Public Disclosure Authorized

Public Disclosure Authorized



**UNITED REPUBLIC OF TANZANIA**

# Expanding Rice Production Project - ERPP

## INTEGRATED PEST MANAGEMENT PLAN

## (IPMP)

**July 2014**

**TABLE OF CONTENTS**

**Abbreviations and Acronyms**

| | |
|---|---|
| ASA | Agricultural Seed Agency |
| ASDP | Agricultural Sector Development Programme |
| ASP | Agriculture Services Providers |
| ASSP | Agricultural Services Support Programme |
| BRN | Big Results Now |
| CAADP | Comprehensive Africa Agriculture Development Program |
| CBAF | Community Based Armyworm Forecasting |
| CBD | Coffee Berry Disease |
| CBO | Community Based Organisation |
| CBSD | Cassava Brown Streak Disease |
| CLR | Coffee Leaf Rust |
| DPP | Director Policy and Planning |
| DPPO | District Plant Protection Officer |
| DRDP | District Rural Development Programme |
| EIA | Environmental Impact Assessment |
| EMA | Environmental Management Act |
| EMU | Environment Management Unit |
| ERPP | Expanding Rice Production Project |
| FAO | Food and Agriculture Organisation |
| FFS | Farmer Field Schools |
| GAFSP | Global Agriculture and Food Security Program |
| GoT | Government of Tanzania |
| GTZ | Gesellschaft fur Technische Zusammenarbeit |
| HPR | Host Plant Resistance |
| ICIPE | International Centre of Insect Physiology and Ecology |
| IFAD | International Fund for Agricultural Development |
| IPPC | International Plant Protection Convention |
| IPM | Integrated Pest Management |
| IPMP | Integrated Pest Management Plan |
| IPN | Integrated Plant Nutrition |
| JSC | Joint Steering Committee |
| JICA | Japan International Cooperation Agency |
| KAEMP | Kagera Agricultural Environmental Management Project |
| KATRIN | Kilombero Agricultural Research and Training Institute |
| LVEMP | Lake Victoria Environmental Management Project |
| M&E | Monitoring and Evaluation |
| MAFC | Ministry of Agriculture and Food Security |
| MANR | Ministry of Agriculture and Natural Resources |
| MARA-FIP | Mara Region—Farmers' Initiative Project |
| MKUKUTA | Mkakati wa Kukuza Uchumi na Kuondoa Umaskini |
| MKUZA | Mkakati wa Kukuza Uchumi Zanzibar |
| MRL | Maximum Residue Levels |
| NAIVS | National Agricultural Input Voucher System |
| NEMC | National Environment Management Council |
| NSGRP | National Strategy for Growth and Reduction of Poverty |
| NPPO | National Plant Protection Officer |
| OPEC | Organization of Petroleum Cooperation |

| | |
|---|---|
| PDO | Project Development Objective |
| PHS | Plant Health Services |
| PMO-RALG | Prime Minister's Office - Regional Administration and Local Government |
| PMP | Pesticides Management Plan |
| POP | Persistent Organic Pollutants |
| PPD | Plant Protection Division |
| PRA | Participatory Rural Appraisals |
| RAS | Regional Administrative Secretary |
| RYMV | Rice Yellow Mosaic Virus |
| SMS | Subject Matter Specialist |
| SpexNPV | Spodoptera exempta nucleopolyhedrovirus |
| TAFSIP | Tanzania Agriculture and Food Security Investment Plan |
| TOSCI | Tanzania Official Seed Certification Institute |
| TPRI | Tropical Pesticides Research Institute |
| ULV | Ultra Low Volume |
| URT | United Republic of Tanzania |
| VEO | Village Extension Officer |
| WHO | World Health Organization |
| WTO | World Trade Organization |
| WTO SPS | World Trade Organization Sanitary and Phytosanitary |
| ZARI | Zanzibar Agriculture Research Institute |
| ZARDI | Zonal Agriculture Research and Development Institutes |

## EXECUTIVE SUMMARY

1. The Expanding Rice Production Project (ERP) aims to increase the productivity and production of ricein targeted areas of Morogoro and Zanzibar. With an allocation of US$ 22.9 million from the Global Agriculture and Food Security Program (GAFSP), the Project will contribute to the implementation of the Tanzania Agriculture and Food Security Investment Plan (TAFSIP) under the Comprehensive Africa Agricultural Development Programme (CAADP). The Project will also contribute to the implementation of the professionally managed collective rice irrigation and marketing schemes under the national Big Results Now (BRN) initiative. The Project will be implemented by the Ministry of Agriculture, Food Security and Cooperatives (MAFC) in the Morogoro Region of Mainland Tanzania, and the Ministry of Agriculture and Natural Resources (MANR) in Zanzibar.

2. The activities funded under the ERP may lead to the increased use of agricultural pesticides, inter alias, in the sector. This Integrated Pest Management Plan (IPMP) has been prepared in order to ensure the Project is managed in compliance with the World Bank's Operational Policy OP 4.09 on Pest Management, and with the related safeguard requirements of the Government of the United Republic of Tanzania (GoT). The IPMP includes proposals for effective and sustainable integrated pest management relating to rice production and marketing systems extending beyond the lifetime of the Project.

3. This IPMP briefly summarizes current knowledge of the incidence of rice pests in the cropping and marketing systems of the Morogoro Region and Zanzibar that are targeted by this Project. The Plan reviews relevant national policies and regulatory systems, and recent experience in the application of Integrated Pest Management (IPM) techniques. These are followed by an outline of the workplan and budget for integrated pest management to be applied in the ERP.

4. The key pest problems encountered in the targeted rice production systems include field insects, weeds, birds and rodents. Few farmers use any pesticides, though government officers occasionally apply pesticides for the control of migratory and outbreak pests such as armyworm and birds. Herbicide use is becoming more common, though still amongst a small minority of the target population. The Project may encourage greater experimentation with herbicide as an option for farmers applying the System of Rice Intensification (SRI) technologies.

5. The project does not expect to promote greater use of insecticide. Nonetheless, it is deemed important to provide all participating farmers with stronger advisory assistance relating to the safe use of both insecticide and herbicide. Pest scouting will be encouraged to allow control of migratory and outbreak pests at an earlier stage, thus reducing the need for pesticide application. Finally, the Project will support the completion of the revisions of the Pest Management Act in Zanzibar.

## 1.0 APPROACH

1. The Integrated Pest Management Plan (IPMP) is designed to minimize potential adverse impacts on human and environmental health through promotion of Integrated Pest Management (IPM), as well as training and supervision for the safe use and disposal of pesticides.

2. The Bank Safeguard Policy OP 4.09 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 workplan to strengthen this capacity".

3. In line with these objectives, IPMP (i) reviews the proposed aims and activities of the Project; (ii) highlights the anticipated pest and pest management problems in the areas targeted by the Project; (iii) reviews national policies and regulations for dealing with these pests; (iv) reviews the country's pest management practices including its experiences with IPM; (v) outlines a workplan for applying IPM to improve the effectiveness and safety of pest management under the proposed Project; and (vi) defines a monitoring and evaluation plan for the implementation of the IPMP.

4. The preparation of this IPMP involved literature reviews, consultations with relevant government departments, and consultations with farm communities. The literature review included the following documents:

i) Tanzania: Expanding Rice Production Project, Project Appraisal Document - February 2014 draft;
ii) Environmental Management Act (2004);
iii) Environmental Impact Assessment and Audit Regulations, 2005-G.N. No 349 of 2005;
iv) Environmental Management (Soil Quality Standards) Regulations, 2007;
v) World Bank Safeguard Policies in particular OP 4.09 and BP 4.01, Annex C;
vi) Tanzania Agriculture and Food Security Investment Plan; and
vii) Agricultural Sector Development Program (ASDP) IPMP Final Report (August 2004).

5. The preparation of this document also involved consultations with regional and district officials in the targeted areas 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.

## 2.0 DESCRIPTION OF THE PROJECT

1. The Government of Tanzania has identified rice as a strategic priority for agricultural development given its potential in improving food security and generating income for large numbers of low income, rural households. The country aims to double its rice production by 2018 in order to meet its domestic demand, and to expand exports to neighboring countries. These priorities are articulated in country's National Rice Development Strategy (URT, 2009). The objectives are more broadly articulated in the National Strategy for Growth and Reduction of Poverty (NSGRP) for both Tanzania Mainland and Zanzibar (known respectively by their Swahili acronyms as MKUKUTA II and MKUZA II), and their associated national development plans including the Vision 2025, the Long Term Perspective Plan 2011/12-2025/26, and the Tanzania Five Year Development Plan 2011/12-2015/16.

### 2.1 Project Development Objective

2. The Project Development Objective (PDO) is to increase the productivity and production of rice in targeted areas of Morogoro and Zanzibar.

### 2.2 Project Components

3. The Project has four main components: (i) sustainable seed systems; (ii) improving crop productivity through better irrigation and crop management; (iii) innovative marketing strategies; and (iv) project management and coordination.

***Component 1: Sustainable Seed Systems***

4. The objective of this component is to enhance the adoption and sustained use of improved rice varieties that have been released by the research system. This will support on-farm demonstrations to introduce the new varieties to farmers, the multiplication and distribution of preferred varieties, and improvements in quality assurance for rice seed.

5. **Subcomponent 1.1: Introducing new varieties to smallholder farmers.** The project will support two years of on-farm demonstrations in the targeted regions of the Tanzania Mainland and Zanzibar in order to confirm the preferences of farmers for the new varieties. The demonstrations will be organized and monitored with support from national rice breeders to assure the information collected is integrated back into national breeding programs. The project will also fund field days, exchange visits and the broader dissemination of information about the new varieties to rice farmers in other regions.

6. **Subcomponent 1.2: Promoting the sustainable production and delivery of preferred varieties.** The project will: (i) strengthen the capacity of the Kilombero Agricultural Research and Training Institute (KATRIN) and the Zanzibar Agricultural Research Institute (ZARI) to produce the requisite quality and quantity of pre-basic seed; (ii) support the Agricultural Seed Agency (ASA) and the Seed Unit at Ministry of Agriculture and Natural Resources (MANR) in Zanzibar to produce adequate quantities of basic seed (from the pre-basic seed); (iii) support ASA and the MANR seed unit, for a limited period, to produce certified seed (including the construction of irrigation infrastructure to support the

expansion of rice seed production); and (iv) provide incentives for the private seed companies to engage in production of certified seed.

7. **Subcomponent 1.3: Strengthening seed quality control.** The project will strengthen seed quality control systems to assure genetic purity, germination capacity, physical purity and freedom from diseases. Support will be provided for the rehabilitation and operation of seed laboratory infrastructure at ASA on the Mainland and Kizimbani in Zanzibar, and for the purification of contaminated varieties (where contamination occurs). Support will also be provided to Tanzania Official Seed Certification Institute (TOSCI) to strengthen the inspection and testing of pre-basic and basic seed, and the certification of rice seed that is multiplied by ASA, MANR and private seed companies.

***Component 2: Improving Crop Productivity through better Irrigation and Crop Management***

8. This component aims to improve smallholder rice production and productivity through improved crop and water management. The project will support expansion and/or rehabilitation of selected irrigation schemes, and promote adoption of improved agronomic practices.

9. **Subcomponent 2.1: Expansion and rehabilitation of irrigation infrastructure:** The project will expand and/or rehabilitate irrigation infrastructure at five irrigation schemes on the Mainland, and eight irrigation schemes in Zanzibar. The project will support the design of the irrigation infrastructure, the construction of the infrastructure, and the strengthening the Irrigator Organizations to assure sustainable operation and maintenance of the irrigation works. In complement, professional managers will be employed on the five Mainland schemes to facilitate the implementation of the BRN strategy of rice scheme management.

10. **Sub-component 2.2: Promoting adoption of improved agronomic practices.** The project will support: (i) farmer-led, on-farm demonstrations of two methods of the System of Rice Intensification (SRI) - one with manual weeding, and one with chemical weed control, (ii) training of extension staff, irrigation technicians and lead farmers, and (iii) a temporary, market-friendly subsidy scheme promoting the uptake of technologies on offer. The subsidy scheme includes an explicit graduation strategy modelled on the lessons obtained under the National Agricultural Input Voucher Scheme (NAIVS).

***Component 3: Innovative Marketing Strategies***

11. The main objective of this component is to increase the quantity of rice marketed by strengthening access to markets and improving price incentives at the farmgate. Activities under this component are targeted at only the Mainland, because of the current absence of marketable surpluses, and hence limited marketing challenges, in Zanzibar. The project will improve market efficiency through two major activities: (i) provision of marketing infrastructure and (ii) strengthening of market linkages.

12. **Sub-Component 3.1: Provision of marketing infrastructure.** The project will construct warehouses for each of five smallholder schemes where irrigation infrastructure will be rehabilitated, and rehabilitate feeder roads in two of these schemes to facilitate improved access to output markets. Feeder roads will be rehabilitated in two irrigation schemes.

13. **Sub-Component 3.2: Strengthening market linkages and market information.** The project will fund studies to help farmers better understand rice markets. It will support the testing of multiple marketing strategies such as contract delivery with nearby processors, the auctioning of grain to groups of traders, warehouse receipts, and the strengthening of market information systems.

***Component 4: Project Management and Coordination***

14. Project implementation will use existing structures in Ministry of Agriculture Food Security and Cooperatives (MAFC) for Tanzania Mainland and the Ministry of Agriculture and Natural Resources (MANR) in Zanzibar. Each of these Ministries will assign a dedicated task team of key staff to ensure that there is adequate capacity to coordinate, implement and monitor the project effectively.

## 2.3 Organization and Implementation Arrangements

15. The Project will be implemented through the MAFC in Mainland Tanzania, and the MANR in Zanzibar. The overall project, and all implementation responsibilities at the national level, will fall under the authority of Directorate of Policy and Planning (DPP) of the MAFC. This will be backed by a special Joint Steering Committee (JSC) bringing together the Permanent Secretaries of MAFC and PMO-RALG in Mainland, and the MANR and President's Office (Regional Administration) for Zanzibar. The JSC will meet once a year to review lessons derived from project implementation, and provide advice on any significant changes in budgets or implementation plans.

16. On the Tanzania Mainland, the Project will have a Coordination Unit based at MAFC composed of a designated Coordinator, Procurement Specialist, Financial Management Specialist, Monitoring and Evaluation Specialist, and Environmental and Social Safeguard Specialist. This unit will be responsible for implementation oversight, budget planning and management, financial management, procurement management, and project reporting. All Team members will be seconded from within government. Responsibility for implementing various components of the project will remain with the relevant Departments of the MAFC. These include the DPP, Plant Health Services (PHS), Environment Management Unit (EMU) of MAFC, Agriculture Seed Agency (ASA), the Kilombero Agriculture and Training Institute (KATRIN) and the Tanzania Official Seed Certification Institute (TOSCI).

17. At the local level, project implementation will be guided by Local Government Authorities working through the District Agricultural Offices. Each district will be responsible for procurement, contract administration, supervision of project activities, and reporting on progress for sites under its jurisdiction.

18. Implementation in Zanzibar will be through a Project Coordination Unit (PCU) at the MANR. The PCU will be led by a designated Project Coordinator, and include expertise in procurement, financial management, safeguards and M&E. This team will be responsible for all implementation oversight, budget planning and management, financial management, procurement management, and project reporting. There will not be devolution of management responsibility to the district level.

## 3.0 ERP TARGETED REGIONS

19. The Project will target the improvement of rice production and marketing systems in the Morogoro Region of East-Central Tanzania, and the improvement of rice production systems in the two main islands of Zanzibar – Unguja and Pemba.

### 3.1 Morogoro Region

20. Morogoro Region is one of the high potential agricultural regions in Tanzania Mainland that is located in the eastern side of the country. The Region has a total area of 73,039 km² out of which 2,240 km² is covered by water. Administratively, Morogoro Region is divided into six (6) districts, namely Kilosa, Kilombero, Ulanga, Mvomero, Morogoro Rural and Morogoro Urban Districts. The Districts are subdivided into divisions, wards, villages and streets (for urban wards)/vitongoji (for rural wards). According to the 2012 National Population and Housing Census, Morogoro Region had a total population of 2,218,492 people with an average household size of 4.4. The average population growth rate is 2.6 percent per annum.

21. Morogoro Region experiences a climate of moderate temperature and rainfall. The Region experiences an average temperature of around $25^0$C almost throughout the year. The warm season normally runs from July to September. Generally, the region experiences two major rainfall seasons: with long rains between November and May, and short rains between January and February. The average annual rainfall varies between 600mm and 1800mm. However, the average annual rainfall varies from year to year and between ecological zones.

22. Soils in the Region vary according to topographical and ecological zones. In the mountainous and hilly areas the common type of soils found are mainly oxisols which are generally low in nitrogen and phosphorus. Valley and low lands are generally characterized by alluvial soils which are fertile in nature. Sandy and clay soils are common in woodlands and grasslands.

23. Agriculture is the major economic activity in the Region. It engages about 80 to 90 percent of the region's labor force. Maize and paddy are the major staple food crops. The majority of farmers are semi-subsistence in orientation, selling grain, and other crops, when rains are favourable, but purchasing grains when the rains fail. Farmers with plots in formal irrigation schemes are more likely to regularly sell crops. The majority of farmers have tried new crop varieties, particularly of maize. The majority regularly apply fertilizer. But only a small minority of these farmers apply pesticides including insecticides and herbicides. The levels of adoption of these modern technologies will be confirmed in the project's baseline surveys.

24. The expansion of irrigation is being widely promoted in the country, and the Morogoro Region, in order to promote the expansion of rice production. This project specifically targets the promotion of the production of double cropped rice. Farmers also produce maize or vegetable crops in irrigation schemes.

### 3.2 Zanzibar

25. The Zanzibar islands, situated off the eastern coast of the country, have moderate potential for the expansion of crop production. The islands have a total area of 2650 km². Zanzibar, based on the 2012 National Census, is estimated to have a population of 1.3 million, and has five regions and ten districts. In Unguja Island, there are three regions

(Urban West, North and South) with six districts. Pemba Island has two regions (North and South) with four districts.

26. Zanzibar experiences a lowland tropical humid type of climate with a bimodal pattern of rainfall influenced by the prevailing monsoon trade winds. Rainfall through Zanzibar varies within the range of 1000 to 2500 mm/yr. Mean annual rainfall for Unguja is 1700 mm, whilst that for Pemba is 1800 mm. The mean maximum temperature is $23.5^0$C and $21^0$C for Unguja and Pemba, respectively. Generally, the region experiences two major rainfall seasons: with long rains between November and May, and short rains between January and February.

27. Zanzibar comprises two major agro-ecological zones: namely the plantation/deep soil zone and the coral rag zone. The permanent, settled agricultural activities are concentrated on the deep soil areas, while the coral rag is popular for root and other drought tolerant or seasonal crops, and activities such as wood harvesting, shifting cultivation and grazing.

28. Rice is considered to be a major staple food, constituting 87 percent of total cereal production. Paddy is widely planted, and the government maintains an objective of achieving self-sufficiency in rice production. Currently, however, the majority of the island's rice is imported from both the mainland and abroad. More than three-quarters of the island rice supplies are imported. The irrigated systems targeted by this project primarily produce paddy rice crops, or paddy-paddy rotations. In the broader farming system, the production of horticultural crops including various sorts of fruits and vegetables is common.

## 4.0 PEST PROBLEMS IN RICE PRODUCTION

29. Tanzanian rice growers face a combination of major pests. Rice pests as identified in the national plant pests field book are shown in Table 4.1. These, and several additional pests are described in a bit more detail in the discussions that follow.

Table 4.1 Major pests of rice and recommended management practices

| Pests | | Recommended management practices |
|---|---|---|
| Insects | Stem borers (*Chilo partellus, C. orichalcociliellus, Maliarpha separatella, Sesamia calamistis*) | • Plant recommended early maturing varieties<br>• Destruction of eggs in the seedbeds<br>• Early planting<br>• Proper fertilisation<br>• Use recommended plant spacing<br>• Observe simultaneous planting<br>• Destruction of stubble after harvest<br>• Clean weeding<br>• Plough after harvest to expose the eggs to natural enemies |
| | Stalk-eyed fly (*Diopsis spp*) | |
| | African rice gall midge (*Orseolia oryzivora)*<br>Small rice grasshoppers (*Oxya spp.) (Senene*) | |
| | African armyworm (*Spodoptera exempta*) | • Resistant varieties<br>• Stalk management in dry season |
| | Flea beetles (*Chaetocnema varicornis*). Suspected to be the key vector of RYMV (Kibanda, 2001; Banwo, et al. in press). | No known control measures. |
| | Rice hispa (*Dicladispa sp)* | |
| Weeds | *Cyperus rotandus*, striga<br>All types (see Table 4.5) | • Early clean weeding<br>• Use recommended herbicides if necessary |
| Diseases | Rice yellow mottle virus | • Field sanitation including burying of crop residues and removal of volunteer plants<br>• Use of resistant varieties |
| | Rice blast (*Pyricularia oryzae)* | • Destruction of crop residues<br>• Clean seeds<br>• Avoid use of excessive nitrogen fertilizers<br>• Use of wide spacing to avoid overcrowding<br>• Use resistance varieties<br>• Appropriate crop rotation<br>• Timely planting<br>• Burying crop debris |
| | Brown leaf spot (*Helminthosporium spp*) | |
| | Sheath rot (*Acrocylindrium oryzae*) | |
| Vermins | Birds<br>Wild pigs<br>Hippopotamus<br>Rats | • Scaring<br>• Bush clearing<br>• Early weeding<br>• Early harvesting<br>• Spraying against Quelea Queleas |

**Source: MAFC: Plant Pests Field Book: A guide to management, 2002; LZARDI-Ukiriguru, 2000**

30. The most common rice diseases and pests in both Morogoro and Zanzibar include the following:

### 4.1 Rice Yellow Mottle Virus (RYMV)

31. The most devastating rice disease in Tanzania is the *Rice Yellow Mottle Virus* (RYMV). Although indigenous to Africa, the disease was reported in Tanzania in 1980s, and now has spread to all the major growing areas, including Zanzibar. The disease can cause up to 92% yield loss on "S*uper*", the most popular rice variety in Tanzania (Banwo, 2003).

32. The only viable control option for the disease is by planting resistant varieties. Unfortunately, only a few of the local varieties in the SSD-1, SSD-3, SSD-5, SSD-7, SSD-35 series have some level of resistance to the disease.

### 4.2 Rice Blast (*Magnaporthe grisea*)

33. Rice Blast is caused by a fungus that attacks the leaf at any stage of growth. It also attacks the stem at the node or at the panicle causing the neck rot symptom. This may cause up to 25 percent losses. The only viable control option for the disease is by planting resistant varieties. Varieties currently on the national variety registration list have varying levels of resistance.

### 4.3 Brown Leaf Spot (*Cochiliolu miyabeanus*)

34. This is a bacterial disease mostly affecting upland rice, as opposed to lowland irrigated systems. It may cause up to 25 percent yield loss. Again, the only available option for controlling this disease is the selection of resistant varieties.

### 4.4 Armyworm

35. The African Armyworm (*Spodoptera exempta*) is a major threat to cereal production in a number of east and southern African countries. It is a major pest of cereal crops (maize, rice, sorghum and millets) as well as pasture (grass family) crops, and therefore a threat to food security and livestock. Overall losses of 30% for crops have been estimated though in major outbreak years, losses in maize of up to 92% are recorded. Armyworm outbreaks vary from year to year, but serious outbreaks occur frequently. The problem with armyworms is that they are highly migratory so that larval outbreaks can appear suddenly at alarming densities, catching farmers unawares and unprepared (Mushobozi et al., 2005.)

36. Due to its economic significance, management and control is centrally co-ordinated by the PHS, a Section under the Division of Crop Development (DCD) of MAFC in Mainland and the Plant Protection Division (PPD) in Zanzibar. Its control combines monitoring in identified breeding areas, forecasting and early warning of potential outbreaks. The national armyworm control programme based at Tengeru-Arusha, runs a network of 100 traps distributed throughout the country (Anon, 1999). The traps are placed at district offices, research stations (including Zanzibar) and in large scale farms. Weekly returns from these traps are used in forecasting potential outbreaks for the following week (Anon, 1999). The information about potential outbreaks is passed to the regions and districts from where it is further passed to farming communities through the extension system. Farmers are advised to inspect their fields for signs of infestation. If the crop is attacked, farmers are advised to spray with *diazinon, fenitrothion* or *chlorpyrifos*, whichever is available at the nearest pesticide

store. Both Ultra Low Volume (ULV) and knapsack sprayers are used depending on available formulation in the outbreak areas.

37. The MAFC Community-Based Armyworm Forecasting (CBAF) Project, conducted from 2003 to 2006, combined forecasting of armyworm outbreaks with the utilization of the natural disease of the armyworm, *Spodoptera exempta* nucleopolyhedrovirus (SpexNPV). This project was piloted in Hai, Kilosa (in the Morogoro Region) and Moshi districts. The results indicated that CBAF achieved a high level of forecasting accuracy, with 75% of all positive forecasts having corresponding outbreaks (Mushobozi *et al.,* 2005). The researchers also were able to demonstrate that ground and aerial sprays of *SpexNPV* gave effective control of outbreaks, and therefore could be used to replace chemical insecticides for armyworm. The team went further and developed a step-by-step manual for preparation of *SpexNPV* as public goods that can be used by private entrepreneurs for commercialization of the product. However this product is not yet commercialized. CBAF has been up scaled in Mvomero district (also in the Morogoro Region).

38. This approach is likely to have a number of benefits.

i. Less pesticide will be used because farmers will be able to identify and apply control measures at the most vulnerable stage of the pest, which is not possible in the current central system of early warning.
ii. Farmers can use less toxic and environmentally friendly proven alternatives to pesticides e.g. botanical extracts and/or bio-pesticides at relatively low cost with minimum environmental hazards.
iii. If well-co-ordinated, the information generated by farming communities can be integrated in the national monitoring and early warning system to improve the quality of the information at national and regional levels.

### 4.5 Elegant Grasshopper

39. This pest destroys the plant at flowering stage causing up to 30 percent losses. Farmers tend to use traditional techniques of control such as scaring the insect with string and noisy objects, or hand harvesting. Insecticide use is uncommon.

### 4.6 Stem Borer

40. This pest attacks the stem of the plant breaking panicles and reducing the number of tillers. This can reduce rice yields by up to 40 percent. Farmers are advised to use Sumithion 50 EC, Thiodan 35 EC when the outbreak is severe.

### 4.6 Birds

41. Seed eating birds can be serious pests of cereal crops, including wheat, rice, sorghum and millet across the country. Bird pest problems in agriculture have proved difficult to resolve due in large part to the behavioural versatility associated with their flocking ability as well as the array of food choices available to the flocking birds. Based on these two factors, effective control is information intensive, and therefore rather challenging.

42. The Quelea birds (Quelea quelea spp.), which in Tanzania occur as swarms (ranging from thousands to a few millions annually), have been occasionally responsible for famines of varying proportions in some areas. For example, in 2001, about 25 percent loss of rice was experienced on 1125 Ha in the Lower Moshi Irrigation scheme. The total damage per bird per

day, if the bird is exclusively feeding on cereal crops, has been estimated at 8 g (Winkfield, 1989) to 10 g (Elliott, 1989). The control of Quelea is a major concern to farmers in Morogoro, and correspondingly to the MAFC. However, the Quelea birds are not common in Zanzibar Islands

43. Several techniques have been tried to reduce bird populations to levels where crop damage is minimal. Traditional methods, slings, bird scares, and scarecrows, are still being used in many parts. Modern techniques of frightening devices, chemical repellents (for Quelea), less preferred crop varieties and alternative cultural practices have been evaluated. All the methods have minimal value in situations where bird pressure is high and where habitation is likely to develop, though repetitive repellent use and other methods may alleviate damage in small plots, or in large fields for a short time.

44. The most commonly used technique for the control of the Quelea is aerial spraying of pesticides (Fenthion) on nesting and roosting sites. The pesticide is recommended to be used at the rate of 2l/ha. This chemical is only applied by MAFC staff in the occasional event of swarming. Nonetheless, concerns remain about possible human health problems and environmental damage resulting from the large scale application of chemical pesticide for Quelea control. Chemical pesticide applied for quelea control present a risk to human, terrestrial, non-target fauna and aquatic ecosystems. The fact that non-target birds and, occasionally other vertebrates may be killed by quelea control operations is well-established (Keita, et.al. 1994; van der Walt et.al. 1998; Verdoorn, 1998)**.** This has led to calls for alternative non-lethal control strategies such as net-catching. There is also a possibility to promote Quelea harvesting for food because they are a good source of first class protein.

### 4.7 Rodents

45. Rodents, particularly the Multi-mammate Shamba Rat, (*Mastomys natalensis*), is one of the major pests attacking paddy in the field and in storage. Generally rodents attack rice at vegetative, ripening and harvesting stages and creating maximum damage to the crop. Losses are sometimes high, but average about 15%.

46. Farmers in outbreak areas are strongly advised to do the following (Mwanjabe & Leirs, 1997; Bell, undated) to reduce potential damage to crops and the environment:

i) Regular surveillance. The earlier the presence of rodents is observed, the cheaper and simpler any subsequent action will be, and losses will remain negligible
ii) Sanitation. It is much easier to notice the presence of rodents if the store is clean and tidy
iii) Proofing i.e. making the store rat-proof in order to discourage rodents from entering
iv) Trapping. Place the traps in strategic positions
v) Use recommended rodenticide. However, bait poisons should be used only if rats are present. In stores or buildings, use single-dose anticoagulant poisons, preferably as ready-made baits.
vi) Encourage team approach for effectiveness. The larger the area managed or controlled with poison, the more effective the impact
vii) Predation. Keep cats in stores and homesteads.

### 4.8 Rice Weeds

47. One of the most difficult problems in rice systems is infestation with a range of weeds including barnyard grass and wild rice. The control of weeds by hand hoe is laborious, and farmers commonly seek deeper water irrigation as a means to reduce weed pressures. Farmers have been advised to plant in rows, and at a wider spacing to ease the use of mechanical weeders. However the adoption of these technologies remains limited.

48. Farmers are also advised to consider the use of herbicides for weed control such as glyphosate, Lipanil, Bactril and 2-4D. This has most recently been recommended in some training programs for the SRI. Herbicide use is currently not common in either Morogoro or Zanzibar, but could become more common in the future as wage rates rise.

49. In addition, the following rice pests have been identified in Zanzibar.

### 4.10 Black Beetles (*Heteronychus andersoni*)

50. This soil borne pest causes up to 5 percent losses primarily in sandy soils of rainfed systems. Farmers experiencing this pest problem are advised to practice late planting of early maturing varieties. There are no chemical controls practiced.

### 4.11 Rice Hispa (*Hispa amigera*)

51. This insect pest injures the plant as both a grub and an adult beetle. The beetles, in particular, feed on the upper surface of leaves and eat everything down to the epidermis. This beetle can cause up to 80 percent losses in the field if not controlled. It is most commonly found in irrigated fields in Pemba. Farmers are advised to stop irrigation and let a field dry in order to control this insect. No chemical treatments are advised.

### 4.12 Rice whorl maggot (*Hydeellia spp*.)

52. This insect feeds on the margins of rice leaves. Heavy infestation can stunt the plant and reduce the number of tillers. The adult fly lays its eggs on the leaf surface. When hatched, the larvae feed on the inner margins of developing leaves. If a rice nursery is not protected, the seedlings may spread the infestation when transplanted. This pest causes up to 50 percent losses in the field, mostly in irrigated plots. While the pest may be controlled with the use of insecticide, there are no recommendations currently offered for this.

## 5.0 POLICY, LEGISLATIONS AND INSTITUTIONAL FRAMEWORK

53. Tanzania (both the Mainland and Zanzibar) has extensive legislation on plant protection and pesticides dating back to 1997. The main component of this legislation, described below, is the Plant Protection Act No 13 (1997) which is currently under revision. A new draft was prepared in 2013 of both the Plant Protection Act and the Pesticide Management Act. These

are still in the process of review to assure compliance with the International Plant Protection Convention.

54. As a member of the World Trade Organisation (WTO), Tanzania is required to comply with the international standards within the WTO framework. Phytosanitary measures include all relevant laws, decrees, regulations, requirements and procedures taken by a state in order to protect plant health and prevent the spread of diseases and pests. However, in order to prevent such measures becoming disguised restrictions on trade, the WTO SPS Agreement requires harmonizing such measures at international level. Conversely, such standards can be argued to be an important way of ensuring market access for Tanzania's international exports. Also Maximum Residue Levels (MRL) set by large target export markets such as the EU, US and Japan require that agricultural products do not have pesticides residues that exceed established quantities. Pesticides control is also a considerable concern nationally, with unacceptable MRLs on some agricultural crops for the domestic market. Greater regulation through strengthened legislation will contribute to the judicious application and safe use of pesticides.

## 5.1 Key Policies, Legislations and Strategies

### 5.1.1 National Environmental Management Policy (1997)

55. The National Environmental Management Policy (NEMP) is set to achieve the following in terms of environmental management: "Integrated multisectoral approaches necessary in addressing the totality of the environment; Fostering government-wide commitment to the integration of environmental concerns in the sectoral policies, strategies and investment decisions; Creating the context for planning and coordination at a multisectoral level, to ensure a more systematic approach, focus and consistency, for the ever-increasing variety of players and intensity of environmental activities".

56. The policy has identified six key major environmental issues in the country. These are land degradation, water pollution, air pollution, loss of wildlife habitats, deterioration of aquatic systems and deforestation. Hence the policy has the following objectives with respect to environmental management in agriculture:

- ensure sustainability, security and equitable and sustainable use of natural resources;
- prevent and control degradation of land, water, vegetation, and air;
- conserve biological diversity of the unique ecosystems the country; and
- raise public awareness and understanding of the essential linkages between environment and development, and to promote individual and community participation in environmental action.

### 5.1.2 Environmental Management Act (EMA) of 2004

57. This Act requires establishment of sector environmental management Units at each Ministry, with the responsibility of ensuring compliance on environmental matters. The Sector Environmental Units have, among others, the responsibilities of

- Advising and implementing policies of the government on the protection and management of environment
- Coordinating activities related to the environment of all persons within the Ministry

- Ensure that environmental concerns are integrated into the Ministry development planning and project implementation in a way which protects the environment
- To prepare and coordinate the implementation of environmental action plans at the national and local levels as required under this Act
- To refer to the council any matter related to the enforcement of the purposes of this Act
- To ensure that sectoral environmental standards are environmentally sound

58. In relation to the management of dangerous materials and processes, of which agricultural chemicals may fall, the Minister responsible for Environment shall have the power to make regulations pertaining to Persistent Organic Pollutants (POP) and pesticides issues, to ensure that they are in compliance with the Stockholm Convention on POP of 2001 and Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade of 1998.

59. The Minister responsible for Environment shall also have the powers to make regulations regarding the prevention and control of pollution. However, this mainly relates to the discharge of hazardous substances such as chemicals or mixtures containing oil in water or any other segment of the environment, except in accordance with guidelines prescribed under this Act or any other written law. It is an offence punishable by law to discharge such chemicals, and in this regard there is payment on the costs of removal, and those incurred during the restoration of environment.

60. The Institution/organisation is expected to give immediate notice of the discharge to the Council or relevant sector Ministry, and commence cleanup operations using the best available clean-up methods, and comply with such directions as the Council may prescribe. In this context, services that relate to the regulation of agricultural chemicals in the Ministry of Agriculture Food Security and Cooperatives shall be at the forefront to ensure the judicial use of agro-pesticides.

### 5.1.3 Plant Protection Act No. 13 (1997)

61. This Act has made provisions for consolidation of plant protection to prevent introduction and spread of harmful organisms, to ensure sustainable plant and environmental protection, to control the importation and use of plant protection substances, to regulate export and imports of plant and plant products and ensure fulfilment of international commitments, and to entrust all plant protection regulatory functions to the government and for matters incidental thereto or connected therewith. The activities of Tanzania Pesticides Research Institute (TPRI) are incorporated into the Act. In relation to IPM, importation of biological control agents is not allowed unless under the prescribed permit by the Ministry responsible for Agriculture (i.e. MAFC).

### 5.1.4 The Plant Protection Act 2013 (Draft)

62. The main objective of this Act is to prevent the introduction or spread of plant disease or pests; provide for phytosanitary control measures; facilitate trade in plants and plant products and to regulate other matters connected thereto. The Act is meant to establish a National Plant Protection Organization (NPPO). The NPPO core function will be to serve as a national contact point for the IPPC and shall develop mechanisms for consultation between

responsible authorities for enforcement of the phytosanitary legislation for Tanzania and promotion of integrated pest management and control.

### 5.1.5 The Pesticide Management Act 2013 (Draft)

68. An Act to provide for the life-cycle management of pesticides, regulating the manufacture, formulation, importation into and exportation from the country, transport, storage, distribution, sale, use and disposal of pesticides and to regulate other matters connected thereto. This Act will establish the Tanzania Pesticides Control Authority (TPCA) responsible for monitoring the trade and use of pesticides, and collecting statistical and other information concerning the import, export, manufacture, distribution, sale and use of pesticides, about pesticide residues and safe use. The act prohibits the importation, manufacturing, formulating, transportation, distribution, exportation or sell of banned, obsolete pesticides under PIC and POPs and any other pesticide banned or severely restricted in the country of origin under any circumstances within the country or any pesticide for which is not in the category/group currently under use.

69. In relation to IPM the authority suggests development and availability of safer alternatives to existing pesticides as per latest global research and development without compromising the importation of biological control agents as allowed in the Biological control agents protocol developed within the Plant Protection Act of 1997.

### 5.1.6 Pesticides Control Regulations GN 193 of 1984

70. The objects of these Regulations are – (i) to ensure the effectiveness of pesticides used in Tanzania for the production of food and fibre and for the protection of public health and safety: (ii) to protect against possible harmful effects of pesticides including: (a) impairment of the health of persona handling pesticides or using or consuming products or substance treated with pesticides; (b) impairment of the health of domestic animals including honey bees from direct application or pesticides or from the consumption of plant or animals treated with pesticides (c) damage to cultivated plants from direct application or pesticides or from persistent soil residues and (d) damage to the natural environment including impairment of the health of wildlife and contamination of waterway lakes and other water bodies.

## 5.2 Institutional Arrangements and Special Programmes

71. MAFC and MANR advocate the use and dissemination of IPM approaches through the agricultural extension services. On the aspects of migratory pests and diseases, MAFC cooperates fully with the neighbouring countries (through regional initiatives on outbreak pest control) in the collective effort to control the damage of such pests. MAFC also has in place supervisory and regulatory instruments to register, license, monitor and supervise manufacturers, importers, distributors and users of agricultural inputs such as pesticides, fertilizers and herbicides.

### 5.2.1 Environmental Management Unit at MAFC

72. EMU was established according to the Environmental Management Act Cap 191 in July, 2008. The functions of the Unit are: to monitor compliance with the requirements of EMA, (2004) within the Ministry; to advise on policy, legal reviews on environmental

management in the agricultural sector in collaboration with Vice President's Office (Division of Environment); to monitor environmental protection compliance in the agricultural sector; and to oversee the implementation of agricultural strategies in order to minimize adverse social-economic impacts due to agricultural activities.

### 5.2.2 Plant Protection Division of MANR

73. The MANR maintains the PPD to similarly monitor, guide and strengthen plant health services in Zanzibar. The Division's mandate includes phytosanitary control, plant quarantine, pesticide monitoring, and the provision of training in the safe use of pesticides.

### 5.2.3 Tropical Pesticides Research Institute (TPRI)

74. TPRI was established by Act of Parliament No. 18 of 1979 with a mandate to undertake, promote, evaluate and disseminate findings on the management of pests, pesticides and biological diversity. The institute dates back to 1945 under colonial government and was known as Colonial Insecticides Research Unit (CIRU).

75. Currently, TPRI is engaged in research and services on management of pests, pesticides and biodiversity to enhance food security, safeguard human health and for facilitating internal and external trade for sustainable development. The Institute is semi-autonomous operating through the MAFC. TPRI's research, training and services are multi and interdisciplinary cutting across sectors.

### 5.2.4 Africa Stockpiles Programme (ASP)

76. Although the Africa Stockpiles Programme (ASP) focused on obsolete pesticides and their associated waste, the 'prevention component' carried out legislative review under this project for the United Republic of Tanzania (URT) including plant protection matters for both Mainland Tanzania legislation and Zanzibar. Through consultative meetings with the pesticide industry stakeholders, international trade requirements were identified and the harmonisation of the sanitary and phytosanitary systems was pursued. The Plant Protection Act 1997 was split into two legislations: The Pesticide Management Act 2013 (Draft) and The Plant Protection Act 2013 (Draft).

77. The programme also addressed the major issues in prevention of accumulation of obsolete pesticides, and its associated wastes by putting in place an empty pesticides container maintenance strategy and the ASP sustainability Roadmap. The bulk of the pesticides distributed in Tanzania are in small packs resulting into increased number of empty pesticide containers. This has resulted in the accumulation of empty pesticide containers in the farming environment. The greatest challenge facing the use of pesticides is recovery and disposal of empty pesticide containers. Currently there is no legal framework mechanism to guide the disposal of the containers. Also the absence of organized disposal system has meant that farmers and other users of pesticides dispose containers by throwing them away or putting them in the solid waste system in urban areas. In addition, the absence of information to rural communities on the risks pertaining to reuse of empty containers has created a major challenge.

78. The strategy identifies the mechanism of dealing with empty pesticide containers and provided the framework of up-scaling the process through the stakeholder partnership and

cost sharing initiatives. If not streamlined in the Good Agricultural Practices, the export market of agricultural produce will give a negative impact internationally.

79. The strategy addressed the following critical issues:

(i) increase awareness amongst pesticide users on the best practice of handling pest containers;
(ii) sensitize the communities on risks of reusing empty pesticide containers for other purposes;
(iii) provision of training and support of local agricultural authorities to promote safer use of pesticides;
(iv) the quantification of the build-up of empty pesticide containers in the government stores and the farming communities; and
(v) establishment of the recycling facilities of the pesticide packaging for which sustainable disposal/recycling options is needed.

## 6.0 PEST CONTROL AND MANAGEMENT OPTIONS

80. This section provides an introductory discussion of the various types of pest control strategies known and applied in Tanzania. This includes a brief review of techniques for biological control, cultural control, chemical control, quarantine and physical or mechanical control, chemical control and botanical control are presented.

### 6.1 Biological Control

81. Every living organism has its natural enemies and diseases which keep its population at equilibrium. The 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 called biological control (bio-control). The National Plant Protection Policy is conducive to the promotion and use of bio-control as a strong IPM component

82. Tanzania has some experience based on the successful control of the cassava mealy bug, the cassava green mite and the water hyacinth (Anon, 1999). However, at national level, the capacity and capability to implement an effective nationwide programme is limited.The most common type of biological control practices in Tanzania is the pursuit of host plant resistance. This is principally sought in the application of selection pressure in crop breeding programs or in the selection of new varieties with stronger resistance to common pests.

83. Resistance to pests is the rule rather than the exception in the plant kingdom. In the co-evolution of pests and hosts, plants have evolved defence mechanisms. Such 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. Moreover to use it the farmer has no need to buy extra equipment or learn new techniques.

84. Tanzanian crop breeders regularly select new varieties for their pest and disease resistance. For example, maize varieties (e.g. TMVI, Staha, Kilima) have been selected for resistance or tolerance to maize streak, the viral disease that causes significant yield loss to late planted maize. All of the cotton varieties produced at Ukiriguru had resistance to jassids since they have hairs to interfere with sucking insect pests. Varieties have also been produced with varying degrees of resistance to fusarium wilt and bacterial blight. Rice varieties have been selected with resistance to RYMV.

85. Host plant resistance (HPR) is recognised in the new Plant Protection Policy as an invaluable component in IPM. Breeding and selecting for resistance to serious pest problems is an issue mandated to the National Agricultural Research programmes. These programmes have produced substantial results in terms of releasing varieties with necessary qualities and tolerance/resistance to a wide range of otherwise devastating pests of cotton, maize, sorghum, beans and cassava. Therefore, the Directorate of Research and Development in MAFC has the capacity and infrastructure to contribute HPR materials to farmers given the necessary logistical support.

## 6.2 Cultural and Crop Sanitation Practices

86. Pests may also be controlled through the adoption of improved cultural and crop sanitation practices. Practices applied in Tanzania include:

i) **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, cotton;
ii) **Intercropping:** The field is used to grow two or more crops at the same time;
iii) **Relay cropping:** For example, banana is relayed with mucuna to reduce the infestation of weevils.
iv) **Fallow:** The field is not cultivated for some years in order to control various parasitic weeds.
v) **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, canavallia etc.
vi) **Trap crops:** These induce the germination of a pest. The trap crop can be intercropped or rotated with a susceptible host (e.g. groundnuts, bambaranuts, cotton etc).
vii) **Mulching:** This is covering of crop fields by dry grasses to control weeds and conserve soil moisture (e.g. in coffee, banana, tomato field etc).
viii) **Hand pulling and hoes weeding:** These practices are the most common and being used by small-scale farmers.
ix) **Burning:** Land clearing and destroying infected plants/crops.
x) **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.
xi) **Use of disease free planting material** e.g. cassava cuttings, sweet potato vines etc.
xii) **Pruning:** Done in coffee, tea orange tree etc. to reduce insect pests and diseases that might infest the crop.
xiii) **Thinning:** Done to reduce plant population in the field (e.g. in maize, rice, sorghum and millet, cotton etc.).

These methods are not commonly applied in rice management systems.

## 6.3 Physical and Mechanical Control

87. Physical and mechanical controls are measures that kill the insect pest, disrupt its physiology or adversely affect the environment of the pest. These differ from cultural control in that the devices or actions are directed against the insect pest instead of modifying agricultural practices. For examples, hand picking of cotton stainers from cotton plants, banana weevils from banana pseudostems, tailed caterpillars from coffee, killing stem borers in coffee or American bollworm from tomato plants are the forms of physical control while use of a fly swatter against annoying flies is a form of mechanical control.

88. Again, these practices are not commonly applied for insect control in rice systems in either Mainland Tanzania or in Zanzibar. However, wider spacing is being promoted as a means to ease the adoption of mechanical rice weeders.

## 6.4 Chemical Control

89. Registered pesticides (Table 6.1 below) can be recommended as a component of IPM packages. All of these pesticides are registered under the by TPRI Act, 1979 and Pesticides Control Regulations GN 193 of 1984.

90. It may be noticed that Tanzania ratified the Convention on POPs in April 2004 but has not yet banned the highly hazardous pesticides (WHO classes Ia, Ib, II – see also Annex III)). It is strongly recommended that, the Registrar of pesticides review the current list of registered pesticides in line with the WHO guidelines. Pesticides classified as among the "dirty dozen" (e.g. Paraquat) and those classified by WHO as Ib should be deregistered immediately. The ERP will not finance, or support the use of, any of these pesticides.

Table 6.1 List of recommended and TPRI registered pesticides for crop production in Tanzania: Oral $LD_{50}$ and WHO classification

| *Chemical* | *Common name* | **Oral LD50/kg* | *WHO class* | *Comments* |
|---|---|---|---|---|
| Insecticides | Betacyfluthrin | 500-800 | II | |
| | Biphenthrin | | | |
| | Carbaryl | 850 | II | |
| | Chlorpyrifos | 135-163 | Ib | Deregister & Phaseout |
| | Cypemethrin | 251-4125 | III | |
| | Cypermethrin + Dimethoate | 251-4125 + 2350 | III | |
| | Deltamethrin | 153-5000 | III | |
| | Dealtamethrin + Dimethoate | 153-5000+2350 | III | |
| | Diazinon | 220 | II | |
| | Dimethoate | 2350 | III | |
| | Endosulfan | 55-110 | Ib | Deregister & Phaseout |
| | Esfenvalerate | 451 | II | |
| | Fenitrothion | 800 | II | |
| | Fenvalerate | 451 | II | |
| | Fenvalerate + Fenitrothion | 451+ 800 | II | |
| | Flucythrinate | | | |
| | Hydrmethyl | | | |
| | Lambda cyhalothrin | 243 | II | |
| | Permethrin | 430-4000 | III | |
| | Pirimiphos methyl | 2050 | III | |
| | Pirimiphos methyl + permethrin | 2050 + 430-4000 | III | |
| | Profenophos | 358 | II | |
| | Profenophos + cypermethrin | 358 + 251-4123 | II | |
| | Quinalphos | 62-137 | Ib | Deregister & Phaseout |
| Nematicides | Carbofuran | 8-14 | Ib | |
| | Dazomet | 520 | II | |
| | Isazophos | 40-60 | Ib | Deregister & Phaseout |
| Herbicides | Atrazine | | | |
| | Diuron | | | |
| | Fluometuron | | | |
| | Glyphosate | | | |

| *Chemical* | *Common name* | **Oral LD50/kg* | *WHO class* | *Comments* |
|---|---|---|---|---|
| | Metolachlor + Atrazine | | | |
| | Metalachlor + Dipropetrin | | | |
| | Paraquat | | | Dirty Dozen: should be banned with immediate effect |
| ***Chemical*** | ***Common name*** | ****Oral LD50/kg*** | ***WHO class*** | ***Comments*** |
| Avicides | Fenthion | | | |
| | Cyanophos | | | |
| Rodenticides | Bromodiolone | | | |
| | Coumatetralyl | | | |
| | Diphacinone | | | |
| Fungicides | Bronopol | | | |
| | Chlorothalonil | 10,000+ | III | |
| | Copper hydroxide | 1,000 | II | |
| | Copper oxychloride | 70-800 | II | |
| | Cupric hydroxide | 1,000 | II | |
| | Cuprous oxide | | | |
| | Cyproconazole | 1,000 | II | |
| | Hexaconazole | 2189 | III | |
| | Mancozeb | 5000+ | III | |
| | Metalaxyl + Mancozeb | 633 + 5000+ | III | |
| | Penconazole | | | |
| | Propineb | 1,000 | II | |
| | Triadimefon | 1,000 | II | |
| | Sulfur | | | |

Sources: TPRI: List of Pesticides Registered in Tanzania, May 2004 and Nyambo 2002 Pesticides.

91. Assessment of botanical pesticides for pre and post-harvest is being done by a number of institutions in the country and some of the potential ones have been recommended for use in crop production (Paul et al. 2001). In beans, extracts of *Tephrosia vogelii* and *Neuratanenia mitis* have been recommended and farmers are using them because they are easily available and less costly. Where these do not occur naturally, farmers have also established the plants in their home gardens to ensure availability when needed.

92. The GTZ-IPM project in Arusha in collaboration with IPM farmer groups and the extension staff has compiled a list of useful botanical pesticides (Table 6.2) that could be used on a wide range of vegetables and other food crops. The information is useful but has to be used with caution. Most of the botanical extracts are already in use by small-scale farmers as crude in-house preparations. However, they should be used with caution since ***not all*** botanical extracts are safe. Tobacco extract is one of the deadly substances and should therefore not be promoted for use on vegetable production. *Tephrosia* spp extract and leaves are toxic to fish (local fishermen use the leaves for fishing) and therefore should be used with caution.

93. None of the suggested botanical extracts (Table 6.2) are registered in Tanzania because they have not been researched enough. In particular, information on dosage rate, mammalian toxicity ($LD_{50}$), side effects on non-target organisms especially potential bio-control agents, biodegradation and reduce analysis data, is not available. However, 3 neem-based and 2 pyrethrum-based commercial formulations are being processed for registration. These two botanicals have been researched and registered in Kenya and elsewhere.

Table 6.2. List of potential plants that can be used to prepare botanical extracts for pre and post harvest pest control

| ***Kiswahili name*** | ***English name*** | ***Scientific name*** |
|---|---|---|
| Mustafeli | Soursoap | Annona muricata |
| Mtopetope | Bull-oxheart | *A. reticulata.* |
| Mtopetope mdogo | Custard apple | *A. squamosa* |
| Vitunguu saumu | Garlic | *Allium sativa* |
| Mwarobaini | Neem | *Azadirachta indica* |
| Kishonanguo | Black Jack | *Bidens pilosa* |
| Pilipili kali | Chili | *Capsicum frutenscens* |
| Mpapai | Pawpaw | *Carica papaya* |
| Mnanaa | Thorn apple | *Datura stramonium* |
| Mnyaa/utupa | Milk bush | *Euphorbia tirucalii* |
| Mchunga kaburi | Barbados nut | *Jatropha curcas* |
| Mwingajini | Wild sage | *Lantana camara* |
| Tumbaku | Tobacco | *Nicotiana* spp |
| Kivumbasi | Mosquito bush | *Ocimum suave* |
| Mbagi mwitu | Mexican marigold | *Tagetes* spp |
| Alizeti mwitu | Wild sunflower | *Tithonia diversifolia* |
| Utupa | Tephrosia | *Tephosia vogelii* |

Source: Paul (2000) and Madata (2001).

## 7.0 EXPERIENCES WITH INTEGRATED PEST MANAGEMENT

### 7.1 Mainland Tanzania

94. During her study Nyambo (2002) gave a comprehensive analysis of the Tanzania Mainland experience on participatory IPM. Information from the analysis and visit to key stakeholders, namely the PHS at MAFC, Zonal Agriculture Research and Development Institutes (ZARDI), Sokoine University of Agriculture, districts and farmers are summarized in this section.

95. The national research institutions have developed IPM approaches for a wide range of key pests of the major crops. Unfortunately, a lot of this information has not reached target farmers. The information that has filtered through to farmers is not user friendly and/or not appropriately formulated and therefore farmers are unable to optimise the benefits of such options (Nyambo et al., 1996). Researchers, extension workers, farmers and other stakeholders must work as partners to achieve effective and sustainable technology development and transfer. Farmers must be active participants in the process of problem identification, development and formulation of appropriate solutions to identified pest problems in the context of other production constraints.

96. In recognition of the shortcomings of the traditional top down extension system in promoting sustainable IPM approaches, and to prepare a foundation to facilitate and enhance grass-root based system of extension, MAFC, in collaboration with GTZ, FAO and IFAD, has implemented several IPM pilot projects to promote farmer participatory integrated pest management approaches in different parts of the country and cropping systems. The lessons from the above projects will be integrated in the Project workplan to support decision making in the dissemination and promotion of appropriate IPM options in rice cropping systems under ERPP.

#### 7.1.1 **GTZ/PHS-IPM**

97. The IPM project was initiated in 1992 by MAFC, namely Plant Health Services (PHS) and the German Agency for Technical Cooperation (GTZ). The IPM pilot area was the western growing zone (Shinyanga). This was the area using a lot of pesticides to reduce losses emanating from pests. The IPM project was resource intensive with the GTZ granting Tshs 500 million which is 90% of the budget allocated for IPM implementation annually, and the counterpart funding by MAFC was Tshs 50 million per annum. The project operated for 11 years under the following phases:

- Baseline and diagnostic surveys, training of counterpart staff, introducing IPM concept at farmers' level, etc. Phase I (1992-1994)
- Development, testing and dissemination of the IPM technical packages on priority crops in the pilot area of the western zone
- Dissemination and extension of IPM technical packages to other regions in the western and northern zones respectively: Tabora, Kigoma, Kagera, Mara, Mwanza, Arusha, Kilimanjaro, Tanga. Phase II (1997-2002)
- Handing over and consolidating the achievements. The project came to end in September 2003.

98. IPM recommendations accomplished by the project include:

- 6 recommendations in cereals (maize and sorghum)

- 4 recommendations in cassava
- 12 recommendations in beans
- 8 recommendations in onions
- 3 recommendations in cotton
- 2 recommendations in sweet potato
- 5 recommendations in vegetables and fruits
- 2 recommendations on weed management

No specific IPM recommendations were developed for rice.

99. The project was also instrumental in the production of the Plant Protection Act 1997, which was operationalized in July 2001. The knowledge base and capacity of the project is centred in PHS headquarters and its plant health services zonal offices in the country.

**Approach and Organizational structure**:

100. The project used a modified farming systems approach for planning, development and field evaluation of IPM options. This is a mixture of participatory and exploratory methods, as deemed appropriate depending on the level of training of the extension workers and the problem to be addressed. The key elements in the approach include socio-economic baseline (knowledge, attitude & practices) and diagnostic technical plant protection surveys done by experts. These surveys generated a wide range of background information and a basis for M&E. This was followed by participatory technology development and transfer through farmer groups, referred to as IPM Working Groups, in different agro-ecological areas in respective regions. The baseline information was later used in the extrapolation of data and options to other sites in the project areas. In this approach, the IPM Working Groups are equivalent to the Farmers Research Groups used in the farming systems approach.

101. **Group formation:** The IPM Working Groups (self-formed groups) were initiated by the project with assistance from Village Extension Officer (VEOs) and local community development officers for purposes of training and promoting IPM. However, if there were already existing self-formed farmer groups in the village, these were also considered for collaboration. After clarification of the expectations and roles of the partners, the groups were recruited.

102. **Group management and promotion of IPM**: The project technical staff visited the IPM Working Groups frequently (several times a week at the beginning of the project) to establish rapport with the group members, to set-up on-farm trials and demonstrations, test extension materials as well as plan and evaluate group activities. The project provided technical information on IPM options, training and group facilitation (moderation).

103. The role of the groups was in testing and fine-tuning of IPM options and other extension recommendations. Once the IPM Working Groups approved a technology, the group results were disseminated to other farmers in other similar agro-ecological areas. After several seasons of training, the IPM Working Group was transformed to an IPM Farmer Training Group and a new IPM Working Group initiated in another village and the process continues.

104. **Participatory Group Training approach:** The IPM Working Group in collaboration with the project technical staff identified key limiting pest problems and other production

constraints for each crop in the area. The project technical staff provided a range of recommended relevant solutions for testing by farmer groups. For selected crops, individual members in the group tested the options in demonstration plots, one crop per farmer. The members make joint visits and analysis of the demonstration plots throughout the growing period until harvest.

105. During the training sessions, farmers were facilitated to recognise the major pest problems, potential damage, management options, insect pest's natural enemies and good post harvest practices with emphasis on IPM. Essentially, group training involved four stages that are summarised as follows:

1. Capacity building to impart knowledge on IPM and participatory methods of technology transfer, group formation and management to selected project technical staff;
2. Demonstration within groups whereby the technology or information is tested for the first time by a farmer within the group under close supervision by the project technical staff. All group members make continuous visits and observations and participate in the analysis of the results;
3. Adaptations in farmer own plots by group members. Farmers are encouraged to keep field records, share the information with group members and carry out joint analysis of the results;
4. Village cycle spill-over whereby the technology is applied by non-IPM farmer groups in the same village;
5. The technology was finally approved for dissemination to other areas with similar crops/pests and agro-ecological similarities.

106. **Participatory evaluation of results and practices**: At the end of each crop season, the project technical staff guided the group members to evaluate the trial results using simple PRA tools. To motivate the groups, a meeting of representatives from all IPM Working Groups was convened once a year for joint evaluation of results.

107. **Internal M & E**: The project has an established continuous internal M&E system to assess project impact and spill-over. The project was using an evaluation form, which was supported by regular field visits for verification.

108. **Spill-over and role model effects:** other follow on projects, briefly discussed below, have copied the project approach.

109. **Capacity Building:** The project trained 999 VEOs/DPPOs in IPM within the project area, i.e. 697 in the Western and 302 in the Northern Zones. The IPM project and the District Councils through their respective support programmes, i.e. MARA-FIP, KAEMP, Care, Farmafrica, DRDPs, Faida, Ecotrust, World Vision, LVEMP, etc. have jointly financed the training. The VEO have in turn trained 484,825 farmers in IPM, i.e. 421,487 in the Western and 63,338 in the Northern Zones.

110. The VEOs also facilitated formation of 44 IPM working groups, each with an average of 15 farmers (14 IPM groups in the Western and 30 IPM groups in the Northern Zones). These groups play a role model for IPM development, testing of recommendations, validating, implementing and disseminating.

111. **Impacts**: The extent of impact achievement with regard to the benefits of IPM such as environmental conservation, restoration of beneficial organisms, etc. has not been evaluated. The following impacts have observed (Nyakunga 2003):

- The use of conventional pesticides in cotton in Shinyanga has been reduced from 6 calendar sprays to maximum 3 sprays without negatively affecting production. The evidence of this is the increased cotton production in the Western Zone from 38,000 tons in 1994/95 to 69,900 tons in 2000/01
- Safety of users against conventional pesticides: The National Plant Protection Advisory Committee has been instituted in line with the Plant Protection Act of 1997 and is actively guiding and monitoring implementation of plant protection activities in Tanzania.
- A cost recovery system for the services rendered under the PPA of 1997 is in place and the PHS is able to strengthen the phytosanitary and quarantine measures at the major entry points. The IPM has also been integrated in the Agriculture and Livestock Policy as a national policy on plant protection and the ASDP has provided that IPM should be disseminated country wide.

112. The success of the GTZ/PHS-IPM initiative was a result of team approach, institutional collaboration (NGOs, national research and extension institutions, and international institutions) harmonisation of technical information between collaborators, adequate flow of funds, good organisational and supervisory skills and staff continuity.

### 7.1.2 KAGERA AGRICULTURAL AND ENVIRONMENTAL MANAGEMENT PROGRAMME (KAEMP)

113. KAEMP was a multi-sectoral initiative of the Kagera region (Lake Zone) jointly funded by IFAD, BSF/JP and OPEC with contributions from the beneficiaries. The project was implemented by Regional Administrative Secretary (RAS) Kagera and managed by the local government machinery. Its main focus was on improvement of food security and poverty reduction, and therefore, has a holistic approach (addresses agriculture, health, livestock, environment management, rural access roads and marketing) to rural development. In this setup, IPM was been embraced as the key pest management in all crops.

114. To support gradual and sustainable adaptation of IPM and integrated plant nutrition (IPN) by resource poor farmers, the project promoted, validated and recommended technologies from national and international agricultural research institutions. Selected technologies had to be applicable, economically viable and environmentally friendly. The major crops grown in the region are cotton, coffee, banana, cassava and beans. Again, rice was not considered.

115. As mentioned above, KAEMP borrowed the IPM approach (baseline studies, group formation and training, internal M & E etc.) from the GTZ/PHS-IPM Shinyanga project. In addition, the linkage between the two projects was strong. GTZ/PHS-IPM technical staff were used as resource persons by KAEMP while Kagera farmers visits the IPM Farmer Training Groups in Shinyanga for learning purposes. However, due to the nature of the KAEMP set-up, some modifications of the Shinyanga approach were deemed necessary in order to accommodate the overall goals of the project. In crop production, declining crop yields, soils fertility and increased pest pressure were identified as major constraints. To address the issues, the project farmer groups were known as *IPM/IPN* groups (integrated pests management/integrated plant nutrition groups).

116. **Capacity building**: Since the project is an integral part of the regional development plan, all extension staff (from the district to the village level) were given training in IPM, IPN, and participatory methods of technology transfer with emphasis on group approaches. In this approach, the district extension officer was the foci for new extension messages. It was the responsibility of each district extension officer to ensure proper technology transfer to end-users and hence the need for them to be well informed about participatory methods of extension. In summary, capacity building in KAEMP was implemented in several stages

1. District technology transfer manager (master trainer) was trained in IPM/IPN concepts and approaches including participatory methods of technology transfer through farmer groups;
2. The master trainer trains the VEOs; and
3. The VEOs train farmer groups.

117. To enhance the learning process between groups, the project facilitated farmer-farmer learning through group exchange visits between groups within and between villages and districts. A few farmer representatives visited the Shinyanga IPM farmer training groups. To promote spillover, KAEMP organised and facilitated field days. The IPM/IPN farmer groups were also used for the transfer of other development messages e.g. health, water, environmental management etc. and therefore were foci for all extension messages.

118. The KAEMP initiative started in September 1999. By May 2001, the adoption of IPM/IPN within groups was 60 percent whereas the spillover (diffusion) after 20 months of operation was 1:3, which is quite impressive (J. B. Anania, E. A. M. Anyosisye, personal communication). KAEMP owes much of its success to the GTZ/PHS-IPM Shinyanga experience. The entire stakeholders at regional, district, village and farm level has received the approach with enthusiasm.The achievements of the project was a result of good political support at regional level, team spirit, sufficient funding, effective capacity building, institutional collaboration, good organisational abilities and focused selection of appropriate technology for transfer to target clients.

### 7.1.3 MARA REGION FARMER INITIATIVE PROJECT (MARAFIP)

119. MARA-FIP was an initiative of Mara region whose main objective was poverty alleviation through strengthening of capacity of the local institutions to respond to farmer's felt needs related to food, agriculture and livestock. The project was organised and implemented by RAS and funded by IFAD. The MARA-FIP was another offspring of the GTZ/PHS-IPM project (S. O. Y. Sassi, personal communication) and therefore, has many common features. However, MARA-FIP used the FAO IPM-FFS approach of group training and technology transfer.

120. **Capacity building:** All district plant protection officers and VEOs were given training in IPM concepts to raise awareness about IPM to facilitate their supervisory role. Five VEOs (project staff) of selected villages for FFS pilot groups were given one-month split course in IPM, group management and participatory technology transfer methods to provide them the capacity to organise and conduct IPM-FFS. There were 5 IPM-FFS groups in the region, one per district. The main focus crops were cassava, cotton, maize, sorghum, legumes (cowpeas, field beans) and sweet potato. The IPM messages/technologies introduced to the FFS groups were borrowed from the Shinyanga IPM project without further refinement. In one case, the "broken telephone message syndrome" was noted with concern.

121. At farmer level, the approach was received with enthusiasm and adoption of some messages among group members was estimated to be about 25 percent (one year after IPM training). The IPM-FFS groups were also used as entry points for other extension messages e.g. soil and water management, livestock management and community health, which is in line with the regional objectives. However, funding to facilitate technical support to farmer groups was a constraint, and scheduled activities were shelved.

### 7.1.4 MBEYA: SOUTHERN HIGHLANDS EXTENSION & RURAL FINANCIAL SERVICES PROJECT/IFAD

122. This initiative started with organised extension farmer groups in 1996/97 using a modified T&V extension method to enhance technology transfer at farm level. Essentially, the approach was still strongly based on the traditional "top-down" extension method (E.D. Y. Kiranga and A. H. Urio, personal communication). In 1998/99 the project introduced IPM-FFS pilots in Mbeya (focused on tomatoes, cabbage, round potatoes and wheat) and Ruvuma (focused on coffee and maize) regions. The IPM-FFS and extension groups ran parallel in the same villages.

123. IPM-**FFS capacity building (IFAD/FAO initiative):** Two VEOs (master trainers) attended a 3 months course in Zimbabwe under the sponsorship of FAO. The project supervisors visited IPM-FFS groups in Kenya for two weeks to gain some basic experience on how to organise and conduct IPM-FFS. This was followed by 2-weeks residential training course in IPM and farmer participatory methods of technology transfer for 25 VEOs in Mbeya and Mbinga districts. The graduates reported back to their duty stations to organise and conduct IPM-FFS in their respective villages.

124. Similar to the GTZ/PHS-IPM project, farmer-farmer learning through exchange visits between farmer groups and within group members was facilitated. Like in the other initiatives, organised field days and exchange visits were used to encourage spillover to non-group members. Institutional collaboration was also emphasised during the project implementation phase. The IPM-FFS approach was highly appreciated by farmers and the VEOs because it was participatory and learning by doing.

### 7.1.5 LESSONS AND GENERAL DISCUSSION

#### Approach

125. All the projects discussed in the section above were actively promoting participatory technology transfer to increase food security and cash income at farm level through self-formed farmer groups. Some of these groups are now officially registered. All the initiatives emphasised IPM in their farmer groups. The groups were used as entry points for other innovations on a felt need basis irrespective of the original purpose. The IPM farmer groups were used as foci for the extension of a wide range relevant and appropriate technology and knowledge, this enhancing group cohesion and overall development. The participatory group approach to technology transfer was received with enthusiasm by all the farmers and VEOs. This is because it involved hands-on-learning, an observation made by all the farmers visited.

#### Capacity Building

126. These model projects have a lot in common. Capacity building with emphasis on participatory methods of technology transfer, group formation and management were deemed necessary and essential for the project technical staff before training farmer groups. Collaboration and sharing of experiences between projects was key to the success of new initiatives in different parts of the country. The GTZ/PHS-IPM project played a major role in the set up and organisation of KAEMP and MARAFIP.

**Institutional Collaboration**

127. Institutional collaboration (as indicated in the GTZ/PHS-IPM initiative) ensured harmonisation of technical information, optimisation of scarce resources, and ensured farmers of the best remedies to priority problems. As indicated above, collaboration between projects within the country was a healthy avenue for sharing experiences that facilitated speedy setup of new initiatives.

**Funding and Logistical Support**

128. This is very crucial in all the projects. Adequate and timely release of funds determined the progress of the projects. Currently, and in particular where donor funding has been phased out, project activities have been constrained by a lack of continuous flow of funds, leading to less frequent visits and training of established farmer groups. Scheduled activities have been affected in most areas and technical input in existing farmer groups has been curtailed. Funds flow from district councils to support extension services, particularly the farmer groups, after decentralisation is minimal and/or non-existent.

129. The lack of logistical support from the district councils is purported to be largely due to lack of awareness among district decision makers of the significance of promoting participatory group approaches in extension.

**Political support**

130. Local political support is also crucial in the implementation and sustainability of group approach to IPM promotion. KAEMP is the only initiative that seems to have stronger support. This is most likely a result of the project set-up and its holistic approach that addresses the broader needs of the region.

## 7.2 ZANZIBAR

131. Integrated Pest Management has been adopted by the PPD of the MANR, Zanzibar to improve agricultural production. The PPD with its mandate on crop protection in Zanzibar has been implementing IPM on four major crops. These are rice, banana, vegetables and cassava. Farmers are empowered on environmentally sound practices such as disease free planting materials, certified seeds, and botanical control.

132. According to a report on "*Experiences in Adoption of Integrated Pest Management (IPM) Strategies in Zanzibar*" (Abdullah *et al.*, 2010), four major problems were identified for the four crops targeted. These were poor crop management, use of diseased seeds and planting materials, depletion of soil nutrients, and continuous cropping on the same land. The associated farming problems were ranked as (i) pests and diseases (ii) poor soil fertility (iii) unavailability of seeds (iv) lack of technical know-how.

133. Most local cultivars were abandoned. Their disappearance has been linked with a decline in resistance to pests and diseases, drought stress, and market demand. The overall

trend in production has been decreasing due to number of factors including depletion of soil nutrients, population pressure. Yield losses caused by pest and diseases can be up to 80 percent. This has forced farmers to increase the production by increasing acreage. However the average yield is still very low.

134. The table below shows the results of farmer practice with IPM from FFS study plots in Zanzibar. However, the capacity to implement IPM in Zanzibar is much weaker than on the Mainland. The islands have few trained staff in IPM, and both extension staff and farmers remain largely ignorant of the Pest Management Act and associated regulations.

Table 6.3. Farmer Field School Study Plots For Major Crops (IPM and Farmers' practice)

| **Crop** | **Farmers' Practice (tons/ ha)** | **IPM Practice (tons/ ha)** | **Increase in yield (%)** |
|---|---|---|---|
| **1. Irrigated rice** | 2.2 | 4.4 | 100 |
| **2. Rainfed rice** | | | |
| - Katrin | 1.9 | 3.0 | 57.9 |
| - BKN – Supa | 1.1 | 1.5 | 36.4 |
| - Supa | 2.0 | 2.4 | 20 |
| - Subang | 2.7 | 3.7 | 37 |

Source: Abdullah *et al.,* (2010)

## 8.0 IMPLEMENTATION STRATEGIES UNDER THE ERPP

135. This IPMP will address the Project needs to monitor and mitigate possible negative impact of any increase in the use of agrochemicals, particularly chemical pesticides by promoting ecological and biological control of pest management. This will be implemented through four main activities. First, a set of planning workshops will be implemented to ensure that key implementation agencies are fully aware of the objectives of the IPMP, the workplans and budgets proposed and the outcomes expected. Specific tasks will be allocated to specific individuals or groups of individuals. These will be followed by annual review workshops supporting the discussion and documentation of field logistics, implementation lessons in the targeted Project regions.

136. Second, the project will support four levels of IPM training. Level one will be the training of technical staff in IPM techniques and pesticide management relevant to irrigated rice based cropping systems. Level two will support training of trainers who are expected to carry a prioritized selection of these messages to the village. Level three will support the training of farmer groups. To the extent possible, this will be integrated into the participatory testing of new cropping technologies being promoted by the ERP. Level four will promote broader awareness of the National Pest Management Act and associated regulations among district extension personnel and also among shopkeepers selling pesticides.

137. Third, on the mainland, the Project will provide funding for on-farm testing of new IPM technologies for rice based cropping systems. This support will be allocated based on the prioritization of the problem being addressed in the targeted rice systems and the probability that the solution may be successfully applied in the near future. In complement, the project will encourage research and extension personnel to work together to develop and disseminate farmer friendly extension materials on IPM technologies or techniques for rice based systems.

138. In Zanzibar, the project will contribute to the review of the National Pest management Act, the development of regulations for the application of this Act, and a broader awareness campaign on the value of IPM practices. Finally, on both the Tanzania Mainland and Zanzibar, the Project will support a monitoring system designed to track the impacts of the IPM training and information dissemination on the adoption of IPM technologies in the targeted rice systems, and knowledge of the safe practices in the use and disposal of pesticides. This will include funding support for baseline surveys, on-going monitoring during project implementation and impact evaluation surveys.

### 8.1 Institutional Roles and Responsibilities

#### i) Activity Set 1: Awareness raising

139. The implementation of this IPMP will be supervised by the designated officers in charge of safeguards management in the Project management committees of both the MAFC and the MANR. The two safeguards managers will organize the initial workshops to discuss the implementation of the IPMP, and annual review workshops to assess progress in implementation, in coordination with the Project leaders of MAFC and MANR.

#### ii) Activity Set 2: Training and capacity building

140. The training efforts at the core of the project commitment will require collaboration across multiple institutions involved in organizing training curriculum and in administering the training. To the extent possible, this is expected to be a participatory process. The success of IPM largely depends on developing and sustaining institutional and human capacity to facilitate experiential learning for making informed decisions in integrating scientific and indigenous knowledge to solve district, ward and village specific problems. Poor communication between farmers, extension agents and researchers has often led to poorly-targeted research or to poor adoption of promising options generated by research. The full benefits of investment in agricultural research thereby remain untapped under these circumstances. Closer farmer-research investigator interaction, adaptive research and participatory learning approaches in capacity building efforts can help to bridge this gap and make research results more adopted by farmers.Capacity building will be achieved through farmer-based collaborative management mechanisms where all key stakeholders shall be regarded as equal partners.

***a) Morogoro Region***

The short course training and associated study tours will be organized by the MAFC Project Coordination Unit. The training of trainers and farmer training will be organized by the Safeguards Advisor/environmental Management Specialist in collaboration with participating LGAs. Other key stakeholders such as NGOs and GoT Ministries/Agencies/Institutions/Departments will be invited to provide their expertise and experience during the trainings at various levels. Farmers, as the principal beneficiaries, will be organized into farmer groups for training and adoption of IPM practices. The farmers will be facilitated to set up Community IPM Action Committees to coordinate IPM activities in their areas (scaling up the armyworm CBAF experience).

141. The MAFC Plant Health Services (PHS), Zonal Agricultural Research and Development Institutes (ZARDIs) and Environmental Management Unit (EMU) for Tanzania Mainland have the mandates to implement crop protection and pest management, research and environmental management respectively. The ERP will provide logistical and technical support to IPM trainers (PHS, EMU, TPRI and KATRIN) and to exploit their experiences in the implementation of IPM and management of outbreak and migratory pest. PHS in collaboration with EMU will undertake to build the capacities of DPPOs to train VEOs and SMS in promoting IPM and environmental management activities. The DPPOs will train the SMSs and VEO/BEOs in IPM and the VEOs and SMSs will train farmers in IPM technologies using Farmers Field Schools (FFS). PHS will provide capacity and policy guidance for implementation of the district PMP. The ZARDIs IPM commodity team will serve as resource persons at FFS and districts or any other mechanism deemed suitable for conducting IPM Trainers and Farmer Group training secessions. The team will also be a major partner to farmer groups in planning and execution of farmer participatory research activities related to IPM.

142. The PHS and EMU will work together to define the curricula for promoting better understanding of the PPA 1997, as well as the draft PPA 2013, and the associated regulations, and to present this to district officials and to rural retailers selling agro-chemicals in the Morogoro Region.

***b) Zanzibar***

143. Farmers will be organized into farmer groups for training and adoption of IPM practices. As on the mainland, farmers will be facilitated to set up Community IPM Action Committees to coordinate IPM activities in their areas (scaling up the armyworm CBAF experience). The MANR Plant Protection Division (PPD) for Zanzibar has the mandate to implement crop protection and pest management, research and environmental management respectively. The ERP will provide logistical and technical support to IPM trainers and to exploit their experiences in the implementation of IPM and management of outbreak and migratory pest. PPD will undertake to build the capacities of DPPOs to train VEOs and SMS in promoting IPM and environmental management activities. The DPPOs will train the SMSs and Block Extension Officers (BEO) in IPM and the BEOs and SMSs will train farmers in IPM technologies via Farmers Field Schools (FFS). PPD will provide capacity and policy guidance for implementation of the district PMP. The ZARDIs IPM commodity team will served as resource persons at FFS and districts or any other mechanism deemed suitable for conducting IPM Trainers and Farmer Group training secessions.

144. The District Health Officers should facilitate capacity building for DPPOs, SMS and BEOs in FFS in partnership with NGOs/CBOs to raise public awareness about IPM, production of extension materials, radio and television programmes in respective districts. They should also monitor the inputs quality supplied by the dealers.

**Activity Set 3 New IPM Technologies for Rice Systems**

***a) Morogoro Region***

145. The applied, adaptive research funding will be allocated and administered by the safeguards advisor participating in the Project Management Team of MAFC. Grants will be provided to national scientists in public research institutes or universities in order to solve priority problems identified in the field during participatory IPM training sessions. Complementary allocations of operational funding will be allocated by the same entities for the preparation of farmer friendly extension materials. This information will be regularly shared with IPM programs in Zanzibar.

***b) Zanzibar***

146. The emphasis of the Zanzibar workplan is to encourage better understanding of the content and application of the Pesticide Management Act and associated regulations for pesticide management. This will be extended with a national campaign for promoting broader awareness of IPM strategies, particularly those that may reduce the use of harmful pesticides. These activities will be organized and implemented by the MANR and PPD.

**iv) Activity Set 4: Monitoring and Evaluation**

147. The safeguards advisors linked with the respective project management teams of the MAFC and the MANR will be responsible for guiding the implementation of the monitoring and evaluation activities of the IPMP. These people are expected to participate in the drafting of the baseline survey, and the end of project survey, assuring inclusion of relevant questions on pest management practices, agro-chemical use and pesticide management. These staff are expected to participate in each of the six monthly implementation support missions. The baseline and impact surveys will be contracted out to a firm specializing in impact surveys.

## 8.2 Specific Pest Management Measures

### Rules for Safe Handling of Pesticides

148. All pesticides are poisonous and thus rules have to be observed to avoid human health impairment and environmental pollution. In addition to material safety data sheet (MSDS) accompanied with any given pesticide, the following general rules will have to be observed:

- Keep only closed original containers with labels.
- Keep pesticides under lock and key in a cool, dry and ventilated place away from fire, food, feed, water and out of reach of children. In the same room also the spraying equipment can be stored.
- Pesticides should be shelved and the floor be of cement to be able to detect leakage and clean it early enough where applicable.
- Equipment for weighing and mixing pesticides should only be used for this purpose and be locked in the store.
- Protective clothing should be used only for spraying purposes.
- Absorb spillage immediately with sawdust or earth; sweep up, burn or bury. Have cement floor for better cleaning.
- Do not re-use empty containers. Empty containers should be burnt if possible or crushed and bury in a sanitary landfill.
- Use a well aerated store and sales room.
- Instruct your personnel on safety precautions before (!) it is too late.
- Make contacts to a qualified physician for emergencies.

149. In view of the above, the use of protective equipment and capacity building on pesticide management aspects will be critical.

### Recommended Pesticides in Tanzania

150. Table 8.1 summarizes the current registration list of pesticides in Tanzania. However, the ERP will not support the purchase, distribution or use of any WHO Class Ia, Ib or II chemicals. This restriction will be explained during project supported training sessions, and will be monitored in the implementation support missions.

Table 8.1: List of recommended and TPRI registered pesticides for crop production in Tanzania[a/]

| *Chemical* | *Common name* | **Oral LD50/kg* | *WHO class* | *Comments* |
|---|---|---|---|---|
| Insecticides | Betacyfluthrin | 500-800 | II | Not supported |
| | Biphenthrin | | | |
| | Chlorpyrifos | 135-163 | Ib | Not supported |
| | Cypemethrin | 251-4125 | III | |
| | Cypermethrin + Dimethoate | 251-4125 + 2350 | III | |
| | Deltamethrin | 153-5000 | III | |
| | Dealtamethrin + Dimethoate | 153-5000+2350 | III | |
| | Diazinon | 220 | II | Not supported |
| | Dimethoate | 2350 | III | |

| *Chemical* | *Common name* | **Oral LD50/kg* | *WHO class* | *Comments* |
|---|---|---|---|---|
| | Esfenvalerate | 451 | II | Not supported |
| | Fenitrothion | 800 | II | Not supported |
| | Fenvalerate | 451 | II | Not supported |
| | Fenvalerate + Fenitrothion | 451+ 800 | II | Not supported |
| | Flucythrinate | | | |
| | Hydrmethyl | | | |
| | Lambda cyhalothrin | 243 | II | Not supported |
| | Permethrin | 430-4000 | III | |
| | Pirimiphos methyl | 2050 | III | |
| | Pirimiphos methyl + permethrin | 2050 + 430-4000 | III | |
| | Profenophos | 358 | II | Not supported |
| | Profenophos + cypermethrin | 358 + 251-4123 | II | Not supported |
| | Quinalphos | 62-137 | Ib | Not supported |
| Nematicides | Dazomet | 520 | II | Not supported |
| | Isazophos | 40-60 | Obsolete | Not supported |
| Herbicides | Atrazine | | | |
| | Diuron | | | |
| | Fluometuron | | | |
| | Glyphosate | | | |
| | Metolachlor + Atrazine | | | |
| | Metalachlor + Dipropetrin | | | |
| | Paraquat | | | Not supported |
| *Chemical* | *Common name* | **Oral LD50/kg* | *WHO class* | *Comments* |
| Avicides | Fenthion | | II | Not supported |
| | Cyanophos | | II | Not supported |
| Rodenticides | Bromodiolone | | Ia | Not supported |
| | Coumatetralyl | | Ia | Not supported |
| | Diphacinone | | Ia | Not supported |
| Fungicides | Bronopol | | | |
| | Chlorothalonil | 10,000+ | III | |
| | Copper hydroxide | 1,000 | II | Not supported |
| | Copper oxychloride | 70-800 | II | Not supported |
| | Cupric hydroxide | 1,000 | II | Not supported |
| | Cuprous oxide | | | |
| | Cyproconazole | 1,000 | II | Not supported |
| | Hexaconazole | 2189 | III | |
| | Mancozeb | 5000+ | III | |
| | Metalaxyl + Mancozeb | 633 + 5000+ | III | |
| | Penconazole | | | |
| | Propineb | 1,000 | II | Not supported |
| | Triadimefon | 1,000 | II | Not supported |
| | Sulfur | | | |

[a/]This table has been slightly updated. Important notice is that an extraordinary meeting of the National Plant Protection Advisory Committee (NPPAC), a body responsible for review of the pesticide list, took place in February 2014; the new list has been approved and the Pesticide Registrar's Office was expected to publish the list before June 2014.

151. Table 8.2 identifies chemicals subject to the Prior Informed Consent (PIC) procedure in Tanzania. The ERP will not support the purchase, distribution or use of any of these chemicals.

Table 8.2 List of pesticides whose use is subject to the PIC procedure in Tanzania

| Chemical | Category | Registration Status in Tanzania | Import Decision |
|---|---|---|---|
| 2,4,5-T and its salts and esters | Pesticide | Not registered | No consent |
| Aldrin | Pesticide | Restricted registration for use in soil against termites | Consent |
| Binapacryl | Pesticide | Not registered | No consent |
| Captafol | Pesticide | Banned since 1986 | No consent |
| Chlordane | Pesticide | Restricted registration for use in soil against grubs, termites, ants and crickets | Consent |
| Chlordimeform | Pesticide | Not registered | No consent |
| Chlorobenzilate | Pesticide | Not registered | No consent |
| DDT | Pesticide | Banned for agricultural use, restricted for public health | Consent for public health |
| Dieldrin | Pesticide | Restricted registration for emergency cases in limited amount | consent |
| Dinitro-*ortho*-cresol (DNOC) and its salts (such as ammonium salt, potassium salt and sodium salt) | Pesticide | Not registered | No consent |
| Dinoseb and its salts and esters | Pesticide | Not registered | No consent |
| 1,2-dibromoethane(EDB) | Pesticide | Restricted registration for fumigation application on soil | consent |
| Ethylene dichloride | Pesticide | Not registered | No consent |
| Ethylene oxide | Pesticide | Not registered | No consent |
| Fluoroacetamide | Pesticide | Not registered | No consent |
| HCH (mixed isomers) | Pesticide | Not registered | No consent |
| Heptachlor | Pesticide | Registered for use in various crops against termites and other soil pests | consent |
| Hexachlorobenzene | Pesticide | Not Registered | No consent |
| Lindane | Pesticide | Registered hides and skins | Consent |
| Mercury compounds, including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds | Pesticide | Not Registered | No consent |
| Monocrotophos | Pesticide | Not registered | No consent |
| Parathion | Pesticide | Banned in 1986 | No consent |
| Pentachlorophenol and its salts and esters | Pesticide | Not registered | No consent |
| Toxaphene | Pesticide | Banned in 1986 | No consent |
| Dustable powder formulations containing a combination of:<br>- Benomyl at or above 7 per cent,<br>- Carbofuran at or above 10 per cent,&<br>- Thiram at or above 15 per cent | Severely hazardous pesticide formulation | Not registered | No consent |
| Monocrotophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l) | Severely hazardous pesticide | Not registered | No consent |
| Methamidophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l) | Severely hazardous pesticide | Not registered | No consent |
| Phosphamidon (Soluble liquid formulations of the substance that exceed 1000 g active ingredient/l) | Severely hazardous pesticide | Not registered | No consent |
| Methyl-parathion (emulsifiable concentrates (EC) at or above 19.5% active ingredient and dusts at or above 1.5% active ingredient) | Severely hazardous pesticide | Banned in 1986 | No consent |

| Chemical | Category | Registration Status in Tanzania | Import Decision |
|---|---|---|---|
| Parathion (all formulations – aero-sols, dustable powder (DP), emulsifiable concentrate (EC), granules (GR) and wettable powders (WP) - of this subs-tance are included, except capsule suspensions (CS)) | Severely hazardous pesticide formulation | Not registered | No consent |

Source: Designated National Authority - Prior Informed Consent Procedure (DNA PIC)

## 8.3 Workplan and budget

152. The MAFC and MANR will each take responsibility for implementation of separate but coordinated workplans and budgets under the ERP. These commitments will be supervised by the safeguards advisor from each Ministry who is a member of the respective Project Management Teams.

Table 8.3: Tanzania Mainland MAFC workplan and budget for implementation of the IPMP

| OUTPUT/ACTIVITY | TIMEFRAME | | | | | RESPONSIBLE | COST ESTIMATES (USD) |
|---|---|---|---|---|---|---|---|
| | YR 1 | YR 2 | YR 3 | YR 4 | YR 5 | | |
| **Output 1.0: ERP IPMP Start Up Workshop** | | | | | | | |
| **Activity 1.1:** Organize and conduct Stakeholders Consultative Meeting on implementation of IPMP (to be carried out in conjunction with ESMF workshop) | | | | | | MAFC, LGAs | **Included in ESMF budget** |
| **Sub- Total for Output 1** | | | | | | | **0** |
| **Output 2.0: Capacities of extension officers and farmers to promote and adopt IPM approaches and safe use of pesticides in rice production are enhanced** | | | | | | | |
| **Activity 2.1:** Prepare, print and disseminate popular and/or swahili versions IPM guidelines on safe use and handling of pesticides; and Community Based Forecasting for outbreak pests (e.g. armyworm, quelea quelea, rats) | | | | | | PHS, EMU, DITS and DRD | **25,000** |
| **Activity 2.2:** To facilitate short courses trainings/workshops for MAFC ERPP implementers on IPM related issues so as to improve knowledge and skills | | | | | | PHS, EMU, DITS and DRD | **20,000** |
| **Activity 2.3:** Mobilize and train farm communities on Community Based Armyworm and Quelea bird Forecasting and control approaches so as to minimize pesticide use | | | | | | PHS, EMU, DITS, DRD and DEMO | **20,000** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Activity 2.4:** To conduct farmer training to disseminate the IPM technologies and safe practices in the use of pesticides and other agro-chemicals in the ERPP areas | | | | | | PHS, EMU and DEMO | **20,000** |
| **Activity 2.5:** Organize field trips and study tours (Local and Foreign) at National, District and farmer level to observe the successful IPM practices for controlling major rice pests in other rice producing areas | | | | | | MAFC and LGAs | **30,000** |
| **Activity 2.6:** Prepare radio programs, and print leaflets, brochures and posters to be disseminated during various agricultural shows in the Project Area | | | | | | PHS, EMU and DRD | **15,000** |
| **Sub- Total for Output 2** | | | | | | | **130,000** |
| **Output 3.0: New IPM Approaches/Packages are identified for ERPP areas** | | | | | | | |
| **Activity 3.1:** To conduct rapid appraisal survey to evaluate methods used by farmers to control major rice pests in ERPP areas | | | | | | MAFC and LGAs | **6,000** |
| **Activity 3.2:** Participatory on-farm testing of new IPM technologies for rice based systems | | | | | | KATRIN, PHS, Extension, EMU | **30,000** |
| **Sub- Total for Output 3** | | | | | | | **36,000** |
| **Output 4.0: Monitoring and Evaluation of IPM activities and IPMP implementation** | | | | | | | |
| **Activity 4.1:** IPM tracking incorporated into ERPP baseline, midterm and end term surveys | | | | | | PHS and EMU | **covered in main project impact survey budgets** |
| **Activity 4.2:** Conduct monitoring and evaluation of ERPP-IPMP implementation | | | | | | EMU | **8,000** |
| **Sub- Total for Output 4** | | | | | | | **8,000** |
| **GRAND TOTAL** | | | | | | | **174,000** |

Table 8.4. Zanzibar MANR Workplan and Budget for the Implementation of the IPMP for the ERPP

| Output/Activity | Timeframe | | | | | | | | | | | | | | | | | | | | Responsible | Indicative Cost (USD) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | YR1 | | | | YR 2 | | | | YR 3 | | | | YR4 | | | | YR5 | | | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | | |
| **Output 1. ERP IPMP Start-Up Workshop** | | | | | | | | | | | | | | | | | | | | | | |
| **Activity 1.1 Start-up Workshop on Environmental Safeguards** | | | | | | | | | | | | | | | | | | | | | | |
| Activity 1.1.1 Discussion of safeguards plan with project stakeholders | | | | | | | | | | | | | | | | | | | | | MANR | in ESMF workplan budget |
| **Total for Output 1** | | | | | | | | | | | | | | | | | | | | | | |
| **Output 2: District SMS, block extension officers and farmers empowered to adopt IPM practices, safe use and handling of pesticide, and environmental management issues in rice production** | | | | | | | | | | | | | | | | | | | | | | |
| **Activitiy 2.1 Develop training manual for use by district SMS and BEO to facilitate IMP practice, safe use and handling of pesticide, and environmental management issues in rice production** | | | | | | | | | | | | | | | | | | | | | MANR - HR | |
| 2.1.1 Hire consultant to develop the manual | | | | | | | | | | | | | | | | | | | | | | 5,000 |
| 2.1.2 Organise technical meeting to share the manual | | | | | | | | | | | | | | | | | | | | | | 1,500 |
| 2.1.3 Translate the Training manual into popular version (Kiswahili) | | | | | | | | | | | | | | | | | | | | | | 2,500 |
| 2.1.4 Publish and distribute copies of Training manual to district agricultural and plant protection officers and farmers | | | | | | | | | | | | | | | | | | | | | | 3,500 |
| **Sub total** | | | | | | | | | | | | | | | | | | | | | | **12,500** |
| **Activity 2.2 Facilitate training for district SMS and BEO on IPM practice, safe use and handling of pesticide, and environmental management issues in rice production** | | | | | | | | | | | | | | | | | | | | | DoA, DoI, DoE, PPD | |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.2.1 Organise skilled training workshops for District SMS and BEO on issues related to IPM practice in rice production and other crops | | | | | | | | | | | | | | | | | | | | | | | 5,000 |
| 2.3.2 Organised field practical visits to expose SMS with IPM practices around project area | | | | | | | | | | | | | | | | | | | | | | | 5,000 |
| 2.3.3 Organize Training of Trainers (ToT) for IPM Field Trainers | | | | | | | | | | | | | | | | | | | | | | | 4,000 |
| **Sub total** | | | | | | | | | | | | | | | | | | | | | | | **14,000** |
| **Activity 2.3 Conduct Farmer Group Training Sessions on IPM, safe use and handling of pesticide, and environmental management issues in rice production** | | | | | | | | | | | | | | | | | | | | | | DoA, DoI, PPD, DoE | |
| 2.4.1 Train farmers on the application of IPM in rice production | | | | | | | | | | | | | | | | | | | | | | | 5,000 |
| 2.4.2 Train farmers on safe use and handling of pesticide and environmental management issues in rice production | | | | | | | | | | | | | | | | | | | | | | | 5,000 |
| 2.4.3 Organise field visits for formers to learn and share experience on IPM practices | | | | | | | | | | | | | | | | | | | | | | | 4,000 |
| **Sub total** | | | | | | | | | | | | | | | | | | | | | | | **14,000** |
| **Total for Output 2** | | | | | | | | | | | | | | | | | | | | | | | **40,500** |
| **Output 3 Strengthening National Pest Management Systems** | | | | | | | | | | | | | | | | | | | | | | MANR | |
| **Activitiy 3.1: Review Pesticide Management Act** | | | | | | | | | | | | | | | | | | | | | | MANR | |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.1.1 Organise 2 national stakeholders workshops (technical, policy makers, local community) to share and review document for comments | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1.2 Translate the Act into popular version (Kiswahili) | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1.3 Print and distribute 100 copies of PMA to district and regional level, Shehia leaders, government departments and agencies | | | | | | | | | | | | | | | | | | | | | | | |
| **Sub total** | | | | | | | | | | | | | | | | | | | | | | | **not in project budget** |
| **Activity 3.2: Develop regulations on pesticide management** | | | | | | | | | | | | | | | | | | | | | | MANR | |
| 3.2.1 Discuss applicability of pest management regulations of Mainland for Zanzibar | | | | | | | | | | | | | | | | | | | | | | | 2500 |
| 3.2.2 Hire consultant to develop regulations on pesticide management | | | | | | | | | | | | | | | | | | | | | | | 5,000 |
| 3.2.3 Organise 2 national stakeholders workshops (technical, policy makers, local community) to share the review regulations | | | | | | | | | | | | | | | | | | | | | | | 3,000 |
| 3.2.4 Translate the regulations into popular version (Kiswahili) | | | | | | | | | | | | | | | | | | | | | | | 1,500 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.2.5 Publish and distribute copies of regulations to the district and regional levels, Shehia leaders, government departments and agencies | | | | | | | | | | | | | | | | | | | | | | | 2,000 |
| **Sub total** | | | | | | | | | | | | | | | | | | | | | | | **11,500** |
| **Activity 3.3: Conduct National awareness programme on IPM practices** | | | | | | | | | | | | | | | | | | | | | | DoA, DoI, PPD | |
| 3.3.1 Prepare and conduct TV and Radio programme | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3.2 Prepare and distribute 2000 brochure with information on IPM practices | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3.3 Prepare and distribute posters to the farmers with message on IPM | | | | | | | | | | | | | | | | | | | | | | | |
| **Sub total** | | | | | | | | | | | | | | | | | | | | | | | not in project budget |
| **Activity 3.4 Establish monitoring and early warning system for pest outbreaks (for armyworm and edible grasshopper)** | | | | | | | | | | | | | | | | | | | | | | | |
| 3.4.1 Define and organize system structure and division of responsibilities | | | | | | | | | | | | | | | | | | | | | | | |
| 3.4.2 System establishment and testing | | | | | | | | | | | | | | | | | | | | | | | |
| Sub total | | | | | | | | | | | | | | | | | | | | | | | not in project budget |
| **Total for Output 3** | | | | | | | | | | | | | | | | | | | | | | | **11,500** |
| **Output 4: Monitoring and Evaluation of IPM activities and IPMP implementation at National, District and Local level** | | | | | | | | | | | | | | | | | | | | | | | |
| **Activity 4.1 IPMP Monitoring** | | | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.1.1 Conduct regular monitoring and evaluation visits on implementation of IPMP in the ERPP areas | | | | | | | | | | | | | | | | | | | | | | DoA, DoI, PPD, DoE | 2500 |
| **Activity 4.2 IPMP Evaluation** | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2.1 Analyze impact of IPM in the project area by conducting Impact assessment and environmental auditing of the applied IPM practices | | | | | | | | | | | | | | | | | | | | | | | in project impact evaluation budget |
| Total for Ouput 4 | | | | | | | | | | | | | | | | | | | | | | | **2,500** |
| **Grand Total** | | | | | | | | | | | | | | | | | | | | | | | **54,500** |

## 9.0 Bibliography


Abdullah Z.S., Lada V. Y., and Khamis Mohd., 2010. Experiences in adoption of Integrated Pest Management (IPM) Strategies in Zanzibar, International Journal of Sustainable Development, Vol., 2 No. 03: 49-55.

ASDP., 2004. Integrated pest management plan. Final Report, August 2004.

Banwo, O.O., 2002. Management of major insect pests of rice in Tanzania. Plant Protection Science. Vol.38, No.3:108-113

Elliott, C.C.H., 1989. The pest status of the quelea. pp 17-34. In: Bruggers, R.L and Elliott C.C.H (eds)., Quelea quelea: Africa's bird pest. Oxford: Oxford University Press.

Nyambo, B., Masaba, D., and Hakiza, G., 1996. Integrated pest management of coffee for small-scale farmers in East Africa . Integrated Pest Management Reviews 1:125-132.

Mushobozi, W.L., Grzywacz, D., Musebe, R., Kimanim M., and Wilson, K., 2005. New approaches to improve the livelihoods of poor farmers and pastoralists in Tanzania through monitoring and control of African armyworm, Spodoptera exempta. Aspects of Applied Biology, Vol. 75:37-45.

Mwanjabe, P. S., and Leirs, H., 1997. An early warning system for IPM-based rodent control in smallholder farming systems in Tanzania. Belgian Journal of Zoology, Vol. 127, No. 1: 49-58

United Republic of Tanzania,1997. Plant Protection Act 13: Government Printers, Dar es Salaam Tanzania

United Republic of Tanzania, 2004. Environmental Management Act No. 20: Government Printers, Dar es Salaam Tanzania.

United Republic of Tanzania, 2005. Environmental Impact Assessment and Audit Regulations, 2005-G.N. No. 349 of 2005.

United Republic of Tanzania, 2007. Environmental Management (Soil Quality Standards) Regulations, 2007.

United Republic of Tanzania, 2008. Ministry of Agriculture Food Security and Cooperatives, 2006/2007 Annual Report

United Republic of Tanzania, 2009. National Rice Development Strategy. Final Draft. Accessed at www.kilimo.go.tz

United Republic of Tanzania, 2009. Agriculture Sector Development Program Integrated Pest Management Plan. Revised Version

United Republic of Tanzania, 2010. National Strategy for Growth and Reduction of Poverty (NSGRP), Ministry of Finance and Economic Affairs

United Republic of Tanzania, 2012. Long Term Perspective Plan 2011/12-2025/26, The Road Map to Middle Income Country. Office of the President.

United Republic of Tanzania, 2012. Tanzania Five Year Development Plan 2011/12-2015/16, Unleashing Tanzania's growth potentials. Office of the President

United Republic of Tanzania, 2012. National Population and Housing Census

Van Der Walt, E., Meinhardt, H. R., Venter, A. J. and Bouwman, H., 1998. Primary and secondary effects of Red-billed Quelea Quelea quelea control in South Africa. Ostrich 69: 456.

Verdoorn, G., 1998. Solving the problems of pesticide misuse for avian conservation in Southern Africa. Ostrich 69: 58.

Winkfield, R. A., 1989. The distribution and importance of small-grain crops in Zimbabwe and their susceptibility to quelea damage. pp. 100–103. In: Africa's Feathered Locust, Mundy, P. J., and Jarvis, M. J. F., (eds). Baobab Books, Harare, Zimbabwe.

Winkfield, 1989. The distribution and importance of small-grain crops in Zimbabwe and their susceptibility to quelea damage. pp. 100-103. In: Africa's Feathered Locust, Mundy, P. J., and Jarvis, M. J. F., (eds). Baobab Books, Harare, Zimbabwe.

World Bank, 2014. Safeguard Policies in particular OP 4.09 and BP 4.01, Annex C.

## Annex 1. Consultative Discussions

*Names of experts preparing the IPMP*

| Name | Title/Profession | Organization |
|---|---|---|
| Margaret Ndaba | Team Leader / Principal Economist | Department of Policy and Planning, Ministry of Agriculture Food Security and cooperatives. |
| Shakwaanande Natai | Head - Environment Management Unit | Environment Management Unit, Ministry of Agriculture Food Security and cooperatives. |
| Victoria Kisamfu | Principal Agriculture Officer | Environment Management Unit, Ministry of Agriculture Food Security and cooperatives. |
| Lait Simkanga | Environmental Engineer | Department of Irrigation and Technical Services, Ministry of Agriculture Food Security and cooperatives. |
| Ronald Komanga | Community Development Officer / Sociologist | Department of Irrigation and Technical Services, Ministry of Agriculture Food Security and cooperatives. |
| Nassor Mkarafuu | | MANR - Zanzibar |
| Tamrin Said | | MANR - Zanzibar |
| Mary Majule | Principal Agriculture Officer | Environment Management Unit, Ministry of Agriculture Food Security and cooperatives. |
| John Banga | Agriculture Officer | Environment Management Unit, Ministry of Agriculture Food Security and cooperatives. |

*Names of people consulted during the preparation of the ERP IPMP*

| Name | Title | Organization |
|---|---|---|
| David Rohrbach | Senior Agricultural Economist | World Bank, Tanzania Country Office |
| Lazaro Kitandu | National IPM Coordinator | Plant Health Services, Ministry of Agriculture Food Security and cooperatives. |
| Nkori Kibanda | Officer In charge | Agriculture Research Institute - KATRIN, Morogoro. |
| Dr. Fidelis Myaka | Director Research and Development | Department of Research and Development, Ministry of Agriculture Food Security and cooperatives. |
| Philemon Kawamala | Marketing and Distribution Manager | Agricultural Seed Agency, Morogoro |
| Dr. Hussein Mansoor | Assistant Director Crop Research | Department of Research and Development, Ministry of Agriculture Food Security and cooperatives. |

*Field consultations*

| Date | Location | Persons | Issues Arising |
|---|---|---|---|
| 23-25 April 2013 | Zanzibar, Unguja and Pemba | Affan Mallim, Permanent Secretary, Baliam Assad, Deputy Permanent Secretary Mbenik Rashid, Director of Agriculture, Othman Maulid, Chief Extension Officer; Rashid Said, Chief Irrigation Officer; Sheha Hamdan, Director of Forestry; Manyam Abdulla, Director of Policy and Planning, Mansura Kassim, | The objectives and possible workplans underlying the Expanding Rice Production Project were discussed in meetings encompassing government officials, village officials and farmers. These included a review of current pest management challenges in rice production. It was noted that most of the schemes are very small and are seeking interlinked rehabilitation with advisory assistance on crop management. Current pest management practices are almost non-existent. Agro-chemical use is very limited with almost no use of |

| | | | |
|---|---|---|---|
| | | Director of Food Security; Mchenga Machena, Chief irrigation Officer and visits to meet with village officials in a cross-section of irrigation schemes including Mtwangio, Loani, Banda Majo, Machigini, Dobi 1, Dobi 2 Kibondo Mzungo and Ole | herbicides or insecticides. A new baseline survey of crop management practices is needed to quantify and confirm these findings.<br>At the national level, particular concern was expressed regarding the need to complete the drafting of key legislation including the drafting of a Pest management Act and associated regulations. Concern was expressed that these need to be well communicated to national stakeholders including farmers.<br>In the districts and irrigation schemes visited, concerns were expressed about the possible expansion of use of herbicides and insecticides and associated risks of groundwater contamination. There is virtually no extension work pursued for pest management and training is needed for both extension staff and farm communities. This includes the need to promote understanding of IPM technologies as well as the safe use and disposal of various pesticides. Interest was also expressed in strengthening national early warning systems for armyworm, though this is not generally viewed as a major problem. |
| 28 April to 1 May 2013 | Morogoro District | L.G. Noah, Acting Regional Administrative Secretary; Firmin Mizambwa, Chief Executive Officer, Agricultural Seed Agency; Henry Mahoo, Associate Professor, Sokoine University of Agriculture; Imani Nzobo, Irrigation Engineer and visits to a corsssection of irrigation schemes including Mvumi, Kalangali, Msolwa Ujamaa and | Discussions of the Expanding Rice Production Project were held with district officials, irrigator organizations and farmers in a cross-section of schemes targeted by the project. These highlighted the fact that the current levels of use of both herbicides and insecticides is limited. While there has been much testing of these technologies, and there is a growing awareness of integrated pest management options, farmer knowledge is limited. These findings need to be more formally confirmed in the project's baseline surveys.<br>Village officials and farmers expressed interest in obtaining a better understanding of pest management techniques, especially for armyworm and birds. This includes the need for better training and coordination of pest scouting and the coordination of control measures. Concerns were expressed about the safe use of pesticides and possible groundwater contamination from herbicides in particular. There is interest in testing the technologies underlying System of Rice Intensification though uncertainty about both the weed control options, and |

| | | | |
|---|---|---|---|
| | | | the practicality of the coordinated use of less water.<br>There are district environmental officers, though complaints that they lack adequate resources to cover their mandates.<br>Extension workers are active, though need additional training in IPM techniques. |
| 14-16 November 2013 | Kilombero District | District Executive Director; District agriculture and irrigation officials, village officials in Njage and Msolwa Ujamaa | District authorities and farmers confirmed their interest in testing SRI technologies and IPM practices. No major pest management concerns were cited. |
| 16-18 November 2013 | Kilosa District | Discussions with district agriculture officers, village officials and farmers in Mvumi and Kilangali | District authorities and farmers confirmed their interest in testing SRI technologies and IPM practices. Farmers in Mvumi are already receiving good extension support but have yet to be exposed to SRI. The residual affectes of pesticide use on the larger Kilangali Farm will need to be monitored. |
| 19-20 November 2013 | Mvomero Districts | Discussions with district agriculture officers, village officials and farmers in Kugugu, Mbogo Kigugu | Framers in these irrigation schemes confirmed their support for the project and the introduction of alternative agronomic and pest management practices. |
| 28 November 2013 | Zanzibar | Discussions with Shehia officials, irrigation scheme officials and farmers in Kibonde Maji, Mtwango and Kaoni | There is very limited use of agro-chemicals in these schemes; however, the introduction of possible herbicide use as part of the package of SRI technologies will require additional training and monitoring. The risks of contamination of groundwater supplies need to be monitored. |
| 29 November 2013 | Zanzibar | Discussions with Shehia officials, irrigation scheme officials and farmers in Banda Maji, Mchangani | There is very limited use of agro-chemicals in these schemes; however, the introduction of possible herbicide use as part of the package of SRI technologies will require additional training and monitoring. The risks of contamination of groundwater supplies need to be monitored. |
| 30 November 3013 | Pemba | Discussions with Shehia officials, irrigation scheme officials and farmers in Dobi 1, Dobi 2 | There is very limited use of agro-chemicals in these schemes; however, the introduction of possible herbicide use as part of the package of SRI technologies will require additional training and monitoring. The risks of contamination of groundwater supplies need to be monitored. |
| 1 December 2013 | Pemba | Discussions with Shehia officials, irrigation scheme officials and farmers in Kwale Mpona, Machihini and Ole | There is very limited use of agro-chemicals in these schemes; however, the introduction of possible herbicide use as part of the package of SRI technologies will require additional training and monitoring. The risks of contamination of groundwater supplies need to be monitored. . |
| 23 April | Zanzibar | Tamirini Said, | Again, concerns were expressed about the |

| | | | |
|---|---|---|---|
| 2014 | | Conservation Officer; Mchenga Mchenga, Irrigation Engineer, MANR, Saleh Juma, Coordinator Planning, MANR | underdeveloped status of Zanzibar's environmental laws and regulations. These are in the process of being adapted from the laws and regulations applied on the Mainland, however, there is need to be sure the proposed laws and regulations are well understood by stakeholders including extension workers and farmers. National authorities called for this to be integrated into the project workplan. There is also a broad need to better train extension staff in basic IPM principles and practices. More information is needed on the current levels of application of pesticides (this is viewed to be more common on horticultural crops like pineapple) and uncommon on rice. And monitoring systems are needed to evaluate changing patterns of use and control possible misuse. |

## Annex 2. Pesticide Classification List – WHO

**Table A2.1: Extremely hazardous (Class 1a) technical grade active ingredients of pesticides (common name) – not permissible in the SAGCOT Investment Project**

| | | |
|---|---|---|
| Aldicarb | Difethialone | Parathion – methyl 1 |
| 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 | Meviphos | |
| Difenacoum | Parathion | |

**Table A2.2: Highly hazardous (Class 1b) technical grade active ingredients of pesticides (common name) – not permissible in the SAGCOT Investment Project**

| | | |
|---|---|---|
| Acrolein | Ethionfencarb | Omethoate |
| Ally alcohol | Famphur | Oxamyl |
| Azinphos – methyl | Fenamiphos | Oxydemeton-methyl |
| Azinphos- methyl | Flucythrinate | Paris green (C) |
| Blasticidin – S | Fluoroacetamide | Pentachlorophenol |
| Butocarboxim | Forrmetanate | Pindone |
| Butoxycarboxim | Furathiocarb | Pirimiphos-ethyl |
| Cadusafos | Heptenophos | Propaphos |
| Calcium arsenate | Isazofos | Propetamphos |
| Carbofuran | Isofenphos | Sodium arsenate |
| Chlorfenvinphos | Isoxathion | Sodium cyanide |
| 3-chloro-1,2-propanediol | Lead arsenate | Strychnine |
| Coumaphos | Mecarban | Tefluthrin |
| Coumatetralyl | Mercuric oxide | Thallium sulfate |
| Zeta-cypermethrin | Methamidophos | Thiometon |
| Demeton-S-methyl | Methidathion | Thiometon |
| Dichlorvos | Methidocarb | Triazophos |
| Dicrotophos | Methomyl | Vamidothion |
| Dinoterb | Monocrotophos | Warfarin |
| Edinofenphos | Nicotine | Zinc phosphide |

**Table A2.3: Moderately hazardous (Class II technical grade active ingredients of pesticides (common name) – not permissible in the SAGCOT Investment Project**

| | | |
|---|---|---|
| Alanycarb | Endosulfan | Paraguat |
| Anilofos | Endothal-sodium | Pebulate |
| Azaconazole | Esfenvalerate | Permethrin |
| Azocyclotin | Ethion | Phenthoate |
| Bendiocarb | Etrimfos | Phosalone |
| Bensulide | Fenitrothion | Phoxin |
| Bifenthrin | Fenobucarb | Piperophos |
| Bilanafos | Fepropidin | Pirimicarb |
| Bioallethrin | Fenpropathrin | Prallethrin |
| Bromoxynil | Fenthion | Profenofos |
| Brobuconazole | Fentin acetate | Propiconazole |
| Bronopol | Fentin hydroxide | Propoxur |
| Butamifos | Fenvalerate | Prosulfocarb |
| Butymine | Fipronil | Prothiofos |

| | | |
|---|---|---|
| Carbaryl | Fluxofenim | Pyraclofos |
| Carbosulfan | Formothion | Pyrazophos |
| Cartap | | Pyrethrnis |
| *Fuberidazole* | | |
| Chloralose | Gamma-HCH | Pyroquilon |
| Cholordane | Guazatine | Quinalphos |
| Chlofenapyr | Haloxyfop | Quizalofop-p-tefuryl |
| Chlorphonium chloride | Heptachlor | Rotenone |
| Chlorpyrifos | Imazalil | Sodium fluoride |
| Clomazone | Imidacloprid | Sodium hexafluorosilicate |
| Copper sulfate | Iminoctadine | Spriroxamine |
| Cuprous oxide | Ioxynil | Sulprofos |
| Cyanazine | Ioxynil octanoate | Terbumeton |
| Cyanophos | Isoprocarb | Tetraconazole |
| Cyfluthrin | Lambda-cynalothrin | Thiacloprid |
| Beta-cyfluthrin | Merchurous chloride | Thiobencarb |
| Cynalothrn | Metaldehyde | Thiocylam |
| Cypermethrin | Metam-sodium | Thiodicarb |
| Alpha-cypermethrin | Methacrifos | Triazamate |
| Cyphermethrin | Methasulfocarb | Trichlorfon |
| Deltamethrin | Methyl isothiocyanate | Tricyclazole |
| Diazinon | Metolcarb | Tridemorph |
| Difenzoquat | Metribuzin | Vernlate |
| Dimethoate | Molinate | Xylylcarb |
| Dinobuton | Naban | |
| Diquat | Naled | |

**Table A2.4: Slightly hazardous (Class III) technical grade active ingredients of pesticides (common name) – Permissible in the SAGCOT Investment Project under IPM**

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

**Table A2.5: Technical grade active ingredients of pesticides unlikely to present acute hazard in normal use (Common name) – Permissible in the SAGCOT Investment Project**

| | | |
|---|---|---|
| Acephate | Mecoprop | Bentazone |
| Acetochlor | Mecoprop-P | Bromofenoxim |
| Acifluorfen | Mefluidide | Butroxydim |

| | | |
|---|---|---|
| Alachlor | Mepiquat | Chinomethionat |
| Allthrin | Metalaxyl | Chlormequat (chloride) |
| Dinocap | Metamitron | Chloracetic acid |
| Diphenamid | Metconazole | Chloracetiamid |
| Dithianon | Methylarsonic acid | Copper hydroxide |
| Dodine | Metolachlor | Copper oxychloride |
| Emphenthrin | Myclobutanil | Nuarimole |
| Esrocarb | 2-Napthyloxyacetic acid | Octhilinone |
| Etridiazole | Nitrapyrin | N-octylbicycloheptene |
| Fenothiocarb | Ametryn | Dicarboximide |
| Ferimzone | Amitraz | Oxadixyl |
| Fluazifop-p-butyl | Azamethiphos | Paclobutrazol |
| Fluchloralin | Bensultap | Pendimethalin |
| Flufenacet | Mecoprop | Pimaricin |
| Fluoroglycofen | Mecoprop-P | Pirimiphos-methyl |
| Flurprimidol | Mefluidide | Prochloraz |
| Flusilazole | Mepiquat | Propachlor |
| Flutriafol | Metalaxyl | Propanil |
| Fomesafen | Metamitron | Propargite |
| Furalaxyl | Metchnazole | Pyrazoxyfen |
| Glufosinate | Methylarsonic acid | Pyridaben |
| Hexazinone | Metolachlor | Pyridaphenthion |
| Hydramethylnon | Myclobutanil | Pyridate |
| Iprobenfos | 2-Napthyloxyacetic acid | Pyrifenox |
| Isoprothiolane | Nitrapyrin | Quinoclamine |
| Isoproturon | Ametryn | Quizalofop |
| Isouron | Amitraz | Resmthrin |
| Malathion | Azamethiphos | Sethoxydim |
| MCPA – thioethyl | Bensultap | Simetryn |
| Sodium | Dithianon | Nuarimole |
| | Dodine | Octhilinone |
| *Sulfluramid* | | |
| | Empenthrin | N-octylbicycloheptene |
| *Tebuconazole* | | |
| Tebufenpyrad | Esrocarb | Dicarboximide |
| Tebuthiuron | Etridiazole | Oxadixyl |
| Thiram | Fenothocarb | Paclobutrazol |
| Tralkoxydim | Ferimzone | Pendimethalin |
| Triadimefon | Fluazifop-p-butyl | Pimaricin |
| Triadimenol | Fluchloralin | Pirimiphos-methyl |
| Tri-allate | Flufenacet | Prochloraz |
| Triclopyr | Fluoroglycofen | Propachlor |
| Triflumizole | Flurprimidol | Propanil |
| Undecan-2-one | Flusilazole | Propargite |
| Uniconazole | Flutriafol | Pyrazonxyfen |
| Ziram | Fomesafen | Pyridaben |
| | Furalaxyl | Pyridaphenthion |
| Cycloate | Glufosinate | Pyridate |
| Cyhexatin | Hexazinone | Pyrifenox |
| Cyproconazole | Hydramethylnon | Quinoclamine |
| Cymoxanil | Iprobenfos | Quizalofop |
| Dazomet | Isoprothiolane | Resmethrin |
| Desmetryn | Isoproturon | Sethoxydim |
| Dichlormid | Isouron | Simetryn |
| Dichlorbenzene | Malathion | Sodium chlorate |
| Dichlorophen | MCPA-thioethyl | Sulfluramid |

| | | |
|---|---|---|
| Dichlorprop | Mecoprop | |
| | | *Tebuconazole* |
| Diclofop | Mecoprop-P | Tebufenpyrad |
| Dienochlor | Mefluidide | Tebuthiuron |
| Diethyltoluamide | Mepiquat | Thiram |
| Difenoconazole | Metalaxyl | Tralkoxydim |
| Dimepiperate | Metamitron | Triadimefon |
| Dimethachlor | Metconazole | Triadimenol |
| Dimethamethryn | Methylarsonic acid | Tri-allate |
| Dimethipin | Metolachlor | Triclopyr |
| Dimethylarsinic acid | Myclobutanil | Triflumizole |
| Diniconazole | 2-Napthyloxyacetic acid | Undecan-2-one |
| Dinocap | Nitrapyrin | Uniconazole |
| Diphenamid | | Ziram |

**Table A2.6: Technical grade ingredients of pesticides unlikely to present acute hazard in normal use (common name) – Permissible in the SAGCOT Investment Project**

| | | |
|---|---|---|
| Aclonifen | Chlorthal-dimethyl | Fenhexamid |
| Acrinathrin | Chlozolinate | Fenoxycarb |
| Alloxydin | Cinmethylin | Fenpiclonil |
| Amitrole | Cinosulfuron | Fenpropimorph |
| Ammonium sulfamate | Clofentezine | Fenuron |
| Ancymidol | Clomeprop | Fenuron-TCA |
| Anthraquinone | Clopyralid | Ferbam |
| Asulam | Cloxyfonac | Flamprop |
| Atrazine | Cryolite (c) | Flucarbazone-sodium |
| Azimsulfuron | Cycloprothrin | Flucycloxuron |
| Azoxystrobine | Cyclosulfamuron | Flufenoxuron |
| Benalaxyl | Cycloxydim | Flumetralin |
| Benafluralin | Cyhalofop | Flumetsulam |
| Benfuresate | Cyromazine | Fluometuron |
| Benomyl | Daimuron | Flupropanate |
| Benoxacor | Dalapon | Flupyrsulfuron |
| Benuslfuron-methyl | Daminozide | Flurenol |
| Bifenox | Desmedipham | Fluridone |
| Bioresmethrin | Diafenthiuron | Flurochloridone |
| Biphenyl | Dichlobenil | Fluroxypyr |
| Bispyribac | Dichlofluanid | Fluthiacet |
| Bitertanol | Diclomezine | Flutolanil |
| Borax | Dicloran | Tau-fluvalinate |
| Bromacil | Diclosulam | Folpet |
| Bromobutide | Diethofencarb | Fosamine |
| Bromopropylate | Diflubenzuron | Fosetyl |
| Bupirimate | Diflufenican | Gibberellic acid |
| Buprofezin | Dikeculac | Glyphosate |
| Butachlor | Dimefuron | Hexaconazole |
| Butralin | Dimethirimol | Hexaflumuron |
| Butylate | Dimethomorph | Hexythiazox |
| Captan | Dimethyl phtalate | Hydroprene |
| Carbendazim | Dinitramine | Hymexazol |

| | | |
|---|---|---|
| Carbetamid | Dipropil isocinchomerate | Imazamethabenzmethyl |
| Carboxin | Dithiopyr | Imazapyr |
| Carpropamid | Diuron | Imazaquin |
| Chlomethoxyfen | Dodemorph | Imazethapyr |
| Chloramben | Ethalfluralin | Imebenconazole |
| Chloransulam methyl | Ethefon | Inabenfide |
| Chlorbromuron | Ethirimol | Iprodione |
| Chlorfluazuron | Ethofumesate | Iprovalicarb |
| Chloridazon | Etofenprox | Isoxaben |
| Chlorimuron | Famoxadone | Kasugamycin |
| Chlorothalonil | Fenarimol | Lenacil |
| Chlorotoluron | Fenbutatin oxide | Linuron |
| Chlorpropham | Fenchlorazole | Maleic hydrazide |
| Chlorpyrifos methyl | Fenchlorim | Mancozeb |
| Chlorsulfuron | Fenfuram | Maneb |
| Mefenacet | Pentanochlor | Rimsulfuron |
| Mepanipyrim | Phenmedipham | Siduron |
| Mepronil | Phenothrin | Simazine |
| Metazachlor | Phnylphenol | Spinosad |
| Methabenzthiazuron | Phosphorus acid | Sulfometuron |
| Methoprene | Phtalide | Sulphur |
| Methoxychlor | Picloram | Tebutam |
| Methyldymron | Piperonyl butoxide | Tecnazene |
| Metiram | Pretilachlor | Teflubenzuron |
| Metobromuron | Promisulfuron | Temphos |
| Metosulam | Probenazole | Terbacil |
| Metoxuron | Procymidone | Terbuthylazine |
| Metsulfuron methyl | Prodiamine | Terbutryn |
| Monolinuron | Prometon | Tetrachlorvinphos |
| 2-(1-Naphthyl) acetamide | Prometryn | Tetradifon |
| 1-naphthylacetic acid | Propamocarb | Tetramethrin |
| Napropamide | Propaquizafop | Thiabendazole |
| Naptalam | Propazine | Thidiazuron |
| Neburon | Propham | Thifensulfuron-methyl |
| Niclosamide | Propineb | Thiophanate-methyl |
| Nicosulfuron | Propyzamide | Thiocarbazil |
| Nitrothal-isopropyl | Pyrazolynate | Tolclofos-methyl |
| Norfluzaron | Pyrazosulfuron | Tolyfluanid |
| Ofurace | Pyrimethanil | Transfluthrin |
| Oryzalin | Pyriminobac | Triasulfuron |
| Oxadiazon | Pyripoxyfen | Tribenuron |
| Oxine-copper | Pyrithiobac sodium | Trietazine |
| Oxycarboxyn | Quinclorac | Triflumuron |
| Oxyfluorfen | Quinmerac | Trifluralin |
| Penconazole | Quinoxyfen | Trifulusulfuron-methyl |
| Pencycuron | Quintozene | Triforine |
| | | Triticonazole |
| | | Validamycin |
| | | Vinclozolin |
| | | Zine |

## Annex 3. Maps of the ERPP Project Area

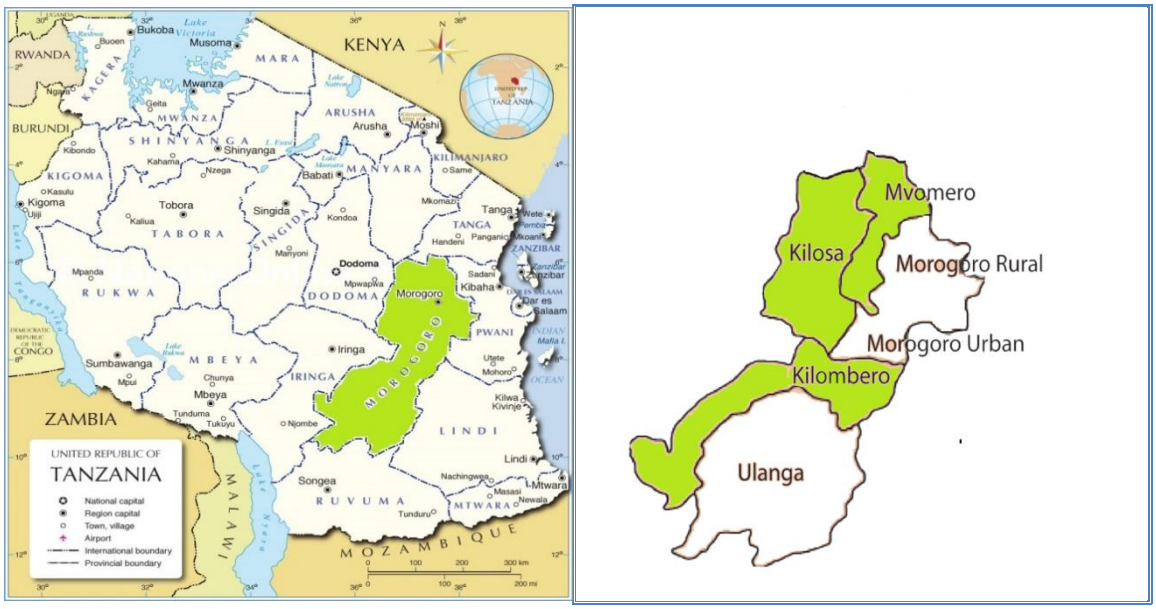


**Figure A3.1: Tanzania Administrative Map (Left) – Districts of Morogoro Region (Right)**


**Figure A3.2: Map of Zanzibar**