REPUBLIC OF MOZAMBIQUE
MINISTRY OF AGRICULTURE

INSTITUTO DE INVESTIGAÇÃO AGRÁRIA DE MOÇAMBIQUE (IIAM)

AGRICULTURAL PRODUCTIVITY PROGRAM
FOR SOUTHERN AFRICA
(APPSA)

PEST MANAGEMENT PLAN
(PMP)

DRAFT

Maputo, December 2012

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**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>APPSA</td>
<td>Agricultural Productivity Program for Southern Africa</td>
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<tr>
<td>CBO</td>
<td>Community Based Organizations</td>
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<tr>
<td>DA</td>
<td>District Administration</td>
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<tr>
<td>DPA</td>
<td>Provincial Directorate of Agriculture</td>
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<td>DPCA</td>
<td>Provincial Directorate of Environmental Affairs</td>
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<td>DUAT</td>
<td>Land use right</td>
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<tr>
<td>IIAM</td>
<td>Institute for Agrarian Research</td>
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<td>IPM</td>
<td>Integrated Pest management</td>
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<td>IPMP</td>
<td>Integrated Pest management Plan</td>
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<tr>
<td>UAS</td>
<td>Umbeluzi Agrarian Station</td>
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<tr>
<td>MCT</td>
<td>Ministry of Science and Technology</td>
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<tr>
<td>MICOA</td>
<td>Ministry of Coordination of Environmental Affairs</td>
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<td>MINAG</td>
<td>Ministry of Agriculture</td>
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<td>MMAS</td>
<td>Ministry of Women and Social Affairs</td>
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<tr>
<td>M&amp;E</td>
<td>Monitoring and Evaluation</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<td>PARPA</td>
<td>Plan of Action for Poverty Reduction</td>
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<td>PMP</td>
<td>Pest Management Plan</td>
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<td>PNISA</td>
<td>National Investment for the Agrarian Sector</td>
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<td>RCoLs</td>
<td>Regional Centres of Leadership</td>
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<td>SADC</td>
<td>Southern Africa Development Community</td>
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</tbody>
</table>
CONTENTS

1. INTRODUCTION ........................................................................................................1
2. PROJECT DESCRIPTION ..........................................................................................2
   2.1. Project Development Objectives and Principles ...........................................2
   2.2. Project Components .......................................................................................2
   2.3. Anticipated R&D project types under APPSA ............................................9
3. PROJECT TARGETED AREAS .............................................................................10
4. POLICY AND INSTITUTIONAL FRAMEWORK ....................................................12
5. PEST MANAGEMENT APPROACH ....................................................................13
   5.1. Current and anticipated pest problems .......................................................13
   5.2. Relevant IPM experience within the project area .......................................14
   5.3. Current pest management practices ............................................................14
   5.4. Pesticides Management ...............................................................................17
6. ENVIRONMENTAL, OCCUPATIONAL AND PUBLIC HEALTH POTENTIAL IMPACTS, MITIGATION MEASURES AND MONITORING ........................................17
   6.1. Move towards IPM .......................................................................................19
   6.2. Authorized pesticides ...................................................................................20
7. INDICATIVE BUDGET ..........................................................................................21
8. ANNEX: PESTICIDES REGULATION ...............................................................22
1. INTRODUCTION

Increased extent of rice crop area associated with APPSA may lead to an increase in pest populations and subsequently a raise in chemicals usage to control these pests in the region. Any increase in pest populations may be detrimental to agricultural productivity or human/animal health, which in turn will augment the dependency on pesticides. Any subsequent increase in the use of chemicals has the potential to cause harm to users, to the public in general, women, children and most vulnerable groups in particular, animals and to the environment.

In the context of this project a pest may be defined as any organism whose presence causes economic loss or otherwise detracts from human welfare. The term covers a broad range of organisms (plant, animals and micro-organisms) that reduce productivity of agriculture. Pest management issues can be raised on a variety of APPSA subprojects such as:

- New land-use development or changed cultivation practices in an area;
- Expansion of agricultural activities into new areas;
- Diversification into new agricultural crops, particularly if these tend to receive high usage of pesticide - e.g. sugar-cane, vegetables and rice;
- Intensification of existing low-technology agriculture systems.

Integrated Pest Management (IPM) based pest management is a mix of ecologically based pest control practices that seeks to reduce reliance on chemicals pesticides. It involves: i) managing pests (keeping them below economically changing levels) rather than seeking to eradicate them; ii) relying, to the extent possible, on non-chemical measures to keep pest populations low; and iii) selecting and applying pesticides, when they have to be used, in a way that minimizes adverse effects on beneficial organisms, humans and the environment (World Bank Pest Management Guidebook – http://go.worldbank.org/JORIVUFRLRO).

This document presents the Pest Management Plan (PMP) to manage potential pest problems that may develop within the APPSA context and help ensure that the use of all pesticides, herbicides, fertilizers and other chemicals associated with the APPSA will be handled properly and in accordance with World Bank Operational Policy - OP 4.09 – Pest Management. According to this policy the PMP is based on the Integrated Pest Management (IPM) approach, which promotes good agricultural practice through the use of responsible and sustainable activities that will result in a reduction in pesticide use. This PMP is focused particularly on rice crop systems to be developed by APPSA throughout its life cycle.
2. PROJECT DESCRIPTION

2.1. Project Development Objectives and Principles

The development objective of APPSA in Mozambique is to enhance the national and regional specialization in agricultural research and technology dissemination for the rice crop, to enhance the regional collaboration in training and dissemination and to facilitate increased sharing of agricultural information, technologies and knowledge beyond borders of other APPSA participating countries.

From the RCoL in Mozambique it is expected that APPSA contributes in such a way that, in a long term perspective, an increase in the adoption of improved agricultural technologies for all the APPSA participating countries is reached, as measured through the increase in the adoption of improved varieties, technologies and better methods of agro processing and handling. It is also expected that the support from APPSA to the RCoL in Mozambique results in an increase of national income due to increased rice production and domestic marketing, and contributes substantially to the reduction of rice imports and, in this way, for a stability of the country balance of payments.

2.2. Project Components

APPSA support to Mozambique will be through an International Development Agency (IDA) credit of US$30 million, with a national counterpart contribution of approximately US$2.2 million.

APPSA in Mozambique includes three components: (1) Technology Generation and Dissemination; (2) Strengthening Regional Centers of Leadership; and (3) Coordination and Facilitation.

Component 1: Technology Generation and Dissemination. Component 1 will finance technology generation and dissemination activities associated with the commodity or commodity group1 being targeted by RCoLs. All activities financed under Component 1 will be undertaken through collaborative R&D projects involving the participation of at least two countries. R&D projects will focus on topics that provide solutions to regional problems. R&D projects will support research, technology dissemination, training, and other activities (e.g., knowledge exchange) that will contribute to enhanced regional collaboration. The proposal for each R&D project will identify a clear objective or specify a well-defined hypothesis and describe a detailed set of activities that will be carried out within a defined time frame and budget. It will outline the collaborative implementation arrangements, detailing the roles responsibilities of the institutions involved and the participating staff. It will include also a results framework that is aligned with the RCoL results framework, as well as an explanation of how performance indicators will be monitored. Every R&D proposal will include a set of activities designed to ensure that technologies generated through APPSA enter the dissemination system and are made available to farmers and other end users.

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1 Research may target the commodity itself, or the larger farming system within which that commodity is produced.
R&D projects will be developed through the following process: (i) for each commodity being targeted by APPSA, priorities will be identified at national level; (ii) for each commodity being targeted by APPSA, regional planning meetings will be convened by CCARDESA to facilitate the identification of regional research and dissemination priorities and preparation of associated sub-project proposals; (iii) a peer review process facilitated by CCARDESA will provide feedback on the relevance and quality of sub-project proposals; and (iv) sub-project proposals will be confirmed and implemented at national level. **Technology Generation Priorities.** Each APPSA participating country will support research relating to the commodity or commodity group being targeted by the RCoL that they are hosting, as well as research relating to the commodities or commodity groups being targeted by RCoLs in other APPSA participating countries. Each country is expected to devote the largest share of its research funds to activities related to the commodity or commodity group being targeted by the RCoL that it is hosting, but a portion of the IDA funds will go to support research on commodities or commodity groups being targeted by RCoLs hosted by other APPSA participating countries.

Research priorities are expected to cover the full range of issues associated with the commodity or commodity group, including germplasm collection and characterization, germplasm improvement (plant breeding), crop management, and post-harvest activities including processing and storage.

**Technology Dissemination Priorities.** The second sub-component will support technology dissemination through a range of activities that link RCoLs to institutions within and across countries to enable scaling up of innovations. Technology generation and dissemination activities will target participation from a range of institutions, in line with FAAP principles of pluralism, and they will aim to strengthen linkages between researchers, extension and end users. Although APPSA is not intended to be a full-fledged dissemination or extension program, it is expected to play an important role in improving and scaling up the technical content, information, and knowledge available within the dissemination system.

Technology dissemination activities supported by APPSA could be expected to focus on:

- Improving the content and accessibility of technology messages and knowledge products around maize, food legumes or rice technologies, including the use of information and communication technologies;
- Improving the capacity of advisory service providers through technical training of lead farmers, extension agents and private or civil society advisory service providers;
- Strengthening the capacity of dissemination officers or technology transfer experts within research institutes to enable them to engage more with farmers, extension agents and advisory service providers;
- Establishing or improving platforms for farmer, private sector and civil society dialogue and consultation around technology priorities;
- Improving farmer-research-extension feedback mechanisms to obtain a better analysis of farmer preferences;
- Regional information sharing and exchange activities with other participating countries;
- Research on technology dissemination methods or tools, including those targeting gender specific issues such as household nutrition and food safety.

APPSA will also support technology multiplication activities by RCoLs to improve the availability of materials for further scaling up by private sector or civil society. This will include seed multiplication at the level of breeder/pre-basic and basic seed production within the research system or initial production in the case of farm implements or machinery.

**Component 2: Strengthening Regional Centers of Leadership.** This component will support core national capacity building activities taking place within the RCoLs and will be driven primarily by the specific needs of each RCoL. In general APPSA will support:

(i) upgrading of research infrastructure including physical infrastructure and equipment;
(ii) improving management and performance systems including knowledge and information systems;
(iii) developing human capital including by providing scientific training at the post graduate level and upgrading skills through short courses or targeted training; and
(iv) strengthening seed, regulatory and related services.

**Mozambique:** Investments in Mozambique will support capacity strengthening, primarily within the **Instituto de Investigação Agrária de Moçambique** (IIAM), but also in the Ministry of Agriculture (MINAG), the Faculty of Agronomy (UEM) and the Ministry of Science and Technology (MCT). To strengthen the capacity of the rice program, IIAM proposes to establish a new research facility around Quelimane in the Zambezia province of central Mozambique. With the help of analysis undertaken by IIAM, potential sites in Nicoadala and Namacurra districts have been identified based on proximity to rice production clusters, accessibility, water quality, and level of investment needs. The preferred site is the location where the rice program is currently undertaking field testing and laboratory analysis in a temporary space. Further feasibility assessments—including a detailed hydrological assessment—are needed to determine which of the potential sites is most appropriate to develop a full-fledged facility. These are expected in draft form prior to appraisal. The size of the new facility will expand the area available for field testing and multiplication to approximately 50 hectares.

APPSA financing will also be used to build laboratory analytical capacity in soil, water and plant analysis; biotechnology; seed quality; Geographic Information System (GIS) and simulation modeling; agro processing and storage; pests and diseases identification; and grain physical and chemical analysis. The RCoL will be staffed with scientists recruited from the CGIAR system, IIAM, and private firms, but gaps have been identified in the areas of molecular biology, agronomy (soil, water and environment), mechanization and agro-processing, and economy, extension, sociology and rural innovation. APPSA will finance post graduate training at the MSc and PhD levels.

Because IIAM has relatively few scientists operating within its headquarters and zonal structures APPSA financing could also be used to finance new research staff on consulting contracts. Measures to transition these positions to the IIAM budget, however, would begin early during implementation. APPSA financing may initially fund 100
percent of newly recruited research staff, but cost sharing measures would be introduced quickly, and by Project closing the salaries of staff will be paid entirely by Government.

**Component 3: Coordination and Facilitation.** This component will finance three main types of activities: (i) research coordination at the national level (to be done by coordination units or teams established in the various implementing agencies); (ii) research facilitation at the regional level by CCARDESA (for example, planning and implementation of regional research and training activities, as well as dissemination of information among the participating countries); and (iii) policy analysis and dialogue to assess what policies are needed to facilitate technology generation and dissemination activities within the region.

**National Level Coordination and Management:** APPSA financing will be provided at the national level to pay for costs related to the coordination of national and regional aspects of the Project (travel, meetings); management and administration costs (including consultants or staff where gaps exist); and national level monitoring and evaluation.

**Regional Facilitation by CCARDESA:** At the regional level, the Project will finance regional facilitation activities including: (i) regional planning, monitoring and evaluation activities needed to establish and monitor regional collaborative activities; and (ii) regional exchange of information, knowledge and technologies. CCARDESA will play an important role in facilitating the development of collaborative research sub-projects, as well as in facilitating peer review and quality control. Financing for the regional facilitation function will be sourced from each participating APPSA country on the basis of a work plan and budget envelope agreed at appraisal stage.

**R&D Policy Analysis and Dialogue:** APPSA financing will support analytical work, needs assessments, and policy dialogue or policy harmonization activities on key areas that affect R&D at national and regional level. This includes issues such as intellectual property rights, progress the implementing the SADC common seed certification system or biosafety regulations.

**Support for SADC Regional Seed Regulatory System.** SADC is currently in the process of rolling out its harmonized seed regulatory system, which is expected to (i) strengthen systems and structures for seed inspection, testing, and certification across the region; (ii) establish a regional variety release catalogue; and (iii) strengthen alignment of national seed systems to SADC harmonized seed policy. APPSA investments in Component 2 at the national level are expected to support the national seed authorities in Malawi, Mozambique, and Zambia in building their capacity and aligning national legislation and regulatory systems to the harmonized regional system. Additional support may be provided under Component 3 at the regional level for support by the SADC Seed Center in facilitating these activities, particularly in technical assistance and capacity building; information and knowledge management; and addressing policy gaps in intellectual property rights.

APPSA support for regional activities related to seed will be channeled through CCARDESA. It will reflect the priorities identified in the five-year strategic plan for the SADC Seed Center, which is currently in draft form, but which is expected to be validated and endorsed in early to mid-2013.
Components 1 and 2 raise the principal safeguards issues associated with the project.

Taking into consideration the regional nature of APPSA, the main research themes/priorities take into consideration the following aspects: a) the strategic importance of rice in Mozambique to balance the country imports and exports (PEDSA), b) regional (CCARDESA) and Global Priorities (GRISP) on Research and Development of Rice in Africa and the World, and c) the common rice research needs identified for the three countries participation in the APPSA programme. The seven research priorities defined for the APPSA in Mozambique are:

1. **Genetic diversity of rice in the country**
   
   Objective: collect, characterize, register, manage and conserve genetic pool of the rice crop as means of protecting local genetic diversity. Main results to be achieved with this research theme are:
   
   (a) Germplasm collected;
   
   (b) Country local germplasm diversity collected, characterized, mapped and registered;
   
   (c) Gene banks for conservation and dissemination created;
   
   (d) Genetic diversity for the relevant characteristics for rice breeding studied.

2. **Rice improvement**

   Objective: Accelerate the development, availability and adoption of more productive varieties of high quality and nutritive value and adapted to biotic and a-biotic factors. Main results to be achieved with this research theme are:

   (a) Varieties adapted to different production systems, with the cooking qualities demanded by the local and regional market (aromatic, long grain, translucent, intermediate amylase content, high head rice recovery) developed;
   
   (b) Varieties for intensive production systems developed;
   
   (c) Hybrids for commercial farming developed;
   
   (d) More healthy and nutritive varieties developed;
   
   (e) Varieties tolerant to diverse biotic and a-biotic factors (pests and diseases, water stress, thermal regime, salinity/sodicity and other toxicities) and adapted to climatic changes developed;
   
   (f) Varieties with wide regional adaptation developed;
   
   (g) Breeder seed produced and maintained.
3. **Agronomy, water and production systems management**

Objective: Develop strategies, crop practices and high productivity technologies taking into account the sustainable management of different rice production systems. Main results to be achieved with this research theme are:

(a) Sustainable rice production systems that are profitable, efficient and viable for specific local production conditions developed;

(b) Efficiency of water use in the rice fields improved;

(c) Integrated soil fertility and water management for the specific conditions of each location (irrigated and rain fed rice) developed;

(d) Crop practices and measures of control conducive for high productivity of irrigated and rain fed rice (direct seeding/transplanting, dates of seeding/transplanting, population density, fertilizer, pest control, diseases and weeds) identified and tested;

(e) Land preparation technology aiming at better water soil fertility management and weeds control improved;

(f) Conservation Agriculture technologies for upland production ecosystems tested;

(g) Impact of climatic changes expected in the rice production systems studied;

(h) Agriculture practices and mechanisms that allow to increased capacity of adaptation to climatic variability and changes developed and tested.

4. **Agricultural mechanization**

Objective: Develop and test appropriate machineries and agricultural implements to support the different activities of the rice production cycle. Main results to be achieved with this research theme are:

(a) Machineries and agricultural tools of different technology levels for pre harvest operations developed and tested;

(b) Machineries and agricultural tools of different technology levels for post harvest operations developed and tested;

(c) Local artisans and operators for operation and maintenance of appropriate agricultural equipment for rice crop production, trained.

5. **Post-harvest technologies**

Objective: Add value to rice post-harvest products, through improvement of quality, more innovative and efficient processing, access to markets and development of new products based on rice. Main results to be achieved with this research theme are:
Technologies and business models for rice post-harvest products in order to increase the post-harvest revenue, the product quality and its market value developed;

Other food products based on rice developed;

Innovative uses for rice byproducts (straw, husk and bran) developed;

Packaging for a more attractive display in the market improved.

6. **Socio economic studies, market search, and impact evaluation**

Objective: Understand, characterize and evaluate existing farming systems and identify the needs for products and technology development that satisfy farmers and market needs in order to enhance their impact. Main results to be achieved with this research theme are:

(a) Social economic organization forms that maximize the productivity and farmers income studied;

(b) Socio economic studies in different rice production regions to identify and evaluate the technological needs for farmers and consumers realized;

(c) Market studies to quantify the rice demand (types, tastes and quality, new products derived from rice, use of byproducts and residues and its degree of quality) realized;

(d) Strategic vision for research and development priorities for each period established;

(e) Impact of research in the development of rice crop evaluated;

(f) Contribution of innovations for the country balance of payments, for Mozambique and other APPSA participating countries, evaluated;

(g) Data base on research results and technological advancements with the rice crop, which can be used at national and regional level, produced.

7. **Innovation and technology development**

Objective: Support the development of the rice sector in Mozambique and in the Region, through the research and development achievements and impacts of APPSA. Main results to be achieved with this research theme are:

(a) Innovative tools for training and communication produced;

(b) Technology extension and dissemination capacity developed;

(c) Sustainable and user friendly Rice technology packages developed;

(d) Effective systems for wide scale adoption of sustainable and viable technologies for rice production, agro-processing and added value, for the country and the region, established.
For the implementation of the above mentioned research thematic areas there will be need to create specialized and support services such as laboratories, green houses and other technological instruments to allow an effective rice research and development in the context of the objectives established for the APPSA. The following support services are previewed:

(a) Soil, water and plant analysis,
(b) Biotechnology products,
(c) Quality control and seed maintenance,
(d) Use of GIS and simulation models,
(e) Agro-processing and storage,
(f) Identification of pests, diseases and weeds,
(g) Chemical and physical analysis of the rice grain,
(h) Meteorology: collection, processing and data analysis.

These specialized services, apart from their primary function to support rice research and development, can also play an important role in service provision, in terms of analysis, diagnosis and recommendations for other agricultural commodities and entities, either public or private, and therefore be a source of revenue for the RCoL.

2.3. **Anticipated R&D project types under APPSA**

Under the context of APPSA the following sub-projects may have an impact on the biophysical and social environment. Potential impacts from these sub-projects are identified in Chapter 8 of the ESMF document.
Table 1. Potential Sub-projects to be financed by APPSA

<table>
<thead>
<tr>
<th>Sector</th>
<th>Sub-projects with potential negative environmental and social impacts</th>
<th>Sub-projects with potential positive environmental and social impacts</th>
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<tbody>
<tr>
<td>Water supply</td>
<td>• Construction/rehabilitation of small dams or weirs</td>
<td>• Construction of flood and drainage related infrastructure</td>
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<td></td>
<td>• Rehabilitation and/or construction of small- scale irrigation and drainage systems</td>
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<tr>
<td>Transportation</td>
<td>• Rehabilitation of access roads</td>
<td></td>
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<tr>
<td>Agriculture and market</td>
<td>• Increased area of rice production</td>
<td>• Promote improved agriculture technologies</td>
</tr>
<tr>
<td></td>
<td>• Construction of small Agro-processing facilities</td>
<td>• Promote conservation agriculture</td>
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<tr>
<td></td>
<td>• Use of agriculture machinery</td>
<td>• Promote IPM approach</td>
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<td></td>
<td>• Testing of different technologies (land preparation, water and soil conservation, pest control, etc)</td>
<td></td>
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<tr>
<td>Infrastructures</td>
<td>• Construction and/or rehabilitation of infrastructures such as laboratories, agro-processing facilities, etc</td>
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3. PROJECT TARGETED AREAS

APPSA will be implemented over a six-year period across 4 candidate IIAM research stations in northern, central and southern Mozambique. Most likely the research stations will be located in Namacurra and Nicoadala (Zambézia Province), Sussundenga (Manica), Nampula (Nampula), Chockwé (Gaza) and Umbelúzi (Maputo) (Figure 1). The Rice CoL headquarters will be located in Namacurra, where new facilities will be built and experimental land of about 50 ha acquired. A number of small-holder farms (to be identified) will also be involved as on-farm experiments.

Overall, targeted areas are located in 5 agro-ecological regions of the country, namely: R1 (Boane-Maputo), R3 (Chockwe-Gaza), R4 (Sussundenga-Manica), R5 (Namacurra and Nicoadala-Zambezia) and R7 (Nampula-Nampula). The environmental description of each zone is presented in Chapter 4 of the ESMF document.
Figure 1: Potential Location of APPSA targeted areas
4. POLICY AND INSTITUTIONAL FRAMEWORK

Mozambique has enacted good pesticide legislation (Ministerial Diploma 153/2002 of 11 September 2002) but the capacity to enforce the legislation is weak (see Annex below, as well as Chapter 6 of the ESMF for much detailed description). According to this legislation only pesticides registered with the National Directorate of Agrarian Services (DNSA) can be used in Mozambique. These include a list of pesticides products that are classified according to their toxic potential (Article 9). Of the 188 registered pesticides, 109 are class III; 67 class II and only 12 Class I (Class I being the most toxic ones). Composition and physical-chemical characteristics of the pesticides proposed for registration conform to the specifications from the World Health Organization (WHO) or the United Nations Food and Agricultural Organization (FAO) and must appear on the label. The regulation requires also proper packaging and handling which meet the necessary requirements regarding occupational safety.

Emphasis is currently placed on the identification, classification, proper storage and disposal of obsolete pesticides of which 900 tones are believed to be stored under poor conditions throughout Mozambique.

Another legal instrument that applies is 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 aims at controlling and maintaining the level of concentration of pollutants at an admissible level for soils and water. The Ministry for the Coordination of Environmental Affairs (MICOA) is responsible for ensuring compliance with this Regulation.

There are no specific policies with regards to pest management and crop protection in the context of IPM approaches in Mozambique. Research into plant health and to a certain extent IPM approaches were carried out by National Agrarian Research Institute (IIAM) and the Eduardo Mondlane University (UEM). Currently IPM approaches in the field are at an early stage in Mozambique with reliance more the use of conventional pesticides.

Institutional capacity is represented at central, provincial and district levels. At the central Level and according to Pesticides Regulations Ministerial Diploma 153/2002 DNSA of the MINAG, through its Registration Unit is the official agency responsible for the registration of the pesticides and the issue of permits for their use, after approval by the National Directorate of Health (DNS/MISAU), the National Directorate for Environmental Impact Assessment (DNAIA/MICOA) and the National Institute for Agrarian Research – Department of Animal Science (IIAM/DCA).

MINAG has established a Technical Advisory Committee which provides advice on issues related to the Pesticide Regulations. This Committee includes representatives from various departments within MINAG and other Institutions (MICOA, MISAU, the National Institute for Standardization and Quality-INNOQ) as well as the private sector.
The Provincial Directorate of Agriculture (DPA) through the Agricultural Services is the institution with the responsibility of inspecting if users have a use, handling or transportation permit. It also should monitor the use and impact of pesticides from agricultural activities and report to DPCA. At the district level pesticide use, handling and transportation is controlled by SDAE, which works with an extension team in providing training for farmers in this matter.

Overall the capacity to deal with pesticides is weak in Mozambique. The above mentioned institutions face limited human, material and financial resources to carry out their activities. For example, pesticide residues are not being monitored on export crops and crops for the domestic market; poisoning statistics by pesticides are not available; and medical staff at rural clinics is not trained to recognize and treat pesticide poisoning and antidotes are not available in rural areas.

In the context of APPSA the consultant suggests to rely on some of the strategic partners such as private companies (Empresa Orizícola da Zambézia, in Zambézia) and NGOs to successfully implement this PMP. A strategy that is being adopted in some districts is the selection of a Contact Farmer who is trained by SDAE/extension worker and has the responsibility of transferring information to the rest of the community. Also, several NGOs and private companies (Empresa Orizícola da Zambézia, in Zambézia) have their own extension teams that collaborate with government in providing extension services. Building upon FAO experience, farmer-field schools are also been used to ensure on-the ground training on how to properly deal with pest management.

5. PEST MANAGEMENT APPROACH

This section presents the current and anticipated pest problems relevant to APPSA, relevant IPM experience within the project area, assessment of proposed or current pest and pesticide management approach and recommendations.

5.1. Current and anticipated pest problems

In general pest attack is low in the APPSA targeted areas, but there is a range of pests, diseases and weeds reported by farmers, officials and the literature. Table 1 summarizes the current pests for rice present or suspected to be present in the targeted areas. The current impact from these pests is low (sometimes unknown or inexistent), except perhaps several birds that attack the areas during harvesting. However, the expected increase in rice crop area extent in the APPSA sites will likely reverse that situation and some pests may become a major economic problem, especially for areas such as Zambézia where rice cultivation is broadly adopted by the farmers. With APPSA more and more farmers may either adopt the farming system or expand their areas and, thus an increase in pest control measures will be needed for this project. Table 1 summarizes some control measures (chemical, cultural and biological) for each crop that can be used in case an outbreak is observed.
In all areas current pest occurrence and pesticide use is currently low but increase in crop area may result in a raise of pest occurrence, especially birds, red locust and rats. These are currently reported to be the major pests in these areas.

Rehabilitation or construction of the irrigation schemes will increase dry season irrigation and thus will allow for a second rice campaign. This may cause the following potential impacts:

- Stalk borers, brown plant hopper and armyworm could increase but the result should not be more insecticide application than currently exists in the command area since less than half the farmers apply only one or more sprays per season;
- Rice diseases are unimportant at the moment but because of the increased cost base of the irrigated rice, farmers/IIAM will be more willing to apply a fungicide to protect their investment. Blast and brown spot could increase in two rice crops per year are grown. There is no reason to believe that fungicide use will be greater than the very low levels that already exists in the area.
- The same consideration applies to weeds as to diseases.

5.2. Relevant IPM experience within the project area

There is a fair amount of knowledge regarding to IPM in the APPSA command area, but it is rarely put into practical use. This is because it is believed that chemicals are more efficient than any other cultural practices they may adopt. However, contacted farmers refer no major pest outbreaks in the area and thus no chemicals have been used.

5.3. Current pest management practices

At present pest and disease control is limited by a combination of limited knowledge, lack of equipment and supplies and lack of finance. IIAM take various measures to minimize or avoid pest infestations such as weeding and application of insecticides and herbicides. Weed control is generally 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. In relation with use of agro-chemicals by farmers, the extension service of the Provincial Directorate of Agriculture (DPA) provides training in the areas which includes among others: type and amount of pesticide per crop and poisonous effects of pesticides on humans, animals and the environment. However the extension network is poor and the workers face several limitations to properly conduct their work.

Control of birds is mainly done by using the traditional way of scaring (the use of scarecrow in very common especially in rice production areas), chasing and guarding of animals.
<table>
<thead>
<tr>
<th>Crop</th>
<th>Common name</th>
<th>Scientific name</th>
<th>Pests</th>
<th>Control methods*</th>
<th>Diseases</th>
<th>Control measures*</th>
<th>Weeds</th>
<th>Control methods*</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice (Oryza sativa - Gramineae)</td>
<td></td>
<td></td>
<td>Spotted Stalk borer</td>
<td>Chilo partellus (0.5ml/l), carbaryl, diazinon, endosulfan, fenthion.</td>
<td>Rice blast</td>
<td>Pyricularia oryzae</td>
<td>Chemical: Mancozeb (140g/100kg of seed) or other fungicide (Sulphur). Cultural: on time harvesting, use resistant varieties.</td>
<td></td>
<td>Chemical: Oxadizon (3-4l/ha), propanil (8-12l/ha). Cultural: transplantation in a clean field, use of non infested seeds, fertilization at the right time, crop rotation (with other family crops) and maintenance of the water level in the field.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pink Stalk borer</td>
<td>Sesamia calamistis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White rice borer</td>
<td>Miliarpha separatella</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stalk-eyed fly (Stalk-eyed borer)</td>
<td>Diopsis thoracica</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>African armyworm</td>
<td>Spodoptera exempta</td>
<td></td>
<td>Chemical: Carbaryl (3g/l), cypermethrin (0.5ml/l), diazinon (1.5ml/l). Cultural: destruction of crop residues and well spaced plants.</td>
<td></td>
<td>Brown spot</td>
<td>Drechslera oryzae=Helminthosporium oryzae</td>
<td>Chemical: Mancozeb (140g/100kg of seed). Cultural: avoid high humidity in the field, destruction of crop residues.</td>
<td></td>
<td>Chemical: bentazona+propanyl (2-4l+8-12l per Ha), MCPA+propanyl (3.5l+8-12l per Ha). Cultural: (See Annual grasses).</td>
</tr>
<tr>
<td>Rice hispid</td>
<td>Trichispa sericea</td>
<td>Chemical: insecticide is not effective. Cultural: destruction of infested crop material and crop residues Biological: use of fungus Beauvaria sp.</td>
<td></td>
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</tr>
</tbody>
</table>

Table 1. Common pests, diseases, and weeds in the APPSA targeted area
<table>
<thead>
<tr>
<th>Crop</th>
<th>Pests</th>
<th>Diseases</th>
<th>Weeds</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Common name</td>
<td>Scientific name</td>
<td>Control methods*</td>
<td>Common name</td>
</tr>
<tr>
<td>Grasshoppers</td>
<td>Homorocorypus nitidulus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical: Carbaryl (4g/l), fenitrothion (660ml/ha), chlorpyrifos (2ml/l), deltamethrin (0.6ml/l)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biological: fungus Metarhizium anisopliae (250ml/ha)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black maize beetle (sugar cane beetle) or black wheat beetle</td>
<td>Heteronychus spp.</td>
<td></td>
<td>leaf spot Khuskia oryzae</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical: dieldrin sprays applied to the soil before planting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cultural: destruction of crop residues</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutworm</td>
<td>Agrotis ipsilon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical: Cypermethrin (1ml/l), chlorpyrifos (2ml/l), diazinon (2ml/l). Cultural: weed destruction, flooding the infested field and drain quickly, deep ploughing.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice weevil</td>
<td>Sitophilus oryzae (L.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical: malathion and methyl bromide (for infested grain).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red billed</td>
<td>Quelea quelea</td>
<td></td>
<td>Seed rot Fusarium spp. And other fungi</td>
<td>Longstamen rice Oryza longistaminata</td>
</tr>
<tr>
<td></td>
<td>Chemical: Fenthion (2-8ml/ha)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Rat</td>
<td>Praomys natalensis</td>
<td></td>
<td></td>
<td>Red rice Oryza sp. Chemical: glyphosate (4-6l/ha), paraquat (3-4l/ha). Cultural: (See Annual grasses).</td>
</tr>
<tr>
<td>Red locust</td>
<td>Nomadacris septemfasciata</td>
<td></td>
<td></td>
<td>Red locust is a sporadically serious pest in Central Mozambique</td>
</tr>
<tr>
<td></td>
<td>Chemical: air plane sprays with carbaryl or dieldrin. Preventive: monitoring the locust activity in outbreak areas.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.4. Pesticides Management

Field observations indicate that although farmers are aware that pesticides are poisonous and they are not being used for rice farms, their responses for other crops still create a major occupational health and environmental risk. In particular some pesticides are often sold in non-standard containers without proper instructions, effective protective clothing and equipment is seldom available (if it exists), on-farm storage sites are highly hazardous (sun and rain exposure), used containers are washed-out in local water bodies and the containers re-used. Conversations with farmers reveal limited knowledge and application of safety practices. At the IIAM level, all the research stations visited have appropriate storage and handling conditions.

Data on pesticides poisoning and environmental contamination are not available or difficult to obtain since no regular system exists for regular monitoring of the risks. Moreover, medical staff at rural clinics is not trained to recognize and treat pesticide poisoning, and antidotes are not available in rural areas.

The main pesticide management problem in the APPSA targeted area is the non-adequate monitoring of pesticides use and handling.

Overall there is a need to consider that the current pest and pesticide management practices within the APPSA command areas are deficient and even though they are practiced for other crops, the consultant recommends the following:

- Promote IPM within APPSA area (See table 1 for detailed biological and cultural control measure per crop);
- Promote the use of precautionary measures such as the use of protective clothing and proper equipment, cleaning of spray equipment, wash after completing spraying activities and observing re-entry points, observation of expiration dates, disposal of containers and waste in general, among others;
- Awareness raising and sensitization training on application methods and IPM practices;
- Promote the design and implementation of monitoring plans that include pesticide control.

6. ENVIRONMENTAL, OCCUPATIONAL AND PUBLIC HEALTH POTENTIAL IMPACTS, MITIGATION MEASURES AND MONITORING

This section deals with the impacts associated with the increases in the use of agricultural pesticides that may result from changes in agricultural practices and intensities (Table 2). The impacts expected from this project are specially associated with the current pesticide management practices identified in section 3.3. Thus mitigation measures are designed to avoid the use of, or properly manage chemical use and improve IPM in the region. The strategy for the implementation of suggested mitigation measures is therefore to utilize the existing structure of DAPS in which the extension team supervises and trains farmers in the use of chemicals. There is a need to promote current practice of keeping chemical use at a minimum. At the IIAM level
there is also a need for capacity building in issues of agro-chemicals storage and handling. For aspects in which expertise has not yet been developed the strategy is to utilize technical assistance provided by APPSA.

The objective of this section is to ensure that:

- Any intensification of agriculture practices does not result in any increase in the use of agricultural chemicals;
- The farmers through IIAM have support and advice in pest and soil management for coping with their new pattern of agriculture; and
- The supply of food for the construction and operation work force is safe in terms of pesticide minimum residue level and has been produced with the attention to human and environmental safety.

### Table 2. Potential impacts, mitigation measures and indicators of monitoring

<table>
<thead>
<tr>
<th>Pesticide management issue</th>
<th>Potential impact</th>
<th>Mitigation measure</th>
<th>Indicators of monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessive use of (out-of-dated) chemicals, disposal of containers in rivers and stream, use of non-authorized and/or non-labeled pesticides.</td>
<td>Decrease in water quality for consumption and irrigation</td>
<td>- Regulatory application of pesticides (type, labeling and quantity); - Promote recycling of containers; - Monitor aquatic biodiversity and weeds.</td>
<td>Number of farmers using pesticides properly (observing expiration dates and dosages); Number of aquatic weeds; Abundance (a/ha) of plant resource species (e.g medicine, food); Patterns of water quality referred in the regulation (Decree 18/2004)</td>
</tr>
<tr>
<td></td>
<td>Proliferation of aquatic weeds</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Loss of biodiversity in particular of aquatic species</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive use of (out-of-dated) chemicals, use of non-authorized and/or non-labeled pesticides</td>
<td>Increase in soil toxicity</td>
<td>- Regulatory application of pesticides (type, labeling and quantity); - Promote the use of cultural and biological control measures (Table 1).</td>
<td>Patterns of soil quality referred in the regulation (Decree 18/2004) Number of farmers using biological and cultural measures.</td>
</tr>
<tr>
<td>Pesticide management issue</td>
<td>Potential impact</td>
<td>Mitigation measure</td>
<td>Indicators of monitoring</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------</td>
<td>-------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Excessive use of (out-of-dated) chemicals, use of polluted water</td>
<td>• Poor crop yield; • Unacceptable levels of pesticide residues in harvested produce and in the food chain.</td>
<td>• Regulatory application of pesticides (type, labeling and quantity); • Promote the use of cultural and biological control measures (Table 2)</td>
<td>Productivity per crop; Quality of the product; Number of farmers using biological and cultural measures.</td>
</tr>
<tr>
<td>Use of empty pesticide’s packages, washed and disposed in rivers, consumption of polluted water, excessive use of chemicals</td>
<td>poisoning of workers/farmers and detrimental effects on human health</td>
<td>• Promote the recycling of packages; • Regulatory application of pesticides (type, labeling and quantity); • Monitor aquatic biodiversity and fishing activity; • Promote first aid training to farmers.</td>
<td>Observed changes in the following areas: Number of farmers recycling containers; Number of packages washed and disposed in rivers; Patterns of water quality referred in the regulation (Decree 18/2004); Fishing yields; Number of farmers trained in first aid.</td>
</tr>
<tr>
<td>Application without protective equipment</td>
<td>increased number of accidents and injuries</td>
<td>• Promote the use of protective equipment; • Promote first aid training</td>
<td>Number of workers/farmers using protective equipment; Number of workers/farmers trained in first aid; Number of accidents/injuries per season.</td>
</tr>
</tbody>
</table>

Overall, pesticide misuse may also result in: (i) Elimination of the natural enemies of crop pests and consequent loss of natural pest control that keeps the populations of crop pests very low; and (ii) Development of pest resistance to pesticides, encouraging further increases in the use of chemical pesticides.

6.1. Move towards IPM

To mitigate the impacts identified in Table 2 the overall approach of APPSA should be to keep pesticide use at a minimum or avoid it and any necessary use is intelligent and considered part of an IPM approach in line with OP 4.09. The exact IPM approach should be defined according to site conditions and capacity of the farmers to adopt and implement new techniques.
The Objectives of an IPM approach are:

- Embed IPM in the project key components of (i) technology generation and dissemination and (ii) practical element affecting all aspects of extension and training;
- Establish an IPM delivery system from research to farmer;
- Implement participatory approaches in IPM for farmers to learn, test, select and implement IPM options to reduce losses due to pests and diseases;
- Establish a monitoring system that provides early warning on pest status, beneficial species, regular and migratory species;
- Collaborate with other IPM programmes in the region.

A significant factor that will constrain uptake of IPM practices is the attitude that pesticides are modern “medicines” that provide fast and effective cure for all problems affecting a crop. Thus the success of any IPM strategy depends not only on the ability of APPSA to define an IPM program and link with strategic partners (private companies or NGOs) but also on the capacity of the different actors (government, extension service, farmers, strategic partners) to fulfill their commitments in these areas. The latter requires some investment in training and capacity building in several topics of IPM and also this PMP implementation as referred in the main document (Chapter 11 – Training and capacity building requirements). It is recommended that APPSA hire an experienced IPM specialist to act as both principal technical resource person and facilitator (for training), for which national expertise is available.

The focus on monitoring and evaluation must be on assess the buildup of IPM capacity, the extent to which IPM techniques are being adopted in crop production and the economic benefits that farmers derive by adopting IPM. Indicators for monitoring IPM adoption are:

1. Number of farmers who have adopted IPM practices;
2. Number of IIAM workers/farmers who have received training in IPM methods;
3. Number of crops in which IPM is applied;
4. Economic and social benefits;
5. Extent of area in which pesticides are used;
6. Efficiency of pesticide use and handling;
7. Level of reduction of pesticide purchase

### 6.2. Authorized pesticides

Unless the project switches to and enforces an organic approach, it is inevitable that pesticides will be recommended for use on some sites. Under the World Bank funding for APPSA, no funding for pesticide acquisition will be provided. However, it would be of consideration the development of a provisional list of pesticides that can be used. A list registered pesticides in Mozambique is provided as an Annex of the Pesticide Regulation (Ministerial Diploma 153/2002
of 11 September 2002) and include among others: cypermethrin, deltamethrin, mancozeb and dimethoate.

7. **INDICATIVE BUDGET**

The costs of PMP implementation will depend on the scale and details of the programme eventually agreed, but the estimated budget for the implementation of this PMP is estimated at **USD$ 253,000** (Table 3).

**Table 3. Estimated budget for PMP implementation**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Annual Amount (*1000 USD)</th>
<th>Total (USD 000)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orientation workshops about IPM</td>
<td>15</td>
<td>15</td>
<td>1 workshop per province</td>
</tr>
<tr>
<td>Training of trainers</td>
<td>25</td>
<td>38</td>
<td>1 TOT for 15 days per province and one refresher in the middle</td>
</tr>
<tr>
<td>IIAM workers/Farmers training</td>
<td>10 10 10 10 10</td>
<td>50</td>
<td>1 training of one week per district per year</td>
</tr>
<tr>
<td>Technical assistance</td>
<td>15 15 15 15 15</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Monitoring and evaluation</td>
<td>15 15 15 15 15</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>50 40 40 53 40 30</td>
<td>253</td>
<td></td>
</tr>
</tbody>
</table>
8. ANNEX: PESTICIDES REGULATION

Ministerial Diploma 153/2002 of 11 September 2002 regulates the use of pesticides in Mozambique. In terms of this regulation only those pesticides registered with the National Directorate of Agricultural Services (DNSA) may be used. DNSA has established a Registration Unit (RU) for the registration of the pesticides and the issue of permits for their use. All substances with a pesticide action or regulators of plant growth and which are to be imported, produced, commercialized and used in Mozambique must be registered. The request for registration must be submitted together with the pesticide's process according to the Standards for Registration and Handling of Pesticides published by DNSA.

Concurring with OP 4.09, the composition and physical-chemical characteristics of the pesticides proposed for registration shall conform to the specifications from the World Health Organization (WHO) or the United Nations Food and Agricultural Organization (FAO) and must appear on the label.

Any company legally established in Mozambique may obtain a title for the registration of pesticides, after approval by the Ministries of Industry and Commerce, Agriculture, Coordination of Environmental Affairs and Health. Registered companies must assume full technical and environmental responsibility of the pesticides. The validity of the title is 2 years, after which it can be renewed.

Pesticides that are not registered but are considered effective in the control of an emergency situation due to an outbreak of epidemics or a plague, can be used with a Permit for Emergency Use, given by the RU according to the Standards for the Registration and Handling of Pesticides. These permits have the validity of the emergency period.