. There are control measures (chemical, cultural and biological) for most crops that can be used in case an outbreak is observed.

Although the tendency has been to increase, in most areas current pest occurrence and pesticide use is estimated by agricultural officers to be currently low, but an increase in crop area, especially of monoculture crops (rice, sugar cane, fruits and horticulture), may result in an increase of pest occurrence, especially birds (for cereal production areas granivorous birds are an important pest), red locust and rats in the lower areas of Zambezia and Sofala in regard to the latter. These are currently reported to be the major pests in these areas. However, amongst most poor farmers, unless encouraged to do so by different forms of external forces, especially if private operators are given space to do so, pesticide use can be kept at a minimum level if the necessary efforts can be timely made. The prevailing lack of tradition of using pesticides, inadequate supply (the network of agricultural input suppliers, including pesticides is still relatively poor) and poor access to low priced and generic pesticides can be used to work in favor of a strategy to control the massive and indiscriminate use of agro-chemicals.

The development of agricultural activities by a series of farmers, including smallholder farmers and small and medium commercial producers has caused (under PROIRRI) and is likely to cause the intensification of the following potential impacts:

- Stalk borers, brown plant hopper and armyworm could increase, but the result should not be an automatic increase in insecticide application than currently exists in the command area since less than half the farmers apply only one or more sprays per season;
- Irrigated agricultural production is not widespread in the project area now. But with increased irrigation there is the possibility that irrigated cereals (e.g. rice and baby corn) may become important and farmers will be more willing to apply a fungicide to protect their investment.
- Local informants believe fungicide use is unlikely to be greater than presently very low levels that already exists in the area.
- The same consideration applies to weeds, diseases, as well as chemical fertilizer use.

5.2 Relevant IPM experience within the project area and POIRRI

In the same way as in other parts of Mozambique traditional farmers have their own knowledge regarding the use of IPM principles in the Project command area. Different forms of intercropping and/or the use of remedies made from local plants are often adopted with the sole propose of keeping pest at by and/or increasing soil fertility.

But like in many other areas of traditional knowledge in Mozambique, the mix of it with modern information and practices and poor encouragement for people to use and expand such knowledge explain that it is slowly disappearing. On farm and on station research and extension should endeavor to promote a better understanding of such traditional knowledge and promote what works.

Now and then there is the belief that chemicals are more efficient than any other cultural practices. Though, farmers in several districts prefer crop rotation (summer (e.g. maize) and winter crops (horticulture and a few beans) and intercropping (cereals and vegetables and legumes)) as being efficient in controlling some pests, especially insects and fungus. It is to be expected that these techniques could also be applied in larger areas to be developed under the Project, as they are common practice in Mozambique. A specific set of interventions should be embraced by the project to reverse this and suggestions are made in this document on how best to go about them.

Under PROIRRI the main crops have been rice (in Zambezia and Sofala provinces), sugar cane (in Sofala) and horticulture and fruit including some cereals (mainly baby corn in Manica). The main producing modalities comprised the smallholder farmers producing for relatively open markets and self-consumption (rice, horticulture and fruit) and out growers (for sugar cane and baby corn), where smallholder farmers were subcontracted by major and well-established operators to complement their production. There were also some minor mixes among provinces, crops and production modalities.

For each of the crops PROIRRI technical assistance per crop prepared technological instructions and recommendations (Cartas Tecnológicas) outlining the main operations and the systems and procedures to be adopted to increase production and productivity.

Among other aspects (equipment, operation and maintenance of equipment and irrigation schemes, conservation, etc.) the instructions and recommendations covered the topic of fertilizers and pesticides. Lessons learned from the process are relevant to delineate how IRRIGA should tackle.

Fertilizers: the use of animal and vegetable manure (compost) was strongly encouraged as one of the ways to add organic matter to the soil to provide nutrients such as Nitrogen (N), Phosphorus (P), and Potassium (K), but in small amounts. These were adopted mainly by smallholder farmers producing for open market and self-consumption but also by outgrowers.

To obtain the maximum yield from the crops, chemical fertilizers were also recommended to be added mainly for vegetables, fruit trees and sugar cane. The most used chemical fertilizers under PROIRRI were (i) ammonium sulfate (ii) calcium ammonium nitrate (iii) super phosphate (iv) ammonium phosphate (v) urea (vi) potassium chloride (vii) potassium sulphate (viii) lime (ix) MAP and (x) KCl.

PROIRRI also encouraged the adoption of Conservation Agriculture, defined as (i) minimal disturbance of the soil (as a consequence of reduced use or no mobilization) to preserve its structure, fauna and organic matter; (ii) maintaining permanent land cover (with crops, residues and other cover materials) to protect it and contribute to the elimination of weeds; and (iii) diversification of rotations and crop combinations, which favor the maintenance of soil micro-organisms and eliminate pests, weeds and plant diseases. This was part of the integrated management of soils, water and biological resources combined with external factors

Pesticides: to begin with the project encouraged the preparation and use of homemade pesticides to lower costs while effectively undertaking the treatment of some pests. Important and recommended pesticides included: (i) petroleum emulsion, which is a contact insecticide useful against many sucking insects; (ii) tobacco mix, which is very effective for the control of aphid infesting horticultural crops; (iii) Margosa (*Azadirachta indica*) seed emulsion (neem) very effective as repellent against locusts. These were haphazardly adopted by all classes of producers and mainly the smallholder producing for open markets and self-consumption.

Additionally, the project had its own list of recommended fungicides, insecticides and herbicides to be used in crops mainly horticultures and fruit. In practical terms the most used were herbicides, namely Pendimethalin, MCPA, Metryn, Gramoxone, Glyphosate, mainly used by sugar cane growers doing outgrowing. In most cases the farmers were not directly involved in the purchase and use of such fertilzers. This was in the hands of the companies that engaged them. At times this raised coflicts between the two sides as the companies then deducted the money spent on pesticides from the final payment owed to farmers.

The environmental and social performance report (PROIRRI, 2017) identified several problems with the way fertilizers and pesticides were handled under PROIRRI. Although alternative and more affordable and healthier products including locally made products were recommended it is noticed that a consistent IPM was absent. The project was not associated with any special efforts to promote it and no systematic assessment was made. This needs to be reversed under IRRIGA.

5.3 Current pest management practices

Presently pest and plant disease control are limited by a combination of lack of knowledge, equipment, supplies and finance. In general, smallholder farmers in the project area take various measures to minimize or avoid pest infestations such as weeding and application of insecticides and herbicides. Weed control is commonly achieved through a combination of tillage-seedbed preparation by several passes of the traditional ox-drawn plough (or manually) and subsequent inter-row weed control cultivations in row crops. Comprehensive data on pesticides use are not available, but provincial officers in the subsector referred to Cypermethrin, Mancozeb, Cobox and Teodan, all under Class III (least toxic), as the main pesticides they use. These are also the pesticides mostly acquired and distributed by the public sector in critical moments.

Control of birds and wild animals (scarce in the targeted area) are mainly done by using the traditional way of scaring (the use of scarecrows is very common especially in cereal production areas), chasing and guarding of animals.

As indicated in Tables xxxx a combination of traditional knowledge and recommended best practices by agricultural formal agents is full of promises to the adoption of IPM.

5.4 Pesticides management

Data on pesticides poisoning and environmental contamination are often not available or difficult to obtain, since no regular government systems exist for regular monitoring of the risks. Moreover, medical personnel at rural clinics are not well trained to recognize and adequately treat pesticide poisoning, and antidotes are not systematically available in rural and in some remote provincial and district/municipal urban areas.

In summary, as related by provincial officers and the assessment report on environmental and social performance (PROIRRI, 2017), the main pesticide management problems in the project targeted area and in Mozambique in general are:

- Unfounded use when applied, which may result in problems for human health and the environment, especially the contamination of soils and water. Signs of soil/water contamination/depletion have been observed in some areas, including soil salt accumulation;
- Use of out-of-date pesticides (observed in most of areas), including by large operators who would be expected to not do so;
- Use of non-authorized and/or non-labeled pesticides or the use of re-packaged pesticides;
- Application without the adequate equipment, with an increase of the risk of contamination;
- Use of empty pesticide's packages for domestic use (e.g. as water and food containers, etc.), washed in rivers and leading to their contamination.
- Lack of adequate monitoring of pesticides use and handling is carried out.

There is a need to correct and improve current pest and pesticide management practices within the country and more in particular in the Project areas, especially given the fact that one of the objectives of the Project is to set the path to be followed in the future regarding the promotion of irrigated agriculture based on lessons learned. The plan of

action under the PMP should contribute to reverse the prevailing negative tendencies, especially those already identified under PROIRRI.

The preliminary assessment indicates that each main area of operation in PM needs to contribute and coordinate with other areas to establish a new order that will be relevant for the project and to feed into to general PM and particularly IMP under irrigation conditions in the country.

6. TOWARDS THE ACTIVE ADOPTION OF THE IPM

6.1 Main Direction of the Plan

To mitigate the potential impacts associated with uncontrolled proliferation of pesticides the general approach of the IRRIGA should be to keep pesticide use at a minimum or avoid it and ensure that any necessary use is intelligent, coherent and considered part of an IPM approach. This is in line with OP 4.09 and BP 4.01 (OP 4.09/BP 4.01). The preliminary discussions with the stakeholders and assessment of the situation on the ground (PROIRRI, 2017) indicates that the formulation of a concise plan of action should adopt a staged approach, of which a general outline is presented. This will need to be endorsed by the project stakeholders and adjusted as more evidence is gathered. The final plan of action adopts the following essential stages:

Table 6-1: Indicative plan of action

Activity	Stakeholders	Objective/Action	Leading agency
Mobilization	INIR/DINAS, IIAM, DNEA, DPASA, SDAE Health and Environment Private sector, NGO, small, medium and large farmers	Establishment of the Core IPM Team (Representatives of Plant Diseases at the provincial and district levels, IRRIGA ESSS, Representatives of the farmers/irrigation schemes, MITADER and the MISAU) A national Workshop in the project area to identify agencies and individuals who will lead the formulation and implementation of the IPM for IRRIGA	IRRIGA assisted by DINAS
Diagnostic	INIR/DINAS, IIAM, DNEA, DPASA, SDAE Health and Environment Private sector, NGO, small, medium and large farmers	Take stock of the main issues affecting the subsector in the country and in the project area. Extensive use of lessons learned from PROIRRI Concise definition of the baseline Agree on the sequence of activities to formulate a plan of action and respective contents	IRRIGA as the convener DINAS as the leading technical department
Formulation of specific action plans	INIR/DINAS, IIAM, DNEA, DPASA, SDAE Health and Environment Private sector, NGO, small, medium and large farmers	Identification of specific issues and activities (including corrective actions vis a vis PROIRRI experiences) to be carried out in: ▪ IPM in general ▪ pesticide regulation per se, ▪ research, ▪ extension, and ▪ pesticide use	DINAS assisted by IIAM, DNEA
Implementation of action plans	INIR/DINAS, IIAM, DNEA, DPASA, SDAE	Separate and coordinated actions in: ▪ IPM in general	IRRIGA coordination

Activity	Stakeholders	Objective/Action	Leading agency
	Health and Environment Private sector, NGO, small, medium and large farmers	▪ pesticide regulation per se, ▪ research, ▪ extension, and ▪ pesticide use	In line with its role and responsibility each agency will work in its area, i.e. regulation, research, extension, IPM and pesticide use
Monitoring and evaluation and lessons learned to feed into the project and the subsector in general	INIR/DINAS, IIAM, DNEA, DPASA, SDAE Health and Environment Private sector, NGO, small, medium and large farmers	Continuous monitoring, introduction of corrective measures where needed, drawing of lessons learned and feeding back into the project and the IPM in general	IRRIGA assisted by DINAS

The Objectives and main action of an IPM approach are presented below in order of sequence:

Table 6-2: Objectives of an IPM

Main areas of and issues for intervention	Actions required	Responsibility
Change current pest management practices	(i) Allocate adequate resources to implement National Plant Protection Policy (ii) Increase IPM awareness amongst policy makers and farming community; (iii) Abolish free distribution of pesticides to farmers and promote safe handling and application of pesticides.	IRRIGA/INIR/DINAS
IPM mainstreaming	Embed IPM into the project key components of: (i) production and commercialization of smallholder agriculture; and (ii) make it a practical element affecting all aspects of extension and training	IRRIGA/INIR/DINAS
IPM research and extension	(i) Strengthen IPM research at MASA/Relevant Research Institutions (ii) Strengthen IPM extension (iii) Strengthen collaboration between MASA and MITADER for field implementation of IPM (iv) Involve the Private Sector, NGOs and Communities in promoting IPM activities; (v) Implement participatory approaches in IPM for farmers to learn, test, select and implement IPM options to reduce losses due to pests and diseases	IIAM/UEM DNEA DINAS IIAM/UEM/DNEA
Increased use and reliance on chemical pesticides	(i) Promote adoption of IPM practices through farmer education and training (ii) Develop strategies to move farmers away from pesticide-dependent pest control practices and promote use of biological control	Extension services in coordination with research including applied research on traditional practices/on farm demonstrations
Enforcement of legislation	(i) Strengthen institutional capacity of MIC (to the	IRRIGA/INIR/DINAS

Main areas of and issues for intervention	Actions required	Responsibility
	extent needed to influence dealers and other agents) and MITADER to effectively supervise compliance with pesticide legislation	
Environmental hazards of pesticide misuse	(i) Create public awareness of the hazards of pesticide misuse through public awareness campaigns (ii) Regular assessment of pesticide residues in irrigated agricultural production systems and in harvested produce. (iii) Monitoring of pesticide poisoning in the farming and rural communities.	IRRIGA/INIR/DINAS/MITADER
Increase in vector populations and of vector borne diseases such as malaria	(i) Collaborate with other IPM programs in the region. (ii) Establish strong collaboration between Africa Stockpile Program and national malaria control project (iii) Conduct regular vector surveillance.	IRRIGA/INIR/DINAS/MOH
Monitoring	(i) Establish a participatory monitoring system that provides early warning on pest status, (ii) identify at what level economic losses will occur, (iii) identify main pest species, beneficial, regular and migratory species	IRRIGA/INIR/DINAS

6.1.1. The Actual Management and Handling of PesticidesSpecific and implementation plans will be site-specific. As such they will (i) identify the pest species more prevalent in a specific project area; (ii) present an estimate of pest populations and comparison to established action thresholds; (iii) select and provide the appropriate management tactics based on current on-site information; (iv) assess the effectiveness of pest management; and (v) keep appropriate records of all the actions taken in that area and subproject to consistently put in place the IPM.

A combination of the provisions of (i) Decree 6/2009 of 31 March that regulates the management of pesticides in the country, to guarantee public health and environmental quality, under the provision of article 9 of Law 20/97 of 1 October; (ii) WB Guidelines on Pest Management; and (iii) recommended best practices results in the following systems and procedures for the handling of pesticides that is relevant for IRRIGA, i.e. farmers and all other pesticide operators and service providers.

Table 6-3: Handling of pesticides

Nr.	Area of Action	Systems and Procedures
1	**Overall**	• Use resistant crops and varieties, crop sequences, associations, and cultural practices that minimize the pressure and maximize biological prevention of pests and diseases. • Maintain regular and quantitative assessment of the balance status between pest and disease and beneficial organisms of all crops. • Apply pest and disease forecasting techniques where available. • Understand and use non-chemical pest and disease management practices. • Decide on interventions following consideration of all possible methods and their short- and long-term effects on farm productivity and environmental implications to minimize the use of agrochemicals, promote integrated pest management (IPM). • Store and use agrochemicals according to legal requirements, e.g. registration for individual crops, rates, timings, and pre-harvest intervals. • Assure that agrochemicals are only applied by specially trained knowledgeable persons. • Assure that equipment used for the handling and application of agrochemicals complies with established safety and maintenance standards. • Maintain accurate records of agrochemical use. • Avoid any point source pollution from agrochemicals resulting from use, storage, cleaning and disposal of products or application equipment. • Avoid impact on non-target areas of any pest and disease management activity.
2	**Procurement**	• Procurement of pesticides will be the sole prerogative of licensed and authorized agents. • In line with GOM llegislation in Mozambique the production, donation, trading, importation and use of any substance with a pesticide action is subject to prior registration: (i) the registration is done on the basis of a request to be submitted by companies duly registered with the DINAS (ii) the companies that register pesticides are also registered with the DINAS as pesticides importer
3	**Storage**	(1) pesticides shall not be stored: (a) in a manner that could result in contamination of animal feeds or commercial fertilizers. (b) above or against feed components, animal foods, foodstuffs, medications, or children's toys. (c) loaded into aerial application equipment within one hundred yards of an airline passenger terminal. (2) for display purposes: (a) pesticides shall not be shelved above or against feed components, animal foods, foodstuffs, medications, or children's toys. (b) shelving or display areas used for pesticide display shall be thoroughly cleaned before they are re-used for display of other products. (3) For liquid bulk pesticide facilities: (a) containers and accessory equipment used for the storage and handling of bulk pesticides shall be of materials and construction compatible with the pesticide stored and the conditions of storage as specified by the label instructions. (b) non-mobile liquid bulk pesticide storage container installations shall be constructed such that a secondary means of containment is provided. (i) secondary containment shall be constructed of sufficient thickness, density and composition to contain any spillage or discharged material. (ii) secondary containment areas shall not contain a drain unless it is plugged to prevent the release of any spillage from the containment area. (ii) non-mobile liquid bulk pesticide storage containers shall be secured or elevated high enough to prevent flotation if the secondary containment structure fills with liquid.

Nr.	Area of Action	Systems and Procedures
		(4) For facilities utilizing containers: (a) bulk pesticide storage and handling facilities shall be sited in accordance with appropriate local, state and national regulations and be constructed of sufficient thickness, density and composition to contain any spillage or discharged material. (b) containers and accessory equipment used for the storage and handling of bulk pesticides shall be of materials and construction compatible with the pesticide stored and the conditions of storage as specified by the label instructions. (c) containers must be protected from wind and precipitation. (d) containers must be placed on pallets or raised platforms. (e) containers must be placed on an impervious surface that extends completely beneath the pallets or raised platforms (f) the registered pesticide label shall be prominently displayed on the bulk pesticide storage container.
4	**Transportation of bulk pesticide containers**	(1) bulk pesticide containers shall meet all applicable standards as specified by the Decree 6/2009 of 31 March. (2) bulk pesticide containers shall be thoroughly secured to prevent spillage of pesticide and damage to containers during transportation. (3) bulk pesticide containers shall bear the registered product label for the material contained within.
5	**Handling and loading of bulk pesticides**	(1) bulk pesticides shall be handled, mixed and loaded in a manner that will assure the protection of crops, livestock, the public and the environment. Physical and chemical properties shall be considered in the handling and loading of bulk pesticides. (2) loading and mixing of bulk pesticides conducted at permanent distribution sites shall be on impervious surfaces with provisions sufficient to allow containment and recovery of any spillage. (a) owners or operators of permanent bulk pesticide distribution sites shall initiate immediate repair to any visible signs of damage to the impervious surfaces where bulk pesticides are loaded or mixed. (b) owners or operators of permanent bulk pesticide distribution sites shall ensure that all impervious surfaces are constructed in such a manner as to prevent water and other liquids from seeping into or flowing onto these areas from adjacent land or structures. (c) owners or operators of permanent bulk pesticide distribution sites shall ensure that all impervious surfaces for loading and mixing of bulk pesticides, are constructed with materials that are compatible with the materials being handled and are not made of asphalt or earthen materials. (3) prior to refilling, bulk pesticide containers must be thoroughly cleaned except when a sealed or dedicated recyclable bulk container is refilled with the same labeled pesticide and bears the same label as the pesticide immediately preceding it.
6	**Application of pesticides**	(1) the most common forms of pesticide application, in conventional agriculture, is the use of mechanical sprayers. The equipment must be in good working condition and this should be ensured by regular testing and setting of standards for application equipment
7	**Disposal of containers and unused pesticides**	(1) empty pesticide containers and containers which have held pesticide-treated seed: (a) shall be disposed in a manner consistent with the pesticide label; or (b) in the absence of specific label instructions, shall be triple-rinsed and disposed in designated disposal sites; and (c) shall not be sold or re-used for any purpose. Re-use of such containers for the storage of human or animal food or water, or for the storage of cooking utensils, dishes or clothing is strictly prohibited. (2) unused pesticides and unwanted pesticide-treated seeds shall be disposed in a manner consistent with their labeling.
8	**Distribution of bulk pesticides**	(1) bulk pesticides may be repackaged for sale or delivery if: (a) a representative of said registered establishment is present when the product is repackaged for sale or delivery; and (b) there is no change in any of the following as a result of the repackaging: (i) the pesticide formulation; (ii) the product labeling, (3) scales and meters used for bulk pesticide sales shall meet the specifications, tolerances and other technical requirements as defined by the INNOQ[38] (4) separate pumps and meters shall be used for each pesticide when distributed for sale.
9	**Custom mixes or blends**	(1) shall be prepared to the order of the user within the recommended range of the pesticide's labeling; (2) shall not be held in inventory; (3) or portions thereof, if

[38] National Standardization and Quality Institute

Nr.	Area of Action	Systems and Procedures
		divided for delivery, shall be labeled with the actual percentage of the pesticide within the custom mix or blend, together with the pertinent and proper directions for its use, purpose and cautions. This requirement may be met by attaching a copy of the end-use labeling of the pesticides used in the blend. (4) shall be prepared in an establishment that is authorized by Decree 6/2009 of 31 March to deal with pesticides

Annex 5 provides a template of an IPM Plan, which should be adjusted and used at the site level to systematically assist compliance with the IPM Plan by IRRIGA subprojects.

A significant factor that can be expected to work as a constraint in the adoption of IPM practices is the attitude that pesticides are modern "medicines" that provide fast and effective cure for all problems affecting crops. Consequently, the success of any IPM strategy depends not only on the ability of the Project to define an IPM program and link it with strategic partners (private companies or NGOs), but also on the capacity of the different actors (government, extension service, farmers, private organizations, strategic partners) to fulfill their commitments in these areas. This requires considerable investment in training and capacity building in several topics of IPM and the implementation of this PMP as referred to in the main ESMF document (Chapter 11 – Training and capacity building requirements).

It is recommended that the IPM for the project will be managed and facilitated by the Hired Service Provider (HSP). The HSP will be responsible for facilitating the main stages of the process, i.e. mobilization, participatory diagnostic, formulation of the detailed plan of action involving the main actors and main areas of intervention that have been identified, implementation, monitoring and evaluation and feedback to the system through lessons learned that are valid for the project and other similar interventions. The HSP will work in close collaboration with a focal point for IPM under IRRIGA stationed at the INIR/DINAS. These will liaise with relevant agricultural operators and services including research and extension services in the fulfilment of their objectives.

Important training aspects could be done with lead farmers or involving experienced farmers. The use of lead farmers is part of the extension system in Mozambique already used in other areas of demonstration. This should be replicated accordingly under the IPM. The success of IPM will depend mostly on developing and sustaining institutional and human capacity to facilitate experiential learning for making informed decisions in integrating scientific and indigenous knowledge to minimize potential detrimental impacts of the use of pesticides. The adaptive research foreseen under the project should also include this subcomponent.

Poor communication between farmers and extension workers and other agricultural and government officers could lead to poorly-targeted research or to poor adoption of promising options generated by research. Ideally some of the training should be led by farmers themselves targeted to other farmers. Experience exchange among different farmers' communities could prove essential for the intended outcomes.

6.2 Possible Interventions in Integrated Pest and Pesticide Management

Based on the descriptions made in previous chapters, this section provides a general outline of various types of pest control strategies known and applied in Mozambique and that can be further investigated and disseminated in wider areas, including the project area, based on evidence. These include a brief review of techniques for biological control, cultural control,

chemical control, quarantine and physical or mechanical control, chemical control and botanical control. The subchapter is complemented by three tables that summarize the best combination of traditional and modern IPM around crops and related pests as these are currently seen in Mozambique. Continuous testing and systematic drawing of lessons learned in recommended under IRRIGA.

6.2.1 STRATEGY FOR INTERVENTION AND PESTICIDE MANAGEMENT ACTION PLAN

6.2.1.1 BIOLOGICAL CONTROL

Biological control involves the use of biological agents and predators to control pests and diseases. The method is usually successful in crops like cassava and involves conservation or optimization of the impact of living agents that already exist in the ecosystem, artificially increasing the number of natural enemies in the agro-ecosystem, introducing the new natural enemies' species where these were non-existent.

Evidence shows that every living organism has its natural enemies and diseases, which keep its population at balance. Natural enemies include predators, parasitoids, nematodes, fungi, bacteria, viruses etc. The use of predators, parasitoids, nematodes, fungi, bacteria and viruses to maintain the population density of pests at a lower level than would occur in their absence is a common method under biological control or simply bio-control.

In the plant kingdom resistance to pests is the rule rather than the exception. In the coevolution of pests and hosts, plants have developed defense mechanisms. The mechanisms may be either physical (waxy surface, hairy leaves etc.) or chemical (production of secondary metabolites) in nature. Pest-resistant crop varieties either suppress pest abundance or elevate the damage tolerance level of the plant. In other words, genetic resistance alters the relationship between pest and host. The inherent genetically based resistance of a plant can protect it against pests or diseases without recourse to pesticides.

In the project area and under IRRIGA research, extension, farmers of all classes, and particularly family, small and medium size farmers will be encouraged to work together to make experiments and come up with combinations that are suitable for the area. The specific ways under which this will be done will be defined as set out in Table 6-2. Under PROIRRI and in other parts of Mozambique the use of (i) petroleum emulsion, which is a contact insecticide useful against many sucking insects; (ii) tobacco mix, which is very effective for the control of aphid infesting horticultural crops; (iii) Margosa (*Azadirachta indica*) seed emulsion (neem) very effective as repellent against locusts; (iv) intercroping with chilli pepper has proved to be effective although not always adopted systematically and not properly disseminated.

6.2.1.2 CULTURAL AND CROP SANITATION PRACTICES

Pests may also be controlled through the adoption of improved cultural and crop sanitation practices. Some of these include:

a) **Crop rotation**: this practice is used to depress weeds and/insect pests and diseases in some crops. For example, *Striga* in sorghum and millet can be controlled/reduced by planting a trap crop like groundnuts or cotton;
b) **Intercropping**: the field is used to grow two or more crops at the same time, which among them interchange disease control elements;

c) **Relay cropping**: where one crop is relayed with another to reduce the infestation of weevils, for example;
d) **Fallow**: the field is not cultivated for some years in order to control various parasitic weeds;
e) **Cover crops**: these are leguminous crops, which are grown to suppress weeds in the field. They can be intercropped or not and they protect and cover the field e.g. pumpkins;
f) **Trap crops**: these induce the germination of a pest. The trap crop can be intercropped or rotated with a susceptible host (e.g. groundnuts, cotton etc.).
g) **Mulching**: this is covering of crop fields by dry grasses to control weeds and conserve soil moisture (e.g. in banana, tomato field etc.);
h) **Hand pulling and hoes weeding**: these practices are the most common and being used by small-scale farmers. In moments of relative abundance of labor in rural areas this practice can be adopted easily;
i) **Burning**: land clearing and destroying infected plants/crops. Although it is fundamental to ensure that burning is strictly controlled and limited to the areas and species being targeted and do not spread to other areas;
j) **Fertilizer/manure application**: the application of nutrients in the form of either inorganic fertilizer or farm-yard manure reduces both the infestation of fields by weeds (e.g. *Striga*) and losses in crop yield;
k) **Use of disease free planting material**: e.g. cassava cuttings, sweet potato vines etc.;
l) **Pruning**: done in tea, orange tree etc. to reduce insect pests and diseases that might infest the crop;
m) **Thinning**: done to reduce plant population in the field (e.g. in maize, rice, sorghum and cotton etc.).

These practices are very common and well-known in Mozambique and the project area and should be encouraged. As with biological control existing knowledge and experiments in the project area should be used and/or carried out to identify the practices that are more suitable to local conditions. Based on evidence these should be disseminated.

6.2.1.3 PHYSICAL AND MECHANICAL CONTROL

These are measures that kill the insect pest, disrupt its physiology or adversely affect the environment of the pest. They are different from cultural measures as the devices or actions adopted are directed against the insect pest instead of modifying agricultural practices. The hand picking of cotton strainers from cotton plants, banana weevils from banana pseudo stems, killing American bollworm from tomato plants are forms of physical control while the use of a fly swatter against annoying flies is a form of mechanical control as is the use of scarecrows to scare off birds, which is very common in relation to rice and wheat and other crops. Some of the mechanical measures are relatively easy to apply where and when there is abundance of manpower. This is generally the case in the targeted areas at the same time that these are well-known mechanisms.

6.2.1.4 CHEMICAL CONTROL

Chemical measures involve the use of herbicides, insecticides and fungicides to manage weeds, pests and diseases. As already explained throughout this document they should be used under certain conditions and when the other less intrusive and poisonous measures have proved to not

be effective. All the aspects of capacity building of individuals and institutions should be used to ensure that the use of chemicals is not done to the detriment of the health of humans and other living organisms and consequently ensuring a healthy environment.

They can be applied as liquid spray, in the form of granules, powder or fumigation in stores. Registered pesticides (**Error! Reference source not found.**) can be recommended as a component of IPM packages. These are registered under Pesticide Regulation (Ministerial Diploma 153/2002 of 11 September 2002) and as said updated on a yearly basis and **Error! Reference source not found.** is the list approved in December 2015 and currently in force.

6.2.2 SUMMARY OF COMBINED AND RECOMMENDED MEASURES

Pests found in agriculture and Public Health are considered all harmful organisms such as insects, weeds, or microorganisms. Current knowledge and experience combining traditional and modern IPM in Mozambique around major crops and respective pests can be summarized in the following tables. Under IRRIGA recommended practices will be adopted systematically and systematic monitoring and evaluation and drawing of lessons learned will inform progress.

Table 6-4: Recommended practices around vegetable

Pests	Name	Portuguese name	Recommendations
	Aceria = *Eriophyes tulipae*	Ácaro do Alho	• Cultural control • Biocontrol • Selective acaricide
	Aculops lycopersici	Ácaro do bronzeado	
	Agromyza sp	Minador	• Cultural control • Biocontrol • Selective insecticide
	Agrotis sp	Lagarta rosca	
	Bagrada picta	Percevejo da couve	• Botanicals • Biocontrol • Resistant varieties • Selective insecticide
	Bemisia spp	Mosca branca	
	Brevicoryne brassicae	Pulgao da couve/repolho	
	Diabroticas sp	Crisomélidos	
	Epitrix sp	Crisomélidos	
	Helicoverpa sp	Lagarta /Broca do fruto	• Cultural control • Strip intercropping • Biocontrol • Pheromone trap • Selective insecticide
	Heliothis sp	Lagarta /Broca do fruto	
	Lariomyza sp	Lagarta mineira	
	Macrosiphum euphorbiae	Afídeos	• Biocontrol • Selective insecticide
	Myzus persicae	Afideos	
	Mylabris occidentalis	Besouro das flores	• Selective insecticide
	Phyllophaga spp	Escaravelho do solo	• Cultural control

	Plutella maculipennis	Teia das couve	• Biocontrol
	Prodenia sp	Lagartas das folhas	• Biocontrol • Selective insecticide
	Solenopsis sp	Formigas	• Cultural control • Selective insecticide
	Spodoptera sp	Lagarta dos frutos	• Biocontrol • Selective insecticide
	Trichoplusia sp	Lagarta medidora	
	Thrips tabaci	Trips	• Resistant varieties • Selective insecticide
	Tetranychus sp	Ácaros vermelho	• Biocontrol
Diseases	*Aspergillus niger*	Podridão dos bolbos	• Phytosanitary measures • Cultural control • Resistant varieties
	Alternaria brassicae	Mancha zonada	
	Alternaria porri	Mancha púrpura	
	Alternaria porri f. sp.dauci	Queima das folhas	
	Alternaria solani	Mancha concêntrica/ Pinta preta	
	Alternaria sp	Pinta preta	
	Botrytis sp	Podridão da cabeça	
	Bremia lactucae	Míldio	
	Cercospora capsici	Mancha cinzenta	
	Cercospora carotae	Pinta cinzenta das folhas	
	Cercospora sp	Mancha cinzenta	
	Cladosporium fulvum	Mancha olivácea	
	Colletotrichum capsici	Antracnoses	
	Colletotrichum gloesporoide	Anthracnoses	
	Corynespora melogenae	Mancha da folha	
	Deficiência de Boro	Necroses do fruto	
	Deficiência de cálcio	Necrose ou podridão apical	
	Deficiência de magnésio	Clorose internerval	
	Erwinia carotovora	Podridão mole	
	Fendilhamento longitudinal da raiz	Deficiência de Boro	
	Fusarium sp	Murcha	
	Helminthosporium sp	Mancha da folha	
	Leveillula taurica	Míldio	
	Peronospora destructor	Míldio	
	Phytophtora, Fusarium, Rizoctonia	Damping off	
	Phytophtora infestans	Queima ou Míldio	
	Pseudomonas solanacearum	Murcha bacteriana	
	Puccinia porri	Ferrugem	• Cultural control

	Rhizoctonia solani	Tombamento das mudas	• Phytosanitary measures • Resistant varieties
	Rhizoctonia sp	Aguado dos alfobres	
	Septoria lactucae	Manchas por septoria	
	Septoria licopersici	Pinta da folha	
	Stemphylum botryosum	Mancha amarela das folhas	
	Xanthomonas axonopodis pv vesicatória	Queda das folhas	
	Xanthomonas campestri	Podridão preta/ Queima dos bordes	
Nematodes	*Meloidogyne* sp	Mal formação da raiz	• Cultural control • Phytosanitary measures • Resistant varieties
	Heterodera sp	Raízes bifurcadas	
Virus	Mosaic Tomato Vírus	Enrolamento do topo	• Cultural control • Phytosanitary measures • Resistant varieties
	Lettuce Yellow Vírus	amarelecimento borde da folhas	

Table 6-5: Recommended practices around maize, rice and sugar cane

Pests	**Name**	**Portuguese name**	**Recommendations**
	Sesamia calamistis	Brocas do colmo	• Cultural control • IPM measures • Resistant varieties
	Chilo partellus	Brocas do Colmo	
	Busseola fusca	Broca do colmo/espiga	
	Rhopalosiphum maydis	Afideos	• Cultural control • IPM measures • Resistant varieties
	Aphis gossipii	Afideos	
	Agrotis segetum	Roscas	
	Spodoptera exempta	Lagarta invasora /do colmo / maçaroca	
	Acanthoplus stratiotes	Matirindinde	
	Zonocerus variategus	Gafanhotos	
	Phymateus viripides	Gafanhotos	
	Heliothis sp	Lagarta das espigas	
	Helicoverpa sp	Lagartas das espigas	
	Quelea – quelea	Pássaro de bico vermelho	
	Mastomys natalensis	Ratos	
	Heterotermes sp	Térmitas e Cupins	
Diseases	*Helminthosporium turcicum*	Mancha da folha	• Cultural control • Phytosanitary measures • Resistant varieties
	Helminthosporium maydis	Mancha da folha	
	Ustilago zea = U. maydis	Carvão comum	
	Erwinia sp	Podridão do colo	
	Diplodia macrospora	Podridão seca das espigas e grãos	
	Fusarium spp	Podridão das espigas	
	Sphacelotheca reiliana	Fungão da bandeira	

	Sphacelotheca sorghi	Carvão do sorgo	• Cultural control • Phytosanitary measures • Resistant varieties
	Ustilago sp	Carvão da espiga	
	Puccinia spp	Ferrugem	
	Sclerospora graminícola	Míldio	
	Diplodia zeae	Podridão do caule	
	Podridão escura da Maçaroca		
Virus	Maize Streak Vírus	Listrado da folha	

Table 6-6: Recommended practices around beans

Pests	Name	Portuguese name	Recommendations
	Térmitas ou Salalé	Broca da vagem	• Cultural control • IPM measures • Resistant varieties
	Solenopsis sp	Formigas	
	Epicauta sp	Besouro das folhas	
	Prodenia litura	Lagarta das folhas	
	Myzus persicae	Afídeos	
	Mylabris occidentalis	Besouro das flores	
	Omphyomia phaseoli	Minador/ Fendilhamento do caule	
	Agrotis sp	Roscas	
	Acanthoscelides obtectus	Lagarta das vagens	
	Prodenia litura	Lagarta das folhas	
	Aphis fabae/ Aphis cracívora	Pulgão preto do feijoeiro	
	Ootheca mutabilis	Crisomélido das folhas	
	Epicauta velata	Besouro da folhas	
	Bemisia tabaci	Mosca branca	
	Tertranychus sp	Ácaros vermelhos	
	Spodoptera spp	Lagarta das vagens	
	Heliothis spp	Lagarta das vagens	
	Anoplocnemis sp	Percevejo das folhas	
Diseases	*Cercospora arachidícola*	Mancha castanha	• Cultural control • Phytosanitary measures • Resistant varieties
	Cercospora personata	Mancha preta arredondadas	
	Puccinia arachidis	Ferrugem	
	Alternaria arachidis	Mancha zonada	
	Rhizoctonia sp	Podridão seca da raiz	
	Ascochita sp	Mancha por Ascochita	
	Colletotrichum sp	Anthracnose das folhas	
	Pseudomonas sp	Mancha bacteriana	
	Uromyces appendiculatus	Ferrugem	
	Colletotrichum lindemuthianum	Anthracnose	• Cultural control • Phytosanitary measures • Resistant varieties
	Glomerela cingulata	Anthracnose	
	Alternaria tenuissima	Mancha concêntrica das folhas	
	Phoma sp	Mancha de Ascoshyta	
	Phaeoisariopsis griseola	Mancha angular	
	Erysiphe poligoni	Míldio	
Nematodes	*Meloidogyne* spp	Nematodos de lesao ou de galha	
Virus		Mosaico comum do Feijoeiro -BCMNV	• Cultural control • Phytosanitary measures • Resistant varieties

6.2.3 MONITORING AND EVALUATION

The focus on monitoring and evaluation must be based on the assessment of the increase in IPM capacity, the extent to which IPM practices and techniques are being adopted in crop production and the economic benefits that farmers derive from adopting IPM. Indicators for monitoring IPM adoption could be but not limited to:

Table 6-7: Monitoring indicators

Monitoring indicators	Number of farmers/percentages over time[39]	Institutional responsibility
Number of farmers who have adopted IPM practices and their specifications		SDAE and extension workers
Number of farmers who have received training in IPM methods		SDAE and extension workers
Number of crops in which IPM is applied		SDAE and extension workers
Quantification of economic, health, environmental and social benefits		DPASA, SDAE and extension workers
Extent of area in which pesticides are used		DPASA, SDAE and extension workers (as part of normal monitoring and evaluation of agricultural seasons)
Efficiency of pesticide use: type of pesticides used, rational use, handling, storage and disposal of pesticide residues and pesticide containers		DPASA, SDAE and extension workers (as part of normal monitoring and evaluation of agricultural seasons)
Level of reduction of pesticide purchase		DPASA, SDAE and extension workers (as part of normal monitoring and evaluation of agricultural seasons)

Monitoring will be a continuous function that will use a systematic collection of data on the above-mentioned indicators and other to measure progress over time. *Evaluation* on the other hand will be the periodic assessment of sustainability, relevance, impact, effectiveness and efficacy of an intervention in relation to stated objectives. Evaluation measures achievements in relation to institutional policies, project objectives, and the goals set for each operation. As can be seen monitoring and evaluation should, in as much as possible, be embedded in the existing data collection and processing done periodically by MASA at all levels, instead of being a separate and standalone process. The progress of IPM will be done taking into consideration the multiple areas in which the strategy will be rolled out notably regulation per se, research, and extension, adoption of IPM and pesticide use in a way that is in line with the strategy.

[39] Targets to be defined after the diagnostic exercise a better definition of the baseline situation.

6.3. AUTHORIZED PESTICIDES

If the project will not completely switch to and enforce a full organic approach, it is inevitable that pesticides will be recommended for use on some sites and crops. In the territory defined by the Project area the use of agro-chemicals, including pesticides is already a reality and growing. There are pockets of farmers that doing so and if no other measures are taken this will tend to grow.

Based on what happened under PROIRRI, when compared with other areas in Mozambique the project area can rank high at the national level in the use of agro-chemicals. This is mainly associated with the production of sugar cane, baby corn, fruits and horticulture. With the planned support to agricultural intensification the use of agro-chemicals can be expected to be intensified.

Under the World Bank funding for the Project, no funding for pesticide acquisition will be provided for farmers. However, it would be recommended to elaborate a provisional list of less harmful pesticides that can be used. A list of registered pesticides in Mozambique is provided as an Annex of the Pesticide Regulation (Ministerial Diploma 153/2002 of 11 September 2002) and includes among others: cypermethrin, deltamethrin, mancozeb and dimethoate. The list is updated on a regular basis and **Error! Reference source not found.**of this document presents the latest version updated in December 2015. Annex 4 of this document presents the WHO Pesticide Classification List by level of hazardousness. The list could guide the classification of pesticides eventually to be used. Annex 5 outlines the site-specific plan to implement IPM at the subroject level. It is provided as a sample plan to be adjusted and used in different subproject contexts.

7. INSTITUTIONAL STRENGTHENING, TRAINING AND CAPACITY BUILDING

Different measures will have to be combined to mitigate the potential adverse impacts likely to occur because of pesticide use in the project areas. Ideally the Department under the DINAS dealing with plant diseases should be better represented in IRRIGA provinces and districts in a way that goes beyond what is currently the practice. There are less than 10 technical staff members at the central level, 2-3 at the provincial level and at the district level the unit is represented by extension workers or any other officials who cumulatively develop other activities. Additionally, the units are ill-equipment in terms of other means to develop their work (transport, laboratories, and other relevant equipment). Support will be provided by the project to have clearly designated officers at both provincial and district level to provide dedicated work to IPM.

IRRIGA IPM will be managed in line with the institutional arrangement of the GOM, this project and the MASA, as described and assessed in Chapter 4. The process involves the relevant government departments (MASA, MISAU, MITADER, and MIC) at central, provincial and district levels. Within the MASA it will actively involve DINAS and its Department of Plant Diseases, the Research Institute (IIAM) and Extension Services. Other national research and higher education institutions (e.g. UEM) will also be involved. The project will take advantage of the fact that the unit dealing with plant diseases is within the same ministry as INIR.

On a day to day basis PIU at Central and Provincial level will rely on their agronomists and the Environmental and Social Safeguards Specialists and all other MASA agents at provincial and district levels to take responsibility for all IPM requirements. This will also extend to TA around the crops to be embraced by the project as was the case under PROIRRI. These will be assigned specific responsibilities for IPM development and implementation. At the subproject level the Project Managers, Agricultural Technical Officers and/or other designated people will have direct responsibility for IPM. Annex 5 will be adjusted to guide their day-to-day work.

The primary mitigation measure includes institutional strengthening and the second is the training of the various categories of stakeholders in the pesticide chain in safe and thoughtful pesticide use and management. The latter includes the delivery of a mix of (i) Information, Education and Communication approaches targeting farmers, pesticide operators and teams; (ii) provision of Personal Protective Equipment (PPE); (iii) training to farmers, and thorough and consistent supervision and monitoring. Specific aspects and numbers of people to be involved will be defined after the diagnostic of the situation and preparation of the final version of the plan of action foreseen in Table 6-1.

7.1 Institutional Strengthening

IPM success relies significantly on developing and sustaining institutional and human capacity to facilitate experiential learning for making informed decisions in integrating scientific and indigenous knowledge to solve specific problems. In this regard IRRIGA is relevant by adopting adaptive research.

Poor communication between farmers, extension workers has often led to poorly-targeted research or to poor adoption of promising options generated or that could be generated by research.

A sound IPM in Mozambique can only be achieved through a good and practical combination of scientific and applied/participatory research involving farmers (including women), extension workers, and researchers. Under IRRIGA stakeholders will need to get together and in a process with multiple stages agree on issues to be addressed and define a plan of action, implement and monitor it. During the formulation of this plan it was not possible to bring all of them together and the information obtained from each of the few that were directly contacted cannot substitute this process of formulation of an agreed plan of action. The issues to be addressed are complex and require a good combination of research, plan and action, lessons learned and so on.

INIR/IRRIGA in coordination with DINAS and the latter through its Plant and Animal Health Services, are required to work together with the IIAM (research stations in the project area (e.g. Chimoio and Nampula and other)) and other related sectors (health and environment) to institute research programs that respond to local needs. For the programs to be adequately responsive they should involve local farmers (including women) and extension workers in the identification of issues to be worked on and subsequent delivery of responses and ways of putting them into practice, including the training, capacity building and skills and attitude development. The "on farm" and "on station" research programs embraced by IIAM should be creatively used to work for this objective.

The private sector and local relevant NGOs should also be involved. The program should also include initiatives such as Farmer Field Schools, Training of Trainers, and regional meetings etc., which could bring together actors from different projects (e.g. SUSTENTA) but with similar objectives in this area.

PROIRRI used the above-described structure to build capacity on irrigation in general and now it should create a line of work to specifically address PM and irrigation.

7.2 Training and Capacity Building

This is not a straight forward perception but in general farmers are aware that pesticides are poisonous and represent a serious occupational health and environmental risk. Also, the cost of pesticides is discouraging for most poor farmers to embark on massive use. To take advantage of this conducive situation there is a need to implement awareness campaigns to raise the understanding of the potential environmental and human health impacts related with inadequate use of pesticide as well as the benefits of the integrated pest management practices.

Capacity building will be achieved through farmer-based collaborative management mechanisms under which all key stakeholders have to be regarded as equal partners whose role will be to facilitate the process and provide technical direction and any other support necessary for the implementation of the activities

The HSP backed by INIR/IRRIGA and DINAS Focal Point will take the necessary steps to prepare comprehensive training manuals, brochures and leaflets on pesticide use and management, targeting different actors within the project, ranging from extension service providers, farmers, loaders, mixers, transporters, government staff among others. The training manual or guides to be developed for use must be simplified and easy to understand and participatory in nature with in-built and demonstration/ practical sessions as much as possible.

More specifically training on IPM, targeting lead farmers, extension workers, local leaders, etc. will include but not be limited to:

- **Learning-by-doing/discovery training programs**: farmers are most apt to adopt new techniques when they acquire knowledge and skills through personal experience, observation, analysis, experimentation, decision-making and practice. This allows to identify farmers' own knowledge and for farmers to understand how IPM applies to their own farms.
- **Recovering collective memory**: pest problems often emerge because traditional agricultural methods were changed in one way or another or lost. These changes can sometimes be reversed. This approach uses group discussions to try to identify what changes might have prompted the current pest problem.
- **Focus groups discussions**: regular meetings among women, men, the youth to discuss production problems including pests and related problems can assist in the success of various control methods. These meetings should be promoted using all forms of local incentives.
- **Demonstration projects**: farmer-field schools can be very effective at promoting IPM within the local community. These pilot sessions demonstrate IPM in action and allow farmers to compare IPM with ongoing cultivation supported by synthetic pesticides.
- **Educational material**: basic written and photographic/figures guides or even videos about pest identification and crop-specific management techniques are essential for training and could be an important factor in motivating farmers to adopt IPM.
- **Youth education**: promoting and improving the quality of programs on IPM and the risks of synthetic pesticides has been effective at technical schools for rural youth. In addition to becoming better farmers in the future, these students can bring informed views back to their communities.

Training in the use of pesticides, targeting lead farmers, extension workers, local leaders, etc., will include but not be limited to:

- **Pesticide selection**: indicating the list of authorized pesticides per target pests, indicating their level of toxicity and hazardous, possible harmful effects and experience of using those pesticides for the pest and the crop.
- **Understanding the pesticide label**: explaining all the information included in the label. Pesticide transport: give indications on how to transport pesticides to avoid any leakages and avoiding the contact with persons or animals.
- **Mixing and loading pesticides**: explain the importance of ensuring the proper dilution of the concentrated pesticide and the need to use protective clothing.
- **Pesticide storage**: give indications on how to storage pesticides (i.e. site location (not allowed in flood areas), security (against illegal entries, as well as children and livestock), isolated from housing, well ventilated, waterproof roof, have a current inventory list of pesticide stock.
- **Container disposal**: giving indications on how to destroy/dispose used pesticide containers
- **Obsolete pesticides**: explain the risks associated with obsolete pesticides and procedures to be followed.
- **Calibration, product quantity and pesticide application**: explaining the importance of application equipment calibration and how to do it.
- **Determining the amount of chemicals to use**: giving explanations on methods to find out the amount of chemicals to apply per hectare and levels of dilution
- **Precautions related to the application of pesticides**: giving indications on important precautions for safe use of pesticide

- **Toxicity, human protection and first aid**: explaining the possible effects of pesticide on human health, ways of pesticides entering in the body, importance of protective clothing and other protective equipment, basic first aid for pesticide exposure (with skin, mouth, eye or respiratory system).

Under IRRIGA the distribution and use of pesticides to or by people who have not received training must be prevented. Inspection and monitoring work foreseen under the ESMF should also include a line of work to take care of this aspect.

All the details on institutional strengthening and training and capacity building should be revisited at the start of the project as suggested in Chapter 6.

8. PROPOSED BUDGET

IRRIGA costs for implementation of PMP requirements will benefit from ESMF safeguard staff who will also be in charge of supervising PMP implementation (preparing plans, monitoring, auditing).

Personnel Protection Equipment costs will be included in Component 3, matching grant window for financing inputs, such as pesticides, e-vouchers; under these, pesticides cost/financing to beneficiaries should be split 90% pesticides and 10% for health and safety personnel protection equipment and training.

The PMP budget proposed should include: project instruments (PMP and Good Agricultural Practices - Hygiene and Safety Environmentally and Socially Friendly Agricultural Farming Systems (Annex 9 of the ESMF), training and traveling costs.

Table 8-1: Estimated total budget and budget distribution items on PMP implementation

IRRIGA PMP Costs	Total Costs (USD)
IRRIGA PMP instruments (preparing PMP)	
Training IRRIGA HR at Central, Provincial and District level	
Capacity building to other IRRIGA department (Central and Provincial)	
Capacity building to Farmers Associations	
Training on Farmer Field Schools (FFS)	
Preparation of IPMP	
NGOs awareness raising, IPMP implementation support	
Personal Protection Equipment (PPE), health and safety	
TOTAL	

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ANNEXES

Annex 1: Registered Pesticides in Mozambique (June 2015)

lista de pesticidas - Dezembro -2015 (1).:

Annex 2: World Bank OP 4.09 Pest Management

Operational Manual

OP 4.09 - Pest Management

These policies were prepared for use by World Bank staff and are not necessarily a complete treatment of the subject.

OP 4.09 December, 1998

This Operational Policy statement was revised in August 2004 to ensure consistency with the requirements of OP/BP 8.60, issued in August 2004.

Note: This OP 4.09 replaces the version dated July 1996. Changes in wording have been made in paras. 1 and 3 and footnotes 2, 3, and 4. Further guidance for implementing the Bank's pest management policy is in the Environmental Assessment Sourcebook (World Bank: Washington, D.C., 1991). Questions regarding agricultural pest management may be addressed to the Director, Rural Development.

Questions regarding pesticide use in public health projects may be directed to the Director, Health Services.

1. In assisting borrowers to manage pests that affect either agriculture or public health, the Bank[1] supports a strategy that promotes the use of biological or environmental control methods and reduces reliance on synthetic chemical pesticides. In Bank-financed projects, the borrower addresses pest management issues in the context of the project's environmental assessment[2].

2. In appraising a project that will involve pest management, the Bank assesses the capacity of the country's regulatory framework and institutions to promote and support safe, effective, and environmentally sound pest management. As necessary, the Bank and the borrower incorporate in the project components to strengthen such capacity.

Agricultural Pest Management[3]

3. The Bank uses various means to assess pest management in the country and support integrated pest management (IPM)[4] and the safe use of agricultural pesticides: economic and sector work, sectoral or project-specific environmental assessments, participatory IPM assessments, and investment projects and components aimed specifically at supporting the adoption and use of IPM.

4. In Bank-financed agriculture operations, pest populations are normally controlled through IPM approaches, such as biological control, cultural practices, and the development and use of crop varieties that are resistant or tolerant to the pest. The Bank may finance the purchase of pesticides when their use is justified under an IPM approach.

Pest Management in Public Health

[1] "Bank" includes IBR D and ID A, and "loans" includes ID A credits and ID A grants.

[2] See OP/ BP 4.0 1, Environmental Assessment

[3] OP 4.0 9 applies to all Bank lending, whether or not the loan finances pesticides. Even if Bank lending for pesticides is not involved, an agricultural development project may lead to substantially increased pesticide use and subsequent environmental problems

[4] IPM refers to a mix of farmer-driven, ecologically based pest control practices that seeks to reduce reliance on synthetic chemical pesticides. It involves (a) managing pests (keeping them below economically damaging levels) rather than seeking to eradicate them; (b) relying, to the extent possible, on nonchemical measures to keep pest populations low; and (c) selecting and applying pesticides, when they have to be used, in a way that minimizes adverse effects on beneficial organisms, humans, and the environment

Operational Manual

OP 4.01, Annex B - Content of an Environmental Assessment Report for a Category A Project

These policies were prepared for use by World Bank staff and are not necessarily a complete treatment of the subject.

OP 4.01 - Annex B January 1999

1. An environmental assessment (EA) report for a Category A project[40] focuses on the significant environmental issues of a project. The report's scope and level of detail should be commensurate with the project's potential impacts. The report submitted to the Bank is prepared in English, French, or Spanish, and the executive summary in English.

2. The EA report should include the following items (not necessarily in the order shown):

(a) Executive summary. Concisely discusses significant findings and recommended actions.

(b) Policy, legal, and administrative framework. Discusses the policy, legal, and administrative framework within which the EA is carried out. Explains the environmental requirements of any co-financiers. Identifies relevant international environmental agreements to which the country is a party.

(c) Project description. Concisely describes the proposed project and its geographic, ecological, social, and temporal context, including any offsite investments that may be required (e.g., dedicated pipelines, access roads, power plants, water supply, housing, and raw material and product storage facilities). Indicates the need for any resettlement plan or indigenous peoples development plan[41] (see also subpara. (h)(v) below). Normally includes a map showing the project site and the project's area of influence.

(d) Baseline data. Assesses the dimensions of the study area and describes relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. Also takes into account current and proposed development activities within the project area but not directly connected to the project. Data should be relevant to decisions about project location, design, operation, or mitigatory measures. The section indicates the accuracy, reliability, and sources of the data.

(e) Environmental impacts. Predicts and assesses the project's likely positive and negative impacts, in quantitative terms to the extent possible. Identifies mitigation measures and any residual negative impacts that cannot be mitigated. Explores opportunities for environmental enhancement. Identifies and estimates the extent and quality of available data, key data gaps, and uncertainties associated with predictions, and specifies topics that do not require further attention.

(f) Analysis of alternatives[42]. Systematically compares feasible alternatives to the proposed project site, technology, design, and operation--including the "without project" situation--in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. For each of the

[40] The EA report for a Category A project is normally an environmental impact assessment, with elements of other instruments included as appropriate. Any report for a Category A operation uses the components described in this annex, but Category A sectoral and regional EA require a different perspective and emphasis among the components. The Environment Sector Board can provide detailed guidance on the focus and components of the various EA instruments.

[41] See OP/BP 4.12, Involuntary Resettlement, and OP/BP 4.10, Indigenous Peoples.

[42] Environmental implications of broad development options for a sector (e.g., alternative ways of meeting projected electric power demand) are best analyzed in least-cost planning or sectoral EA. Environmental implications of broad development options for a region (e.g., alternative strategies for improving standards of living in a rural area) are best addressed through a regional development plan or a regional EA. EIA is normally best suited to the analysis of alternatives within a given project concept (e.g., a geothermal power plant, or a project aimed at meeting local energy demand), including detailed site, technology, design, and operational alternatives.

alternatives, quantifies the environmental impacts to the extent possible, and attaches economic values where feasible. States the basis for selecting the particular project design proposed and justifies recommended emission levels and approaches to pollution prevention and abatement.

(g) Environmental management plan (EMP). Covers mitigation measures, monitoring, and institutional strengthening; see outline in OP 4.01, Annex C.

(h) Appendixes

(i) List of EA report preparers--individuals and organizations.

(ii) References--written materials both published and unpublished, used in study preparation.

(iii) Record of interagency and consultation meetings, including consultations for obtaining the informed views of the affected people and local nongovernmental organizations (NGOs). The record specifies any means other than consultations (e.g., surveys) that were used to obtain the views of affected groups and local NGOs.

(iv) Tables presenting the relevant data referred to or summarized in the main text.

(v) List of associated reports (e.g., resettlement plan or indigenous peoples development plan).

Table 1. Extremely hazardous (Class l a): Active Ingredients of Pesticides (Common name):

Aldicarb	Difethialone	Parathion-methyl
Brodifacoum	Diphacinone	Phenylmercury acetate
Bromadiolone	Disulfoton	Phorate
Bromethalin	Ethoprophos	Phosphamidon
Calcium cyanide	Flocoumafen	Sodium fluoroacetate
Captafol	Fonofos	Sulfotep
Chlorethoxyfos	Hexachlorobenzene	Tebupirimfos
Chlormephos	Mercuric chloride	Terbufos
Chlorophacinone	Mevinphos Difenacoum	Parathion

3.4. Highly hazardous (Class l b) technical grade active ingredients of pesticides (common name)

Acrolein	Ethiofencarb	Omethoate
Allyl alcohol	Famphur	Oxamyl
Azinphos-ethyl	Fenamiphos	Oxydemeton-methyl
Azinphos-methyl	Flucythrinate	Paris green {C}
Blasticidin-S	Fluoroacetamide	Pentachlorophenol
Butocarboxim	Formetanate	Pindone
Butoxycarboxim	Furathiocarb	Pirimiphos-ethyl
Cadusafos	Heptenophos	Propaphos
Calcium arsenate	Isazofos	Propetamphos
Carbofuran	Isofenphos	Sodium arsenite
Chlorfenvinphos	Isoxathion	Sodium cyanide
3-Chloro-1,2-propanediol	Lead arsenate	Strychnine
Coumaphos	Mecarbam	Tefluthrin
Coumatetralyl	Mercuric oxide	Thallium sulfate
Zeta-cypermethrin	Methamidophos	Thiofanox
Demeton-S-methyl	Methidathion	Thiometon
Dichlorvos	Methiocarb	Triazophos
Dicrotophos	Methomyl	Vamidothion
Dinoterb	Monocrotophos	Warfarin
Edinofenphos	Nicotine	Zinc phosphide

Table 3. Moderately hazardous (Class II) Technical Grade Active Ingredients of Pesticides (Common name)

Alanycarb	Endosulfan	Paraquat
Anilofos	Endothal-sodium	Pebulate
Azaconazole	Esfenvalerate	Permethrin
Azocyclotin	Ethion	Phenthoate
Bendiocarb	Etrimfos	Phosalone
Bensulide	Fenitrothion	Phoxim
Bifenthrin	Fenobucarb	Piperophos
Bilanafos	Fenpropidin	Pirimicarb
Bioallethrin	Fenpropathrin	Prallethrin
Bromoxynil	Fenthion	Profenofos
Brobuconazole	Fentin acetate	Propiconazole
Bronopol	Ferntin hydroxide	Propoxur
Butamifos	Fenvalerate	Prosulfocarb
Butylamine	Fipronil	Prothiofos
Carbaryl	Fluxofenim	Pyraclofos
Carbosulfan	Formothion	Pyrazophos

Cartap
Chloralose
Chlordane
Chlorfenapyr
Chlorphonium chloride
Chlorpyrifos
Clomazone
Copper sulfate
Cuprous oxide
Cyanazine
Cyanophos
Cyfluthrin
Beta-cyfluthrin
Cynalothrin
Cypermethrin
Alpha-cypermethrin
Cyphenothrin
Deltamethrin
Diazinon
Difenzoquat
Dimethoate
Dinobuton Nabam
Diquat Naled
Fuberidazole
Gamma-HCH
Guazatine
Haloxyfop
Heptachlor
Imazalil
Imidacloprid Sodium
Iminoctadine
loxynil
loxynil octanoate
Isoprocarb
Lambda-cynalothrin
Mercurous chloride
Metaldehyde
Metam-sodium
Methacrifos
Methasulfocarb
Methyl isothiocyanate
Metolcarb
Metribuzin
Molinate
Pyrethrins
Pyroquilon
Quinalphos
Quizalofop-p-tefuryl
Rotenone
Sodium fluoride
Hexafluorosilicate
Spiroxamine
Suiprofos
Terbumeton
Tetraconazole
Thiacloprid
Thiobencarb
Thiocyclam
Thiodicarb
Triazamate
Trichlorfon
Tricyclazole
Tridemorph
Vernolate
Xylylcarb

Acephate
Acetochlor
Acifluorfen
Alachlor
Allethrin
Ametryn
Amitraz
Azamethiphos
Bensultap
Bentazone
Bromofenoxim
Butroxydim
Chinomethionat
Chlormequat (chloride)
Chloracetic acid
Chlorthiamid
Copper hydrixide
Copper oxychloride
Cucloate
Cyhexatin
Cymoxanil
Cyproconazole
Dazomet
Desmethryn
Dicamba
Dichlormid
Dichlorbenzene
Dichlorophen
Dichlorprop
Diclofop
Dienochlor
Diethyltoluamide
Difenoconazole
Dimepiperate
Dimethachlor
Dimethamethryn
Dimethipin
Dimethylarsinic acid
Diniconazole

Table 4: Technical Grade Active Ingredients of Pesticides Unlikely to Present Acute Hazard in Normal Use (Common name):

Acephate
Acetochlor
Acifluorfen
Alachlor
Allethrin
Dinocap
Diphenamid
Dithianon
Dodine
Empenthrin
Esrocarb
Etridiazole
Fenothiocarb
Ferimzone
Fluazifop-p-butyl
Fluchloralin
Flufenacet
Fluoroglycofen
Flurprimidol
Mecoprop
Mecoprop-P
Mefluidide
Mepiquat
Metalaxyl
Metamitron
Metconazole
Methylarsonic acid
Metolachlor
Myclobutanil
2-Napthyloxyacetic acid
Nitrapyrin
Ametryn
Amitraz
Azamethiphos
Bensultap
Mecoprop
Mecoprop-P
Mefluidide
Bentazone
Bromofenoxim
Butroxydim
Chinomethionat
Chlormequat (chloride)
Chloracetic acid
Chlorthiamid
Copper hydrixide
Copper oxychloride
Nuarimole
Octhilinone
N-octylbicycloheptene
Dicarboximide
Oxadixyl
Paclobutrazol
Pendimethalin
Pimaricin
Pirimiphos-methyl
Prochloraz

Flusilazole	Mepiquat	Propachlor
Flutriafol	Metalaxyl	Propanil
Fomesafen	Metamitron	Propargite
Furalaxyl	Metconazole	Pyrazoxyfen
Glufosinate	Methylarsonic acid	Pyridaben
Hexazinone	Metolachlor	Pyridaphenthion
Hydramethylnon	Myclobutanil	Pyridate
Iprobenfos	2-Napthyloxyacetic acid	Pyrifenox
Isoprothiolane	Nitrapyrin	Quinoclamine
Isoproturon	Ametryn	Quizalofop
Isouron	Amitraz	Resmethrin
Malathion	Azamethiphos	Sethoxydim
MCPA-thioethyl	Bensultap	Simetryn

Annex 5: Sample IPM Plan

Sample IPM Plan

IRRIGA SUBPROJECT NAME AND LOCATION

IPM Plan
SUBPROJECT NAME
PROVINCE
DISTRICT
ADDRESS
PHONE, FAX, EMAIL

INTRODUCTION

Pests are populations of living organism (animals, plants, or microorganism) that interfere with agricultural activities and other facilities for human purposes.

Integrated Pest Management (IPM) is an approach that establishes a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks.

IRRIGA SUBPROJECT XXXX has adopted this Integrated Pest Management Plan for the farm and farming activities, buildings and grounds under its responsibility. The plan outlines procedures to be followed to protect the health and safety of farmers, other workers/contractors/subcontractors and visitors from pest and pesticide hazards. The plan is designed to voluntarily comply with policies and regulations adopted under IRRIGA.

The objectives of this IPM plan include:

- Elimination of significant threats caused by pests to the health and safety of farmers, other workers/contractors/subcontractors, visitors and the public.
- Prevention of loss or damage to crops by pests.
- Protection of environmental quality in and around farming areas.

This IPM plan will be stored in the office of the designated IPM Coordinator for the Subproject.

IPM COORDINATOR

The General Manager/Chief Agricultural Technician of the Subproject or designee shall be the Subproject IPM Coordinator and be responsible to implement the IPM plan and to coordinate pest management-related communications between the Subproject, its partners, service providers, staff and the public.

The General Manager/Chief Agricultural Technician shall designate an employee at the Subproject to serve as the IPM Site Coordinator for the farming and other related activities.

IPM COMMITTEE

The Subproject will maintain an IPM or other safety-related committees with responsibility for annual review of the IPM program and for assisting the IPM Coordinator in resolving pest-related issues. The committee will address IPM issues as needed and at least annually. Minutes will be taken of committee meetings and kept on file by the IPM Coordinator. Membership will include the IPM Coordinator and IPM Site Coordinators, and may also include community members, health advocates, farmers/workers and IRRIGA PIU representatives at the local/district level.

POSTING AND NOTIFICATION OF PESTICIDE APPLICATIONS

The IPM Coordinator shall be responsible to annually notify farmers, other workers/contractors/subcontractors and all interested and affected parties of the procedures for requesting notification of planned and emergency applications of pesticides in the farm and related farming facilities, including the buildings storing agricultural inputs.

When pesticide applications are scheduled in the Subproject Service Providers and staff shall provide notification in accordance with the law, including:

a) Posting a pest control information sign with the date, time and location of the application and the product applied in an appropriate area and including contact information for additional details.
b) Providing this information to all individuals working in the farm site.
c) Providing this information to all farmers, other workers/contractors/subcontractors who have requested notification of individual applications of pesticides.

Where pests pose an immediate threat to the health and safety of farmers, other workers/contractors/subcontractors, the Subproject may authorize an emergency pesticide application and shall notify by telephone and/or any other fast mean of communication any guardian who has requested such notification.

RECORD KEEPING & PUBLIC ACCESS TO INFORMATION

The Subproject will maintain records of all Service Providers' visits and pest control treatments for at least three (3) years. Information regarding pest management activities will be made available to the public at the Subproject's administrative office. Requests to be notified of pesticide applications may also be made to this office. All guardians will be informed of their option to receive notification of all pesticide applications at enrollment and once annually.

TRAINING

All the Subproject staff and personnel will be provided with onsite training on IPM policy at hire and during annual updating training. Training will include the rationale for the IPM policy and program and specific elements including use of the pest-sighting log and prohibition on pesticide applications by non-certified individuals.

Moreover, designated staff including the IPM Coordinator, IPM Site Coordinators and those who conduct regular inspections of the Subproject facilities will receive advanced training on identifying pest infestations and pest-conducive conditions. This training will improve the ability of Subproject staff and personnel to oversee Service Providers and Subproject staff compliance with IPM policy and plan.

GENERAL IPM STRATEGIES

Pest management strategies may include education, exclusion, sanitation, maintenance, biological and mechanical controls, and pre-approved, site-appropriate pesticides.

An Integrated Pest Management decision at the Subproject shall consist of the following steps:

a) Identification of pest species.
b) Estimation of pest populations and comparison to established action thresholds.
c) Selection of the appropriate management tactics based on current on-site information.
d) Assessment of effectiveness of pest management.
e) Keeping appropriate records.

Decisions concerning whether pesticides should be applied in a given situation will be based on a review of all available options. Efforts will be made to avoid the use of pesticides by adequate pest proofing of facilities, good sanitation practices, selection of pest-resistant plant materials, and appropriate agricultural practices.

When it is determined that a pesticide must be used to meet pest management objectives, the least-hazardous material, adequate for the specific context/activity, will be chosen.

All pesticide storage, transportation, and application will be conducted in accordance with the requirement of the WB **OP 4.09 - Pest Management** and the GOM relevant regulations (MASA, MITADER and the MISAU), Subproject defined/adopted policies and procedures, and local rules.

No person shall apply, store, or dispose of any pesticide on Subproject managed facilities without an appropriate pesticide applicator license. All pesticide applicators will be trained in the principles and practices of IPM and the use of pesticides approved for use by the Subproject. All applicators must comply with the IPM policy and follow appropriate regulations and label precautions when using pesticides in or around the Subproject facilities.

Pest-specific strategies will be included in the IPM Program Specifications provided to each service provider.

SUBPROJECT SERVICE PROVIDER ROLES

All Subproject service providers will be guided by written and signed contracts including Subproject developed IPM program specifications for structural pest control providers.

Service providers will be directed to provide special attention to pest-vulnerable areas including input (seeds, equipment, other inputs) storage, preparation and serving areas; and passageways in and around farming areas.

Service providers or other IPM experts will be asked to provide input on any Subproject facility renovation or reconstruction projects including reviewing plans for pest-conducive conditions, suggesting pest-proofing measures and inspecting farms and surrounding areas and farming facilities where applicable to prevent and avoid pest problems.

SUBPROJECT STAFF ROLES

The Subproject administration will provide support to assist the IPM Coordinator in maintaining an IPM program that relies on minimal pesticide use. Such support will include efforts to promptly address any structural, agricultural, or sanitation changes recommended by the coordinator to reduce or prevent pest problems.

Furthermore, the Subproject administration will assist the Coordinator in developing and delivering materials and programs for staff, students, and the public to educate them about the importance of good public health and pest control.

The facility director is responsible for ensuring staff compliance with the IPM policy and plan, including the attached check list (to be developed).

PEST-SPECIFIC STRATEGIES

The following strategies will be used for frequently encountered pests:

1. LOCUSTS (as an example)

a) Locusts species will be identified to aid in locating nesting sites, preferred food, habits and appropriate hazards when necessary.

b) Traditional management: some of methods which are used for control of locust adult and hopper populations by the farmers are as follows: (i) beating or trampling on the hoppers; (ii) digging up egg pods or plowing fields infested with egg pods; (iii) scattering straw over roosting sites and then burning it; (iv) lighting fires or making noise to prevent swarms from settling in crops; (v) driving hoppers into trenches and burning, drowning, or crushing them; and (vi) use of flame throwers

ADD MORE PESTS AS APPROPRIATE. THE DINAS PLANT DISEASE DEPARTMENT CAN ASSIST IN COMPLETING THE PLAN, CONTACT FOR MORE INFORMATION.