UNITED REPUBLIC OF TANZANIA

MINISTRY OF AGRICULTURE LIVESTOCK AND FISHERIES

CATALYZING THE FUTURE AGRI-FOOD SYSTEMS OF TANZANIA PROJECT (CFAST)

INTEGRATED PEST MANAGEMENT PLAN

23 JANUARY 2017

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Abbreviations and Acronyms

ASA	Agricultural Seed Agency
ASDP	Agricultural Sector Development Programme
ASP	Agriculture Services Providers
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
FAO	Food and Agriculture Organisation
FFS	Farmer Field Schools
GAFSP	Global Agriculture and Food Security Program
GoT	Government of Tanzania
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
LVEMP	Lake Victoria Environmental Management Project
M&E	Monitoring and Evaluation
MALF	Ministry of Agriculture Livestock and Fisheries
MKUKUTA	Mkakati wa Kukuza Uchumi na Kuondoa Umaskini
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
ZARDI	Zonal Agriculture Research and Development Institutes

EXECUTIVE SUMMARY

1. The CFAST project aims at supporting the transformation of selected agri-food systems to yield higher revenue to farm households, while being more resilient to climate change. The project will develop and implement business plans for joining the value chains and marketing of the main crop (in most cases rice) as well as for diversifying the production system into higher value crops and enterprises (e.g. vegetables, fruits, and aqua-culture) and in making complementary community investments to enable all farmers, especially women, to work on their plots and engage in processing and marketing. Such an approach is expected to: (i) empower the small scale farmers and their organizations, (ii) sustainably increase the productivity and competitiveness of the priority commodity value chains and associated production systems; (iii) increase the volume and value of produce that enters the market channels for both domestic and export markets, as well as reliable raw material supply for local industries; (iv) allow for significant impact of investments, especially in infrastructure and other interventions in priority areas as selected by the IOs and recorded in their business plans (especially irrigation, value addition and marketing infrastructures); (v) enhance economies of scale by improving farmers (in IOs) access to agricultural inputs and financial services, and lower transaction costs for input/output markets, as volumes and competition increase; (vi) promote expanded investments by private sector, at farm and off-farm levels, especially in priority value chains and (vii) through community investments alleviate women's 'time poverty' and improve child nutrition. The CFAST project design follows the guidance from the ASDP-2 Program Document, which emphasizes the role of strong and inclusive small farmer organizations as the main vehicle for enabling small holders to participate in the private sector stimulated agricultural growth and value chains (Agricultural Sector Program Document 2, 2015).

2. The activities that will be funded under the CFAST may lead to the increased use of agricultural pesticides, especially when growing vegetables of high value. 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 CFAST Regions especially Mbeya Region which has high percentage of irrigation scheme to be supported by CFAST. 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 CFAST.

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.

6. 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. The training will target Extension staff and farmers, irrigation technicians and Trainers/TOTs. The training will focus on IPM concept, elements of IPM, biology and life cycle of rice pests and management options, soil management, preparation of bio-pesticides and application, and pesticides management.

7. 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".

8. 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.

9. 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) CFAST Draft Project Appraisal Document
ii) CFAST Project Concept Note;
iii) Environmental Management Act (2004);
iv) Environmental Impact Assessment and Audit Regulations, 2005-G.N. No 349 of 2005;
v) Environmental Management (Soil Quality Standards) Regulations, 2007;
vi) World Bank Safeguard Policies in particular OP 4.09 and BP 4.01,
vii) Tanzania Agriculture and Food Security Investment Plan; and

10. 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.

1.0 DESCRIPTION OF THE PROJECT

CFAST is structured as an Investment Project Financing (IPF), funded by an International Development Association (IDA) credit in the amount of US$100 million. Through its components, CFAST will finance the goods and works, non-consulting services, consultants' services, and training and operating costs required for successful project implementation.

1. **Component 1: Linking Farmers to Agricultural Value Chains (US$22.1 million)**
   The objective of this component is to strengthen IOs in each of the selected schemes to become effective players in agricultural value chains. The component will finance three integrated interventions: (i) capacity assessment of IOs and business plan formulation; (ii) capacity building and coaching to fulfil business plan objectives; and (iii) investment in complementary community infrastructure. PSPs with proven track records of working with farmers and their organizations and on value chains will be engaged to facilitate and broker market linkages and to support IOs in market-oriented planning and business plan implementation. Support will be provided via the PSPs to consolidate the existing farmer organizations into IOs, per the Irrigation Act of 2013.

2. **Subcomponent 1.1: Capacity assessment and business plan formulation (US$3.3 million)**
   This subcomponent will finance the identification of market opportunities for sourcing produce from IOs, as well as an assessment of IOs' institutional and productive capacity to link with market actors in agricultural value chains.1 The assessment will be used to develop tailored capacity-building investments for each IO. Globally tested methodologies such as SCOPEinsight2 will be utilized in assessing IOs' capacity.

   The results of the capacity assessment and market opportunities screening will be combined in a business plan for each IO. The plan will elaborate investment and specific capacity-building needs, business objectives, budget, financial feasibility, and expected results. The plan will also include community infrastructure programs (such as daycare facilities, child nutrition programs, strengthening of access roads, and so on) to support and enable all IO members (men and women of different age groups) to participate fully in the economic activities and decision making of their IO.
   The business plan will be reviewed and approved by the Zonal Steering Committee (ZSC). The project will co-finance costs of the business plan related to: (i) irrigation infrastructure rehabilitation (see Component 2), (ii) technical assistance for business plan implementation and building capacity of IOs, and (iii) complementary community infrastructure investments. CFAST will not provide direct credit to IOs for production inputs but may facilitate access to financial service providers. For large IOs that may wish to develop several market links, the business plan may contain specific chapters for each of those links.

3. **Subcomponent 1.2: Capacity Building and Coaching for Successful Market Linkages**

[1] In parallel through Component 2, a feasibility study of irrigation schemes on demand for the crops chosen will be conducted.

[2] Independent assessment company focused on gap analysis and capacity building for farmer organizations in value chains; see *http://www.scopeinsight.com/.*

(US$9.6 million)
On the basis of the business plan, this subcomponent will finance the delivery of tailored capacity building and technical assistance to IOs to achieve successful market linkages. This effort will include skills training and hands-on coaching on climate-smart and labor-saving production practices (climate-smart agriculture,3 mechanization,4 choice and sourcing of seed and fertilizer, labor needs, extension support), as well as the formulation of a diversification plan (for example, for pursuing vegetable/fruit production, aquaculture, poultry production and postharvest processing). Technical assistance may cover capacity building for food quality and food safety management. Capacity building will also include business management and administration. This subcomponent will ensure that IOs are able to take on value-chain management functions beyond their traditional role of managing irrigation schemes.

4. **Subcomponent 1.3: Community Investments (US$9.3 million)**
In their business plans, IOs may apply for support to undertake community investments, targeted mainly at enabling farmers, especially women, to fully join the economic activities in the schemes. An example could be a daycare center run by trusted community women to care for children of mothers who otherwise have time constraints for field work. Such childcare centers can also be utilized to provide nutritious meals and nutrition education to beneficiary families. For this purpose, PSPs will provide technical training to community cooks. Community investments may also include feeder roads and bridges over canals for easier access, solar-powered lights to improve visibility and security, and minor warehouse rehabilitation works.

The project will ensure the integration of young people—male and female, age 16–29—into the implementation of specific interventions. Young people will take an active role in formulating the business plan and in the delivery of technical assistance to IOs in collaboration with the PSPs. Other youth-related activities include the allocation of plots to produce non-traditional high-value products (vegetables, fruits, mushrooms, and so on) and investments in value-addition facilities (including packaging and light processing equipment).

In three years, the supported IOs will have gone through a cycle of business planning and implementation and will have built their capacity to foster linkages with stakeholders in the value chain. At that point, the IOs are expected to continue their activities without further project support.

5. **Component 2: Developing and Managing Climate-Smart and Sustainable Irrigation Infrastructure (US$56.7 million)**
This component will finance the feasibility studies, design, supervision, and rehabilitation works of irrigation infrastructure of the selected IOs, as well as build irrigation system management capacities in IOs. The component will focus on reducing the amount of water for unit output (crop per drop) to mitigate climate change effects. This component is organized around two complementary subcomponents: (i) irrigation infrastructure development and (ii)

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[3] For example, drying and wetting cycles to reduce water use and crop management components in the System of Rice Intensification.

[4] Along the value chain from planting to postharvest and marketing; labor-saving technologies for women farmers and vulnerable groups are of special importance.

improved management of irrigation infrastructure.

6. **Subcomponent 2.1: Irrigation Infrastructure Development (US$53.6 million)**
The project will finance rehabilitation and upgrading of existing irrigation infrastructure on about 15,000 ha in 20 irrigation schemes. In these schemes, the project will mainly support the improvement of infrastructure to prevent seepage, upgrading of intakes, and leveling of irrigated plots. The guiding principle is to manage water resources efficiently, reduce waste, and ensure proper drainage of irrigation water. As needed and where water abstraction permits allow, consideration will be given to expanding selected irrigation schemes back to their full potential (their full command area). Feasibility studies will be conducted prior to rehabilitation works. The rehabilitation investments will pay special attention to climate resilience capabilities (the ability to withstand larger than normal changes in water availability) through approaches such as overhead irrigation, drip irrigation, sensor technology, and rainwater harvesting.

7. **Sub-component 2.2: Improved Management of Irrigation Infrastructure (US$3.1 million)**
This subcomponent will support effective management of the irrigation system. As the newly established NIC is still acquiring the full capacity to play its leading role in irrigation infrastructure management, the project will establish a technical assistance team for irrigation management by small IOs to provide hands-on capacity building assistance to IOs, scheme-level extension staff, and irrigation technicians on various aspects of irrigation management. The technical assistance team will also provide capacity-building support to the NIC.

8. **Component 3: Monitoring and Evaluation, Knowledge Sharing, Learning, and Project Replication (US$5.6 million)**
Subcomponent 3.1: Monitoring and Evaluation (US$2.4 million)
A Monitoring and Evaluation (M&E) system will be financed and operated to capture data on physical and financial progress, the performance of implementing agencies and service providers, and the achievements of outcomes and impact vis-à-vis the PDOs. The MDU/Project Implementation Unit will have primary responsibility for monitoring progress and outcomes based on indicators defined in the project results framework. The project will explore innovative tools for geo- and time-referenced data collection, such as remote sensing and satellite imagery and tablets to record monitoring and survey data.

Subcomponent 3.2: Knowledge Generation, Sharing, and Learning (US$2.9 million)
Since CFAST is a transformation model that may be rolled out at a bigger scale afterwards, it is essential to learn from it as much as possible. Under this subcomponent, an analytical model will be applied to distinguish success factors in the implementation of CFAST in individual schemes, such as the quality of the IO and its management, the type of support of local governments and PSPs, the involvement of the local farm community, the type of market linkages (voluntary, contractual), the type of diversification pursued, and the impact of non-agricultural community investments. Peer-to-peer learning, international knowledge exchange, and annual networking among key project stakeholders (including IOs, government officials, and the private sector) will be supported. The International Food Policy Research Institute (IFPRI) will collaborate with the project in implementing this component.

Subcomponent 3.3: Project Replication (US$0.3 million)
This subcomponent will finance MALF's effort in preparing follow-up investments, once the model has been sufficiently validated. It will finance preparation of background studies and consultation processes. Support through this subcomponent will allow MALF to select new

areas, new market opportunities, and new farmer groups with potential for implementing the CFAST approach. It will also allow the MDU to develop rosters of PSPs, both for market access and for irrigation rehabilitation that can be relied on to roll out the approach.

9. **Component 4: Institutional Strengthening and Project Management (US$9.4 million)**
Subcomponent 4.1: Project Management (US$7.5 million)
Project funds under this subcomponent will finance project implementation, management, and coordination support. Specifically, this support includes: (i) project oversight and coordination costs of MALF's Ministerial Delivery Unit (MDU); (ii) establishment and operation of a Project Implementation Unit (PIU); (iii) fiduciary management, including external\internal audits and accounting; (iv) project M&E; (v) performance monitoring and reporting; (vi) environmental and social safeguards management, including implementation of mitigation measures; and (vii) development and implementation of a communication plan.

10. **Subcomponent 4.2: Capacity Building (US$2.0 million)**
This subcomponent will finance a range of capacity-building initiatives to benefit the various actors involved in project implementation, particularly government agencies and Local Government Authorities (LGAs). It will focus on enhancing the knowledge and skills of technical experts to support IOs effectively in areas such as efficient fiduciary management, internal auditing, accounting, project management, ability to apply market-oriented approaches, and irrigation management. Capacity building will be done through two approaches: (i) diploma and short-term tailored training courses and internships at universities (such as Sokoine University of Agriculture, University of Dar es Salaam, Mbeya University of Science and Technology) and technical training institutes, such as Ministry of Agriculture Training Institutes (MATIs), the Horticultural Research and Training Institute (HORTI), the Livestock Training Institute (LITI), and the Water Development and Management Institute (WDMI); and (ii) MALF recruitment of recent graduates with diverse expertise to further strengthen the ministry's overall capacity.

11. **Component 5. Contingent Emergency Response (zero component)**
This zero-budget component is included to provide immediate and effective response to an Eligible Crisis or Emergency. In case of an emergency, funds can be shifted toward this component.

12. **B. Project Cost and Financing**
CFAST will be financed through an IDA Credit of US$100 million. The financing plan is presented in the summary table below.

Table 1: Summary of project cost and financing

Project Components	Project cost	IBRD or IDA Financing
Linking Farmers to Agricultural Value Chains	22.10	22.10
Developing and Managing Climate-Smart Sustainable Irrigation Infrastructure	56.70	56.70
M&E, Knowledge Sharing, Learning, and Project Replication	5.60	5.60

Institutional Strengthening and Project Management	9.40	9.40
Contingent Emergency Response	0.00	0.00
Total Costs		
Total Project Costs	93.80	93.80
Physical Contingencies	2.90	2.90
Price Contingencies	3.30	3.30
Front End Fees	0.00	0.00
Total Financing Required	100.00	100.00

2.0 CFAST TARGETED REGIONS

13. The aim of the CFAST project is to support activities linking organized smallholder farmers with markets to enhance their income and productivity. CFAST has been envisioned to be in full support of the second phase ASDP25 currently in the pipeline. The Project will collaborate with the SAGCOT project which focuses on agribusiness development in the Southern Agricultural Growth Corridor of Tanzania (SAGCOT): namely Mbeya, Iringa, Rukwa and Katavi Regions.

14. The proposed CFAST project will focus on implementing activities on an integrated approach to improve value chains through increased productivity of targeted commodities and forging sustainable market linkages.

15. Anticipated subprojects include infrastructure development involving rehabilitation or upgrading of irrigation infrastructures and other works and operations aimed at improvements at the level of irrigation schemes and connecting the schemes to markets. Such infrastructure/facilities as warehouses, farm roads, drainage systems etc. would need to be part and parcel of the IOs' business development plans. Subprojects approved for funding by CFAST will be planned and implemented by target smallholder farmers and their associations assisted by Private Service Providers, Public Extension Workers from respective District and Regional authorities and the Ministerial Delivery Unit (MDU) at the Ministry of Agriculture, Fisheries and Livestock. Infrastructure investments will be coupled with improvements of both on-farm and organizational management capability of the smallholder farmer's organizations and Participating Districts and Regions.

3.0 PEST PROBLEMS IN RICE PRODUCTION

1. 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 2 Major pests of rice and recommended management practices

Pests		Recommended management practices
Insect pests	Stem borers (*Chilo partellus, C. orichalcociliellus, Maliarpha separatella, Sesamia calamistis*)	• Use Stem borer resistant varieties e.g. ITA 121, LAC 23, IR 4625-132-1-2, IR 8, TOS 4153 • Early ploughing and destruction of crop residues
	Stalk-eyed fly (*Diopsis spp*)	

[5] Aide Memoire: WB Preparation Mission of the CFAST Project, October 12-21, 2016 appreciation of the approach and the principles of operation behind ASDP2

Pests		Recommended management practices
	Stem borer African rice gall midge (*Orseolia oryzivora)* Small rice grasshoppers (*Oxya spp.) (Senene*)	• Raising of healthy nursery. • Early and timely planting/ sowing. • Observe simultaneous planting • Use recommended plant spacing • Destruction of left over nurseries, removal of weeds from field and cleaning of bunds • Use of botanicals such as Neem, *Solanum nigram*, *Tagetes minuta*, • Balanced use of fertilizers and micronutrients as per local recommendation (Proper fertilization) • Proper water management (alternate wetting and drying • Harvest close to ground level. • Plough after harvest to expose the eggs to natural enemies • Plant recommended early maturity varieties • Use insecticides registered in Tanzania based on recommended dose rates Fenitrothion 500g/L and Deltamethrin 25g/L • Timely planting • Clean weeding
	African armyworm (*Spodoptera exempta*)	• resistant varieties • Stalk management in dry season • Early weeding (field sanitation) • Hand-picking of caterpillars • Use light traps • Put ashes in the trenches to make it more difficult for the caterpillars to escape. • Place branches around fields to give armyworms a place to assemble where they are easily collected by hand. • Use of botanicals such as Neem • Pyrethrum (should be applied in the evening since armyworm prefer to feed at night) • Pyrethrum liquid; mix 20g pyrethrum powder with 10litres
	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 All types (see Table 4.5)	• Early clean weeding • Prepare the land well, good land preparation followed by flooding for atleast two weeks kills the existing weeds

Pests		Recommended management practices
		• Clean the irrigation canals and the borders of the field • Pre-irrigate the field, it induces germination of weeds which are later destroyed during ploughing • Varietal choice: vigorous tillering variety is more competitive with weeds • Use of good quality rice seed which are not contaminated with weed seed • Use of biological agents to control weeds e.g *Dactylaria higginsii* against *C. rotundus* and *C. iria* • Flooding • rotation and fallow; rotation with non-grain crop prevents build-up of crop-specific weed • Rogue the field to remove the off-types and weeds which were not adequately removed by other control measures • Hand hoe weeding • Rouging out weeds • Use selective herbicides like 2-4-D Amine with regards to crop growth stage
Diseases	Rice yellow mottle virus	• Seed treatment with seed dressing products/botanicals • crop rotation • Field sanitation including burying of crop residues and removal of volunteer plants • Use of resistant varieties
	Rice blast (*Pyricularia oryzae)* Brown leaf spot (*Helminthosporium spp*) Sheath rot (*Acrocylindrium oryzae*)	• Destruction of crop residues • Clean seeds • Avoid use of excessive nitrogen fertilizers • Use of wide spacing to avoid overcrowding • Use resistance varieties • Appropriate crop rotation • Timely planting • Burying of crop debris • Delaying planting time where irrigation facilities are available • Field sanitation and Bush clearing • Change nursery sites • Thorough cleaning of farm implements e.g. tractor, hoe and personal hygiene when shifting from infected to uninfected RYMV field to avoid virus transmission

Pests		Recommended management practices
Vermins	Birds Wild pigs Hippopotamus Rats	• Scaring • Bush clearing • Early weeding • Early weeding and field sanitation • Early harvesting • Monitoring and management of outbreak flocks • Bird trapping • Farmers to scout potential breeding sites and destroy nests • Bird scaring; used to keep birds out of the fields, e.g. People shouting, noise-making devices, whips, throwing rocks or dried mud at the birds, and use of bird kites, scarecrows and flags. However, birds become familiar to these devices quickly, therefore, only providing protection for a short period of time. • Bird-tape; tapes are placed over the rice plants. This could be one of the best options for scaring birds. • Monitoring and organised aerial spraying using fenthion 60%ULV at the rate of 2.0l/ha • Lethal techniques are primarily implemented by national or regional (governmental) crop protection units. • Spot spraying against *Quelea quelea* targeting targeting roosting sites and treatment with avicides (use of Queletox 60% ULV common name Fenthion 600g/l) and the use of explosives or flamethrowers. • The use of repellents

Source: MALF: Plant Pests Field Book: A guide to management, 2002;

2. The most common rice diseases and pests in the project area include the following:

3.1 Rice Yellow Mottle Virus (RYMV)

3. 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. The disease can cause up to 92% yield loss on "S*uper*", the most popular rice variety in Tanzania (Banwo, 2003).

4. 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.

3.2 Rice Blast (*Magnaporthe grisea*)

5. 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.

3.3 Brown Leaf Spot (*Cochiliolu miyabeanus*)

6. 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.

3.4 Armyworm

7. 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.)

8. 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 MALF. 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 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.

9. The MALF 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, 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 SAGCOT areas including CFAST Regions.

10. 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.

3.5 Elegant Grasshopper

11. 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.

3.6 Stem Borer

- 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 spray neem cake powder/seeds 25-50 g/L, and Fenitrothion 500g/L and/or Deltamethrin 25g/L, when the outbreak is severe.

3.7 Birds

12. 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.

13. 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 Mbeya and Iringa regions and correspondingly to the MALF.

14. 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.

15. 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 MALF 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.

3.8 Rodents

16. 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%.

17. 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.

3.9 Rice Weeds

18. 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.

19. 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 Mbeya, Iringa and Njombe but may become common in the future as wage rates rise.

4.0 POLICY, LEGISLATIONS AND INSTITUTIONAL FRAMEWORK

20. Tanzania 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.

21. 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.

4.1 Key Policies, Legislations and Strategies

4.1.1 National Environmental Management Policy (1997)

22. 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".

23. 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.

4.1.2 Environmental Management Act (EMA) of 2004

24. 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

25. 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.

26. 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.

27. 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.

4.1.3 Plant Protection Act No. 13 (1997)

28. 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. MALF).

4.1.4 The Plant Protection Act 2013

29. 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.

4.1.5 The Pesticide Management Act 2013

30. 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.

31. 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.

4.1.6 Pesticides Control Regulations GN 193 of 1984

32. 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.

4.2 Institutional Arrangements and Special Programmes

33. MALF advocate the use and dissemination of IPM approaches through the agricultural extension services. On the aspects of migratory pests and diseases, MALF cooperates fully with the neighbouring countries (through regional initiatives on outbreak pest control) in the collective effort to control the damage of such pests. MALF 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.

4.2.1 Environmental Management Unit at MALF

34. 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.

4.2.2 Tropical Pesticides Research Institute (TPRI)

35. 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).

36. 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 MALF. TPRI's research, training and services are multi and interdisciplinary cutting across sectors.

4.2.3 Africa Stockpiles Programme (ASP)

37. 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 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).

38. 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.

39. 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.

40. 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.

5.0 PEST CONTROL AND MANAGEMENT OPTIONS

41. 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.

5.1 Biological Control

42. 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

43. Tanzania has some experience based on the successful control of the cassava mealy bug, the cassava green mite and the water hyacinth (Anon, 1999), coconut pest Coreid bug -Pseuthoraptus wayii by *Plutellus xyllostela* and Cabbage pests Diamond Bugs by *Diadegma* xyllostela. 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.

44. 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.

45. 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.

46. 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.

5.2 Cultural and Crop Sanitation Practices

47. 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, Bambara nuts, 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.

5.3 Physical and Mechanical Control

48. 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 strainers from cotton plants, banana weevils from banana pseudo-stems, 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.

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

5.4 Chemical Control

50. 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.

51. 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 CFAST will not finance, or support the use of, any of these pesticides.

Recommended classes of pesticides to be used within the irrigation scheme

Pesticides that are recommended for use within the irrigation schemes fall within the WHO classes III and IV which pose less danger when compared with Classes I and II. These are Pyrethroids, Carbamates and Organophosphates (Figure 3). Organochlorines such as Endosulfan are not recommended as they have been found to be toxic to amphibians (TPRI, 2010).

a) *Pyrethroids*: All pyrethroids are highly toxic to bees and highly toxic to fish and other aquatic organisms, except Deltamethrin which has low toxicity to other aquatic organisms. All other pyrethroids have very low toxicity to birds but highly toxic to mammals. In terms of persistency in the environment, only bifenthrin is persistent, the rest of the pyrethroids have low to medium persistency. Although Bifenthrin does not accumulate in the environment, there is potential for bioaccumulation in aquatic organisms for other pyrethroids.

b) *Carbamates*: Carbamates are highly toxic to bees, some aquatic organisms, mammals and birds. On the other hand, this insecticide has very low toxic properties on fish. In general, carbamates have low to medium indications for persistency in the environment and bioaccumulation in organisms.

c) *Organophosphates*: Organophosphates have different characteristics and impacts on different organisms depending on the type of insecticide. For example, Fenitrothion has low toxicity on mammals and fish and is not persistent in the environment, but it is highly toxic to bees, birds and other aquatic organisms, like crustaceans and aquatic insects and has a medium toxicity to aquatic worms. It has moderate to medium potential to bio accumulate in organisms. Malathion is highly toxic to bees, but it has very low impacts on fish and other aquatic organism and has very low potential to persist in the environment or bio-accumulate in organisms. It shows low to medium toxicity on mammals and birds. Pirimiphos-methyl is highly toxic to fish and other aquatic organisms and has a high potential to persist in the environment. It has low to medium toxic effects on mammals and bees. It does not bio-accumulate in organisms.

Pesticide	**Mammals**	**Birds**	**Fish**	***other aquatic organisms***	**Bees**	**Persistence**	**Bioaccumulate**[1]
Pyrethroids							
Carbamates							
Organophosphates							

[1]Bioaccumulation in the environment, not in mammalian bodies (mammalian detoxification produces different results).

Key to colours:

High Toxicity

Medium to High Toxicity

Medium Toxicity

Low to Medium Toxicity

Low Toxicity

Data Not Found

5.5 Mitigation against Chemical Control Measures

The following measures are proposed to mitigate the potential adverse impacts likely to occur as a result of pesticide use in the irrigation schemes. The primary mitigation measures include training in IPM technology, including safe and judicious pesticide use and management; delivery of a mix of Information Education and Communication approaches targeting farmers, pesticide operators and teams; provision of Personal Protective Equipment (PPE); training to farmers, and consistent supervision and monitoring. It is also important to have appropriate pesticide storage facilities, and equipping health facilities with adequate exposure treatment drugs. **Table….. below**

Table 3: Mitigation measures to be employed by using various control methods at the irrigation scheme

Control method	Impacts (+ve or –ve)	Mitigation measure
Cultural:		
- Crop sanitation, mulching, pruning, thinning	- Improves the health of the crop and its ability to fight pests and diseases - Improves soil condition and helps to minimize weed infestation	- No mitigation measure required
- Weeding	- Pulling of weeds have minimum impacts to the environment - Use of herbicides will have an impact on environment	- No mitigation measure required - Use measures proposed under chemical control
- Use of resistant varieties and tissue culture	- Use of pesticides is minimized and hence beneficial to environment	- No mitigation measure required
Mechanical:		
- Use of weeders and tillage equipment	- Minimizes use of herbicides - Health and safety may be impacted if operators are not skilled	- Use skilled manpower to operate the equipment - In case of accidents use proper procedures for treatment
- Insect traps (light, pheromones)	- Early detection of pests results in early application of pesticides before the situation becomes critical	- No mitigation measure required
- Manual weeding	- Involves no use of pesticides, hence friendly to environment - High labor costs - May impose danger to laborers (snake bites, etc)	- If any accident occurs, rush the affected to hospital or nearby dispensary for treatment

Control method	Impacts (+ve or –ve)	Mitigation measure
Biological:		
- Application of biological control agents such as Bt (*Bacillus thuringiensis*), wasps - Isolation of bacteria on the KST which inhibits chytrid fungus	- Cost effective - Involves no use of pesticides hence no environmental or health risks - Applied selectively against one or two pests - Takes long to generate results, hence cannot be used in emergency situations - Possibility of acquiring a new host if the old host is completely eliminated	- If the situation of acquiring new host arises, try to establish the minimum population required for survival
- Botanical extracts (neem, tephrosia)	- Friendly to the environment - Application rates are based on estimates. Usually preparation of extracts need a lot of material (such as leaves) for one application	- Try to establish an effective application rate
Chemical: - Lack of knowledge on the toxicity of pesticides to transporters and those involved in application	- Exposure to humans through inhalation, ingestion or dermal contact	- Train store keepers, transporters and all those involved with handling of pesticides. Training should be in the aspects of toxicity, steps to be taken in case of accidents or emergency, combustibility and handling of vehicle contamination - Female farmers who will be handling pesticides must be warned of the possibility of foetal exposure - Use of drugs recommended for treatment of exposure[6] (
-	- High costs of PPEs which makes farmers reluctant to purchase them	- Provide Personal Protective Equipment (helmet, respirators, overalls, gloves and rubber boots) or protective clothing (long legged trousers, long sleeved shirts, boots and wide

Control method	Impacts (+ve or –ve)	Mitigation measure
		brimmed hat) - Train on how to use and the benefits of using such gear
- Indiscriminate disposal of pesticide containers	- Risks of containers being used by other persons and children	- Containers should never be used to carry anything else apart from the intended formulation - Containers not to be used in households - Follow container disposal procedures provided by PHS or TPRI if available
- Water contamination	- Health risks to humans - Impacts on biodiversity (birds, bees, fish) - Impacts on amphibians at the gorge - Reduced densities of beneficial species	- Train farmers on health risks associated with improper use of chemicals - Regular monitoring of water quality. Check the presence of Organochlorines and other pesticides to determine if a lethal dose has been reached

5.6 Training of pesticide applicators

At least two selected farmers per village will receive detailed training on the emergency steps to take if accidental exposure of the chemical occurs through ingestion, eye or dermal contact with the chemical. The following are basic first aid procedures that will be included in the training program as part of handling pesticide poisoning.

- Follow the first aid instructions on the pesticide label. Take the pesticide can or label to the doctor or medical practitioner if seeking medical assistance.
- For poison on skin: remove contaminated clothing and drench skin with water, cleanse skin and hair thoroughly with detergent and water, and dry victim and wrap in blanket.
- For chemical burns: remove contaminated clothing, wash with large quantities of running water, cover burned area immediately with loose, clean soft cloth (Do NOT apply ointments, greases, powders or other medications to burn).
- Poison in Eye: wash eye quickly but gently, hold eyelid open and wash with gentle stream of clean running water for 15 minutes or more (Do NOT use chemicals or medicines in the water; they may worsen the injury)
- Inhaled Poison: carry victim to fresh air immediately, open all windows and doors, loosen tight clothing and apply artificial respiration if the victim is not breathing or victim’s skin is grey or blue. If the victim is in an enclosed area, do not enter without proper protective clothing and equipment

- Poison in mouth or swallowed: rinse mouth with plenty of water, give victim large amounts (up to 1 liter) of milk or water to drink, induce vomiting only if the pesticide label instructs you to do so.

6.0 EXPERIENCES WITH INTEGRATED PEST MANAGEMENT

52. During her study Nyambo (2002) gave a comprehensive analysis of the Tanzania 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.

53. 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.

54. 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 CFAST.

6.1 GTZ/PHS-IPM

55. The GTZ/PHS-IPM was initiated in 1992 by MAFC, namely German Agency for Technical Cooperation (GTZ) and the Plant Health Services (PHS). 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 GTZ/PHS was resource intensive with the GTZ granting of Tshs 500 million which was 90% of the budget allocated for IPM implementation annually, and the counterpart funding by MAFC was Tshs 50 million per annum. The GTZ/PHS 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 Northern and 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 (1999-2003)
- Handing over and consolidating the achievements. The project came to end in September 2003.

68. IPM recommendations accomplished by the GTZ/PHS 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
- 3 recommendations in Coffee
- 2 recommendations on weed management

No specific IPM recommendations were developed for rice.

56. The GTZ/PHS 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 of GTZ/PHS project:

57. The GTZ/PHS 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.

58. **Group formation:** The GTZ/PHS- 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.

59. **Group management and promotion of GTZ/PHS IPM**: The GTZ/PHS 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).

69. 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.

60. **Participatory Group Training approach:** The GTZ/PHS -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.

61. 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.

62. **Participatory evaluation of results and practices** GTZ/PHS-IPM: 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.

63. **Internal Monitoring and Evaluation**: 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.

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

65. **Capacity Building:** The GTZ/PHS 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.

66. 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.

67. **Impacts**: The extent of impact achievement with regard to the benefits of IPM under GTZ/PHS 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.

68. 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. In the CFAST project area, the success of the IPM can be demonstrated on the following project:

6.2 Mbeya: Southern Highlands Extension and Rural Financial Services Project/IFAD

69. 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.

70. 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.

71. 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.

6.3 LESSONS LEARNT FROM PAST IPM

6.3.1 Approach

72. The project discussed in the section above was 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.

6.3.2 Capacity Building

73. 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 a key to the success of new initiatives in different parts of the country. The GTZ/PHS-IPM project will play a major role in the set up and implementation of CFAST.

6.3.3 Funding and Logistical Support

74. 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.

75. 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.

7.0 IMPLEMENTATION STRATEGIES UNDER THE IPPM

76. 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.

77. 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.

78. 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 CFAST. 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.

79. Third, 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.

80. Fourth, **Research on resistant/Tolerant varieties and bio-pesticides:** Resistant /tolerant varieties will help to reduse pests and diseases pressure in rice, while research on identified bio-pesticides will reduce use of conventional pesticides which seems to pollute the environment. Bio-pesticides seems to have no residual effects and are easily available and preparation

7.1 Institutional Roles and Responsibilities

i) Activity Set 1: Awareness raising

81. The implementation of this IPMP will be supervised by the designated officers in charge of safeguards management in the MDU. The safeguards officer will organize the initial workshops to discuss the implementation of the IPMP, and annual review workshops to assess progress in implementation, in coordination CFAST implementers. The following are expected to be audience in the meeting/workshop which will be presented through Power Point and discussion; Rice producer stakeholders (Agricultural Experts from MALF/Irrigation, PO-RALG, LGAs under irrigation schemes, National Irrigation Commission, IPM expertise, Environmental expertise, Representatives from Irrigation schemes, Farmers, Research, Training Institutions e.g. Universities, Private sectors, NGOs.

ii) Activity Set 2: Training and capacity building

82. 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 which will target on; technical staff in IPM techniques and pesticide from both National and Zonal Offices, Master Trainers/TOTs, Extension Agents and Farmers. The training will focus on IPM concept, elements of IPM, biology and life cycle of rice pests and management options, soil management, preparation of bio-pesticides and application, and pesticides management. 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 i.e. Farmer Field School (FFS) and Agro-ecosystem Analysis (AESA) will be used as a tool during the training process where all key stakeholders shall be regarded as equal partners

83. The MALF Plant Health Services (PHS), Zonal Agricultural Research and Development Institutes (ZARDIs) and Environmental Management Unit (EMU) have the mandates to implement crop protection and pest management, research and environmental management respectively. The CFAST 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.

84. 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 project area.

iii. Activity Set 3: Research on Bio-pesticides and Resistant/Tolerant Varieties

85. The applied, adaptive research funding will be allocated and administered by the safeguards advisor participating in the Project Management Team of MALF. 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 research on Resistant/Tolerant varieties, bio-pesticides and preparation of farmer friendly extension materials

iv. Activity Set 4: Monitoring and Evaluation

86. The safeguards officer linked with the respective project management teams of the CFAST 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. They 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.

Surveillance of pests status in irrigation schemes prio-project start-up and Monitoring of crop development, pest's status and mitigation during crop stage (seedling stage, tillaring, panicle/booting stage, panicle initiation, and during harvesting stage, Measure taken by farmers/farmer groups and facilitators to mitigate the challenge if any.

Table 4: Surveillance of pest status in irrigation schemes

S/N	Type of pesticides used	Rate of application	Application Frequency	Reasons	Cost of pesticides	Pesticides damage	Methods used to manage pests	Cases of pesticides reported (hospital/police)	Yields before the project/training per acreage	Yield harvested/acreage	
										Conv	IPM
1											
2											
3											

NB: Cases of pesticides reported refer to people damaged by pesticides (during spraying or affected by pesticides due to spraying

7.2 Specific pesticides impacts and mitigation measures

All pesticides are poisonous and thus rules have to be observed to avoid human health impairment and environmental pollution. As a result of increased use of industrial fertilizers and pesticides due to agricultural intensification in the area, soil and water pollution might rise especially if recommended application rates are not followed and safe use, handling and storage of agrochemicals is not observed. Prolonged agricultural use of these products may result in the presence of their compounds in soil and water, and they degrade the environment.

In addition to material safety data sheet (MSDS) accompanied with any given pesticide, the Table below gives the mitigation measures and monitoring required.

Table 5: Specific pesticides impacts and mitigation measures

S/N	Pesticides impacts	Mitigation measures	Monitoring measures
	Soil and water pollution (Soil degradation and water quality impacts)	• Follow agrochemical application instructions • Awareness creation to farmer on the application, handling and storage of pesticides • DO NOT contaminate streams, rivers or waterways with used container • Some chemicals undergo microbial degradation in aerobic conditions; • Therefore slightly persistent in soil and water • Absorb spillage immediately with sawdust or earth; sweep up or bury. • 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 farmers on safety precautions before (!) it is too late. • Make contacts to a qualified physician for emergencies.	Monitor quality of soil and water for agrochemical contamination Monitor levels of pollutants from agrochemicals in water
	Public and occupational Health (toxic to human, aquatic organisms and environment)	• Keep 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 • Use Protective Clothing during spraying/application of agrochemicals.	

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

7.3 Recommended Pesticides in Tanzania

88. Table 8.1 summarizes the current registration list of pesticides in Tanzania. However, the CFAST 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 6: 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	
	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

Chemical	*Common name*	**Oral LD50/kg*	*WHO class*	*Comments*
	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.

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

Table 7: 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

Chemical	Category	Registration Status in Tanzania	Import Decision
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: - Benomyl at or above 7 per cent, - Carbofuran at or above 10 per cent,& - 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
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)

7.4 Work plan and budget

90. The CFAST project will take responsibility for implementation of a separate but coordinated workplans and budgets under the CFAST. These commitments will be supervised by the Safeguards Officer who is a member of the respective Project Management Teams and will closely collaborate with respective Ministries.

Table 8: 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: CFAST 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)						CFAST, MALF, LGAs	**30,000**
Sub- Total for Output 1							
Output 2.0: Capacities of extension officers and farmers to promote and adopt IPM approaches and pesticides management in rice production are enhanced							
Activity 2.1: Prepare, print and disseminate popular and/or Kiswahili versions IPM guidelines on three major						PHS, EMU, NIRC and DRD	**25,000**

insect-pests and diseases of rice, pesticides management and Community Based Forecasting for outbreak pests (e.g. armyworm, quelea quelea, rats)							
Activity 2.2: To facilitate short courses trainings/workshops for implementers on IPM related issues so as to improve knowledge and skills						PHS, EMU, CITS 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, NIRC, 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 CFAST						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						MALF 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							**160,000**
Output 3.0: New IPM Approaches/Packages are identified for CFAST areas							
Activity 3.1: To conduct rapid appraisal survey to evaluate methods used by farmers to control major rice pests in CFAST areas						MALF and LGAs	**15,000**
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							**45,000**
Output 4.0: Monitoring and Evaluation of IPM activities and IPMP implementation							
Activity 4.1: IPM tracking incorporated into CFAST baseline, midterm and end term surveys						PHS and EMU	**covered in main project impact survey budgets**

Activity 4.2: Conduct monitoring and evaluation of CFAST-IPMP implementation						EMU	**10,000**
Sub- Total for Output 4							**10,000**
GRAND TOTAL							**215,000**

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

Appendix 1: Names of experts prepared IPMP

Name	Title/Profession	Organization
Eng. January Kayumbe	Head, MDU- CFAST Coordinator	Ministerial Delivery Unit MALF.
Eng. Lait Simkanga	Environmental Engineer	National Irrigation Commission
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Appendix II: 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			
	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	

Chemical	*Common name*	**Oral LD50/kg*	*WHO class*	*Comments*
	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.

Appendix III: 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).

Appendix IV: 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