Toxics-Free Sustainable Development Goals (SDGs)

TANZANIA: NATIONAL REPORT ON ALTERNATIVES TO HIGHLY HAZARDOUS PESTICIDES (HHPs) - SECOND PHASE

MAY 2021

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LIST OF ABBREVIATIONS AND ACRONYMS

ASDP	-	Agricultural Sector Development Programme
ASP	-	Africa Stockpiles Programme
CBOs	-	Community Based Organizations
CSOs	-	Civil Society Organizations
DPPOs	-	District Plant Protection Officers
DRDPs	-	District Rural Development Programmes
FFS	-	Farmer Field School
FTC	-	Farmer Training Centre
GTZ	-	Gesellschaft fur TechnischeZusammenarbeit (German Technical Cooperation)
HHPs	-	Highly Hazardous Pesticides
IFAD	-	International Fund for Agricultural Development
IPM	-	Integrated Pest Management
IPMP	-	Integrated Pest Management Plan
KAEMP	-	Kagera Environmental Management Programme
KIHATA	-	Kilimo Hai Tanzania (Organic Agriculture in Tanzania)
LVEMP	-	Lake Victoria Environmental Management Project
MAFS	-	Ministry of Agriculture and Food Security
MARAFIP	-	Mara Region Farmer Initiative Project
M&E	-	Monitoring and Evaluation
NEI	-	Natural Extraction Industry
NGOs	-	Non-Governmental Organizations
OPEC	-	Organization of Petroleum Exporting Countries
PAN-UK	-	Pesticide Action Network UK
PPA	-	Plant Protection Act
PHS	-	Plant Health Services
RAS	-	Regional Administrative Secretary
SAT	-	Sustainable Agriculture Tanzania
SPFS	-	Special Programme for Food Security
T&V	-	Training and Visit System
TOAM	-	Tanzania Organic Agriculture Movement
TPRI	-	Tropical Pest Management Institute
VEOs	-	Village Executive Officers

1. INTRODUCTION

Highly hazardous pesticides (HHPs) are a threat to human health and the environment, with significant impacts on developing and transition countries. In 2005, more than 100 governments at the Fourth International Conference on Chemicals Management (ICCM4) agreed that HHPs are an issue of global concern and reached a consensus resolution to give priority to promoting agro-ecological alternatives in the process of implementing the strategy on HHPs developed by FAO-UNEP-WHO.

Tanzania is endowed with a range of natural resources and a favourable climate that allows a range of crops to be grown (Mlambiti and Isinika, 1997; Food Studies Group, 1992). The major crops grown in Tanzania are grains (maize, rice, sorghum and millets), legumes (beans, cowpeas) tubers (cassava, sweet potato, round potatoes, carrots), vegetables and fruits (tomato, leafy vegetables, onions, citrus fruits, pineapples), fibers (cotton and sisal), beverages (coffee and tea) and spices. Agriculture continues to be the leading economic sector in terms of number of people employed in it. Over 80 percent of the population lives from agriculture, particularly small scale agriculture.

Local communities, particularly smallholder farmers and civil society organizations, have discovered several alternatives to HHPs and they are using them to replace HHPs when necessary. The results from fieldwork carried out by AGENDA in November 2020 shows that farmers, especially those who are practicing organic and agro-ecology farming, are using alternatives, mainly herbal concoctions. According to them, the alternatives have been helpful despite the challenges encountered. However, the information has not been reported to the government so the application of such practices has not spread to farmers in other areas.

AGENDA previously participated in a Toxics-Free SDGs project related to phasing-out HHPs in Tanzania, and this report is a continuation of that project. It covers the period from October 1, 2020 to January 31, 2021, as required by the agreement. The work included the review of the registered plant protection substances for use in Tanzania to identify HHPs among them, as well as other tasks.

In implementing this project, AGENDA visited four groups of smallholder farmers in Mvomero district in Morogoro region. AGENDA was accompanied by the agricultural officers (district and ward). At all levels, the discussions were based on the opportunities and challenges faced by farmers regarding crop and animal production. Emphasis was on the situation of HHPs use, especially those used for tomatoes production, their alternatives, organic production and marketing opportunities, their knowledge, attitude and practice, etc. The information below is from the literature review, consultation with stakeholders and the field visit. In addition to this report, AGENDA has prepared an outline of a 'Strategy to phase-out HHPs in Tanzania'

and has submitted it to the national body responsible for registration of plant protection pesticides, Tropical Pesticides Research Institute (TPRI), as a suggestion for their consideration.

2. NATIONAL POLICY FRAMEWORKS THAT SUPPORT ECOSYSTEM APPROACHES AS ALTERNATIVES TO SYNTHETIC PESTICIDES

2.1 National IPM policy framework

Tanzania has a national Integrated Pest Management Plan (IPMP) which was revised in 2009 and implemented under the Agricultural Sector Development Program (ASDP). IPM practices have been documented for some crops including maize, banana, cotton, cashew nuts and tomatoes; these were developed by the Ministry of Agriculture. The utilization of such practices by farmers requires increase in awareness, and should also be subject to review to accommodate newer practices.

Below (Tables 1&2) is information from the IPMP for tomatoes. Similar information for selected crops, i.e. cotton, coffee, banana, cassava and beans, has been included in this report in Annex 2 and Tables A1, A2, A3, A4 and A5.

Table 1. Major pests of tomatoes and recommended management practices

Pest		***Recommended management practices***
Insects	American bollworm *(Helicoverpaarmigera)*	• Inspect the crop regularly for new infestations • Use botanicals like Neem extract • Apply recommended insecticides at recommended dosage rate
	Cutworms (*Agrotisspp*)	• Early ploughing expose cutworms to predators • Apply wood ash around plants • Inspect the crop regularly soon after transplanting because this is the most susceptible stage of the crop • Mechanical (hand collect crush them) • Use appropriate trapping methods. Crush the caterpillars or feed them to chickens • Use repellent botanicals e.g. Mexican marigold • Spry with recommended insecticide if necessary
Nematodes	Root knot nematodes (Meloidogyne) Kiswahili Name: *Minyoo fundo*	• Optima rotation and fallow • Deep ploughing • Avoid contaminated water • Plant tolerant/resistant varieties e.g. Tengeru 97, Tanya and Meru • Sterilize seedbed before sowing • Transplant clean seedlings only

Mites	Red spider mites Kiswahili Name: *Utitiri mwekundu*	• Avoid dusty conditions during extreme dry season • Encourage moist microclimate by frequent irrigation • Encourage natural enemies by mulching • Frequent weeding • Inspect the crop regularly for new infestations • Apply a recommended miticide if necessary

Source: https://www.kilimo.go.tz/uploads/IPMP_Plan.pdf

Table 2. Major diseases of tomatoes and recommended management practices

Pest		***Recommended management practices***
Diseases	Late blight *(Phytophthora infestants)* Kiswahili name: *Baka jani chelewa*	• Plant tolerant varieties, e.g. Meru and Kiboko • Use certified disease-free seeds • Regular crop scouting to detect early attack • Field sanitation after harvest by removal of infected plant parts • Crop rotation • Avoid moist microclimate at shady places • Use recommended spacing • Observe recommended time of planting • Shade management • Decrease humidity through pruning, de-suckering, staking and weeding • Apply mulch to reduce splash and spread of the disease
	Early blight (*Alternaria soloni*)	• Remove infected plants starting from nursery • Weed out Solanacea plants • Observe recommended time of planting • Regular crop scouting to detect early attack • Apply recommended fungicide if necessary
	Powdery mildew (Oidium lycopersicum)	• Use tolerant varieties, e.g. Kiboko • Sanitation, remove infested leaves • Practice crop rotation • Use botanical and other natural pesticides if validated • Regular crop scouting to detect early attack • Apply recommended fungicide if necessary
	Bacterial wait *(Pseudomonas solanacearum)*	• Practice good crop rotation • Practice deep ploughing/post harvesting cultivation to expose soil to sun • Add organic matter to the soil (cow dung, mulch green manure • Identifying and removing /destroy plants undesirable characteristics affected plants and weed-hots or bury outside the field • Avoid transferring infested soil, including soil on roots of plants • Do not irrigate with contaminated water from infested areas • Choose seedbed in clean, uninfected area
	Fusarium wilt *(Fusarium oxysporum)* Kiswahili: Mnyauko Fusaria	• Use resistant varieties e.g. Tengeru 97 Tengeru 97 is resistant to both fusarim wilt races 1 and 2

		• Practice good crop rotation • Sanitation and crop hygiene • Deep ploughing • Avoid transferring infested soil, including soil on roots of plants • Do not irrigate with contaminated water from infested areas • Add organic matter to the soil (cow dung, mulch, green manure)
	Bacteria spot (Xanfhomonas compestris pv Vesicatoria) Kiswahili name: *Madoa Bakteria*	• Use clean seed • Three year crop rotation • Avoid working in field under wet conditions • Avoid injuries to fruits
	Tomato yellow leat curl (TYLC)- virus vectored by whitefly (Bemisia tabaci) and some thrip species Kiswahili names: *Rasta, Ngumi, Bondia*	• Use disease-free planting materials • Time of planting • Scouting of the disease and removal of affected plants • Intercrop with onion. This also reduces aphids in tomatoes • Iterncrop with eggplants as traps to draw whiteflies away from less tolerant and virus prone crop like tomatoes • Good management of irrigation water • Remove and destroy crop residues immediately after the final harvest • Avoid planting lantana camara near tomato fields • Spray if necessary but use recommended insecticides

Source: https://www.kilimo.go.tz/uploads/IPMP_Plan.pdf

2.2 National organic agriculture policy framework

Organic agriculture in government policies in Tanzanian is captured in the National Livestock Policy of 2006. Organic livestock farming policy statements are mentioned on page 56 as quoted below.

i. In collaboration with other stakeholders the Government will promote and create awareness on organic livestock farming;
ii. The Government in collaboration with other stakeholders will encourage and promote investment in organic livestock farming;
iii. The Government will strengthen technical support services in organic farming practices.

It is also outlined in the National Agriculture Policy 2013, section 3.21 (organic agriculture and policy statements), where it is stated that:

i) Registration and availability of organic inputs to farmers shall be facilitated;
ii) The Government shall facilitate accreditation of organic products in order to reduce certification costs;
iii) Initiatives for regulation and certification of organic products shall be promoted; and

iv) In collaboration with private sector, effective coordination among stakeholders shall be enhanced.

2.3 Policy frameworks that support the manufacture, import, distribution and use of bio-pesticides

In Tanzania, pesticides are regulated through legislation, registration and enforcement. The pesticides registration and control scheme is guided by the Plant Protection Act (PPA) No. 13 of 1997 and the Plant Protection Regulations of 1999. These legislations control the life-cycle of pesticides, which include manufacturing/formulation, importation, registration, importation, sale and distribution, use, transportation and disposal. Bio-pesticides are included in those legislations.

The PPA has made provisions for consolidation of plant protection to prevent introduction and spread of harmful organisms, ensure sustainable plant and environmental protection, control the importation and use of plant protection substances, regulate export and imports of plant and plant products and ensure fulfillment 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 the 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. Bio-pesticides are among the plant protection substances that are registered by TPRI, as they do for other pesticides.

3. NATIONAL IMPLEMENTATION OF CROP-SPECIFIC, PEST-SPECIFIC ALTERNATIVES TO HHPs

Under the IPMP, several packages of IPM technologies specific to crops or pests were developed; tested and implemented (an example for tomatoes is shown above in Tables 1 and 2). Smallholder farmers in selected areas (agro-ecological zones) were trained on formulation and application of such alternatives. The technology is still applied by few farmers around the country, such as at Mvomero in Morogoro Region.

3.1 National IPM implementations

In promoting sustainable IPM approaches and to prepare a foundation to facilitate and enhance grass-roots based systems of extension, the Ministry of Agriculture and Food Security, in collaboration with GTZ, FAO and IFAD, has been implementing IPM pilot projects

to promote farmer participatory integrated pest management (IPM) approaches in different parts of the country and cropping systems. The following are examples of IPM pilot projects implemented in Tanzania:

i. The GTZ/PHS-IPM

The IPM project was initiated in 1992 by the Ministry of Agriculture and Food Security, namely Plant Health Services (PHS), and the German Agency for Technical Cooperation (GTZ). The IPM pilot area was the western growing zone (Shinyanga). This was the area using a lot of pesticides to reduce losses emanating from pests. The IPM project was resource intensive, with the GTZ granting Tshs. 500 million (US$ 215,500) which is 90% of the budget allocated for IPM implementation annually. The counterpart funding by the Ministry of Agriculture was Tshs 50 million (US$ 21,550) per annum. The project operated for 11 years under the following phases:

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

Spill-over and role model effects: Kagera Agricultural and Environmental Management Programme (KAEMP) and Mara Region Farmer Initiative Project (MARAFIP) copied the project approach.

Capacity Building: The project trained 999 Village Executive Officers and District Plant Protection Officers (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, Lake Victoria Environmental Management Project (LVEMP), etc., have jointly financed the training. The VEOs have in turn trained 484,825 farmers in IPM, i.e. 421,487 in the western and 63,338 in the northern zones.

The VEOs 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 were role models for IPM development, testing of recommendations, validating, implementing and disseminating information.

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

- The use of conventional pesticides in cotton in Shinyanga has been reduced from 6 calendar sprays to a maximum of 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 was instituted in line with the Plant Protection Act (PPA) of 1997 and actively guided monitoring and implementation of plant protection activities in Tanzania.
- IPM has been integrated in the Agriculture and Livestock Policy as a national policy on plant protection and the Agricultural Sector Development Programme (ASDP) has emphasized that IPM should be disseminated country-wide.

  The government, in collaboration with development partners and farmers, developed various methods/techniqueswhich have been practiced for over a decade now. Some of the methods/techniques are shown above in Table 1 and Table 2 and in Annex 2 below, and some of such practices are still in use to-date, including by the farmers who were visited under this project at Mvomero. Another example of the practices used for tomatoes production include: selection of seeds that are tolerant to diseases. The list that appears on the IPMP (Table 4 below) shows in general the plants that can be used to prepare botanical extracts (hence, not crop specific).

  Currently, the government is also implementing ASDP II, which emphasizes on the application of IPM by farmers as outlined in the IPMP. That means both the government and the farmers have the will to practice IPM, though inadequate resources (financial and skill) may be the hindrance.

ii. **Kagera Agricultural and Environmental Management Programme (KAEMP)** was a multi-sectoral initiative of the Kagera region (Lake Zone) jointly funded by IFAD, BSF/JP and OPEC, with contributions from the beneficiaries. The project was implemented by Regional Administrative Secretary (RAS) for Kagera and managed by the local government machinery. Its main focus was on improvement of food security and poverty elevation, and, therefore, had a holistic approach (addresses agriculture, health, livestock, environment management, rural access roads and marketing) to rural development. In this setup, IPM was embraced as the key pest management method in all crops. KAEMP borrowed the IPM approach (baseline studies, group formation and training, internal M & E, etc.) from the GTZ/PHS-IPM Shinyanga project. The major crops grown in the region are cotton, coffee, banana, cassava and beans.

iii. **Mara Region Farmer Initiative Project (MARAFIP)** is an initiative of Mara region whose main objective is poverty alleviation through strengthening of capacity of the local institutions to respond to farmer's felt needs related to food, agriculture and livestock. The project is organized and implemented by the Regional Administrative

Secretary (RAS) and funded by IFAD. MARAFIP is another offspring of the GTZ/PHS-IPM project, and uses the FAO IPM-FFS approach of group training and technology transfer. All district plant protection officers and VEOs were given training in IPM concepts to raise awareness about IPM to facilitate their supervisory role. Five Village Executive Officers (VEOs) (project staff) of selected villages for farmer field schools (FFS) pilot groups were given a one-month split course in IPM, group management and participatory technology transfer methods to provide them the capacity to organize and conduct IPM-FFS. The approach focused on cowpeas, field beans and sweet potato. No details of the practices have been outlined.

iv. **Mbeya: Southern Highlands Extension & Rural Financial Services Project/IFAD:** This initiative started with organized extension farmer groups in 1996/97 using a modified Training and Visit System (T&V) extension method to enhance technology transfer at the farm level. Essentially, the approach was still strongly based on the traditional "top-down" extension method. 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.

v. **IPM-FFS capacity building (IFAD/FAO initiative):** Two VEOs (master trainers) attended a 3-month 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 organize and conduct IPM-FFS. This was followed by a 2-week 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 organize and conduct IPM-FFS in their respective villages. Farmer-farmer learning through exchange visits between farmer groups and within group members was facilitated. Like in the other initiatives, organized field days and exchange visits were used to encourage spillover to non-group members. For Mbeya region, the training was focused on tomatoes, cabbages, round potatoes and wheat, and in Ruvuma – Mbinga it focused on coffee and maize.

vi. **Morogoro Special Programme for Food Security (SPFS)/FAO Project:** This was an initiative of the Ministry of Agriculture and Food Security in collaboration with FAO that targeted Morogoro and Kilombero districts, with a focus on maize and rice (the major crops in the area) and promotion of small livestock (poultry, and milk goats).
The project started in 1996 and ended in 1998. The initiative promoted farmer participatory group approaches of technology transfer. Because this capacity was not within the project staff, training in participatory approaches was organized and

provided by the Co-operative College Moshi for the project core staff (E. Shayo, personal communication).

vii. **PHS IPM promotion activities 2003/06**: Between 2003 and 2006, PHS, in collaboration with the Participatory Agricultural Development and Empowerment Project (PADEP), conducted a series of sensitization workshops for key policy makers in the agricultural high potential areas; facilitated the establishment of 875 FFs (21,875 farmers) in 11 regions; and designated four farmer training centres (FTCs): Mkindu - Morogoro, Bihawana – Dodoma, Inyala - Mbeya and Ichenga - Iringa for FFS training (Riwa 2007). In addition, the FAO-supported special programme for food security (SPFS) established 314 FFSs (Mero 2006). TPRI conducted a limited number of training courses for pesticide dealers, stockists and retailers, and some of the course participants are officially registered with TPRI under the provisions of the PPA 1997 and Regulations 1997 (WH Riwa personal communication 2009, personal observations).

viii. **The GTZ-IPM project in Arusha,** in collaboration with IPM farmer groups and the extension staff, has compiled a list of useful botanical pesticides that could be used on a wide range of vegetables and other food crops, these are shown in Table 4 below.

ix. **PAN-UK ASP IPM Research project**

Pesticide Action Network-United Kingdom (PAN-UK) supported the Africa Stockpiles Programme (ASP) IPM Research, which contributed to strengthening the government ASP action plan in two major activities: (1) facilitated AGENDA for Environment and Responsible Development (AGENDA) and other NGOs in Tanzania to conduct multi-stakeholder awareness workshops for policy makers on responsible use and environment friendly pesticides; and (2) conducted courses on eco-toxicological monitoring and community-based pesticide action monitoring for other NGOs, CBOs and CSOs. The PAN-UK ASP IPM research project facilitated the promotion of IPM in Tanzania through preparation of a country paper on existing opportunities for the ASP-Tanzania project to mainstream IPM and organic farming in Tanzania as strategies to minimize potential hazards of pesticide use through further promotion of IPM practices at the farmer level (Nyambo 2007a, 2007b, Riwa 2007).

3.2 National organic agriculture implementation

In Tanzania, the national organic agriculture implementation is coordinated by the Ministry of Agriculture. It is guided by the National Organic Agriculture Development Programme for Tanzania 2009-2015 (Mpango wa Kuendeleza Kilimo Hai Tanzania (MKUKIHATA) 2009-2015), which is a comprehensive programme for the development of the organic sector. It is aligned with Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania (MKUKUTA), which is the

National Strategy for Growth and Poverty Reduction and the Agriculture Sector Development Programme, and has a strong focus on food security and poverty alleviation through income generation and a market-led expansion of the organic agriculture sector. Some smallholder farmers have been implementing organic farming for many years. Most of organic farming inputs are prepared by farmers themselves, since they are not available for sale as is the case for conventional pesticides.

Table 3 below shows some information from the smallholder farmers visited in Mvomero district, Morogoro region under this project. The groups use plant extracts to control pests (as alternatives to chemical pesticides) for some of the crops they cultivate. Some photographs inAnnex1 provide examples on products and practices deployed by farmers. Similar groups exist in other regions in Tanzania although the crops and organic extracts may be different. Farmers reported that there is market for organic products, but the challenge is to produce an adequate amount.

The farmers visited by AGENDA explained that they prefer producing crops based on organic methods. They gave reasons such as benefits to their health, land conservation and the economy – meaning most of the natural remedies are available within their areas, and implying that they won't spend much money for conventional pesticides. They are aware that the use of conventional pesticides has impacts to their health and non-targeted organisms, and of the money they would have to spend to buy the pesticides.

Moreover, as noted in Section 3.1 above, the benefits of IPM have been explained, including the increased production of cotton. The farmers in the project villages felt that there was an increase in tomatoes production, but could not tell to what extent because they don't keep data.

As for the price, no difference, as most products mix at the market – except for specific markets that are dedicated to selling only the organic products. The price may be a bit higher for farmers who have specific or arranged dealers like the ones selling organic avocados abroad. For common public markets, the price of tomatoes is determined by availability of the product and not whether it is organic or not.

Table 3: Some alternatives to chemical pesticides available and used by farmers

S/N	Name of Pesticide/Reg. No.	Name of HHP replaced by farmers	Name of alternative	Target crops	Image
	Supercron/ IN/0603	Profenofos	Neem	Tomatoes, hot pepper	

	Vegimax	N/A	Moringa oleifera	Tomatoes, cucumber	
	TickBuster/AC/0031	N/A	Rabbit urine	Maize, beans, rice	
	Buster		Tephrosia	Maize, beans, rice	
	Ninja/IN/0338 Ninja/IN/0681	Lambdacyhalothrin	Moringa oleifera,neem, African birds-eye chili, garlic	Beans, cowpeas	
	Kungfu/IN/0320	Lambdacyhalothrin	Moringa oleifera,neem, chili, African birds-eye chili, garlic,	Maize, cowpeas, beans, tomatoes	
	Roundup 360 SC/HE/0055	Glyphosate	Neem,Moringa oleifera, garlic,African birds-eye chili	Rice	
	Duduba 450 EC	Cypermethrin +chlorpyrifos	Neem,Moringa oleifera,garlic,African birds-eye chili	Rice	
	Wiltigo Plus 50EC	Emamectin benzoate	Neem,Moringa oleifera, garlic, African birds-eye chili	Rice	

3.3 Practices based on indigenous knowledge that are being used to replace HHPs

The following are practices based on indigenous knowledge that are being used to replace HHPs in Tanzania:

i. Use of botanicals such as marigold, lantana camara, neem leaves, pyrethrum, pepper, pawpaw leaves, *utupa (*Tephrosia*)* and peas leaves on pests and diseases, some of which are shown in Table 4.
ii. Mixed cropping that includes nitrification plants.
iii. Use of soot and cow dung grannies in storing grain for households.
iv. Scratching/ grading of Sodom apple are applied as pesticides.
v. Use of tall khaki weed leaves and tobacco to preserve grains.
vi. Cow's urine sprayed to tomato plants in order to protect from diseases.
vii. 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.
viii. Intercropping: The field is used to grow two or more crops at the same time.
ix. Relay cropping: For example, banana is relayed with mucuna to reduce the infestation of weevils.

x. Fallow: The field is not cultivated for some years in order to control various parasitic weeds.
xi. Cover crops: These are leguminous crops, which are grown to suppress weeds in the field. They can be intercropped and they protect and cover the field, e.g. pumpkins, canavallia, etc.
xii. Trap crops: These induce the germination of a pest. The trap crop can be intercropped or rotated with a susceptible host (e.g. groundnuts, bambaranuts, cotton, etc.).
xiii. 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.).
xiv. Hand pulling and hoes weeding: These practices are the most common and being used by small-scale farmers.
xv. Burning: Land clearing and destroying infected plants/crops.
xvi. 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.
xvii. Use of disease-free planting material, e.g. cassava cuttings, sweet potato vines, etc.
xviii. Pruning: Done in coffee, tea orange tree, etc. to reduce insect pests and diseases that might infest the crop.
xix. Thinning: Done to reduce plant population in the field (e.g. in maize, rice, sorghum and millet, cotton, etc.).

Table 4: Plants that are used to prepare botanical extracts for pre- and post-harvest pest control

Kiswahili name	**English name**	**Scientific name**
Kitunguu swaumu	Garlic	*Allium sativa*
Mwarobaini	Neem	*Azadirachta indica*
Pilipili kali/kichaa	Chili/ African birds-eye chili	*Capsicum frutenscens*
Mpapai	Pawpaw	*Carica papaya*
Mlonge	Moringa oleifera	*Horseradish*
Majani ya Mkorosho	Cashewnut leaves	-
Tango pori	Cucumis dipsaceus	-
Tangawizi	Ginger	*Zingibar officinale*
Mualovera/Mshubiri	Barbados aloe	*Aloe vera*
Mnanaa	Thorn apple	*Datura stramonium*
Mnyaa/utupa	Milk bush	*Euphorbia tirucalii*
Mwingajini	Wild sage	*Lantana camara*
Tumbaku	Tobacco	*Nicotiana spp*
Kivumbasi	Mosquito bush	*Ocimum suave*
Mbagimwitu	Mexican marigold	*Tagetes spp*
Alizetimwitu	Wild sunflower	*Tithonia diversifolia*
Utupa	Tephrosia	*Tephosiavogelii*

4. NATIONAL INITIATIVES IN AGRO-ECOLOGY IMPLEMENTATION

Some of agro-ecology implementation has been part of IPM implementation.

4.1 Organizations that support and initiate agro-ecological implementations in Tanzania

The following are some of the organizations that support and initiate agro-ecological implementations in Tanzania:

i) Tanzania Organic Agriculture Movement (TOAM) is the national umbrella organization for the organic sector in Tanzania.
ii) Sustainable Agriculture Tanzania (SAT)- NGO in Morogoro.
iii) NEI – Natural Extraction Industry, Mvomero district, Morogoro.
iv) NEO LIFE – NGO in Mvomero district, Morogoro.
v) MVIWATA - National Network of Farmers Groups in Tanzania.
vi) PELUM - Participatory Ecological Land Use Management- NGO in Morogoro.
vii) TOFO - Tanzania Organic Foundation.
viii) KIHATA - Kilimo Hai Tanzania (Organic Agriculture in Tanzania).

4.2 Main national challenges in the implementation of agro-ecology in Tanzania

i) Limited agro-ecology research and dissemination of results.
ii) Limited water for irrigation.
iii) Wild animals invading the farms/crops.
v) Limited support from policy level, due to inadequate resources to enforce the set out laws and guidelines.
vi) Little awareness among the community/ farmers on agro-ecological practices.
vii) It is difficult – a lot of time and process to prepare and use plant extracts to control pests.

4.3 Recommendations and project ideas emerging from the challenges

1. There is need for further discussions with stakeholders for them to buy-in to the initiative to phase-out HHPs in Tanzania and to promote organic and agro-ecology farming.
2. Training to farmers on preparation and use of alternatives to HHPs.
3. Increase awareness on the human health and environmental effects and the need to phase-out HHPs with alternatives.
4. Promotion of best practices and alternatives by farmers using better alternatives to synthetic pesticides.

5. TPRI and other responsible authorities to collaborate more with farmers in researching and registering alternatives to pesticides as well as providing guidance for their application.
6. More support required from policy level, especially on technology transfer and sharing of experiences within the Africa region.
7. Promote awareness among the community/ farmers on agro-ecological practices.
8. Promote agro-ecology research and dissemination of results, initiate demonstration farms.

5. DEVELOPMENT, SUBMISSION AND DISCUSSION OF A STRATEGY TO PHASE-OUT HHPs IN TANZANIA

With this project, AGENDA developed a suggested strategy to phase-out HHPs in Tanzania. The draft strategy and the list of HHPs registered in Tanzania have been submitted to TPRI for their review and action. AGENDA also had a dialogue with the Registrar of Pesticides on the phase-out of HHPs in Tanzania, where the Registrar acknowledged AGENDA's work but could not give specific action items or dates to phase-out HHPs. He went further, saying that the phase-out of HHPs is not something that can happen overnight – it has to be tabled and decided by relevant committees. They have to satisfy themselves on the availability of suitable (effective and safe) alternatives.

KEY REFERENCES

(i) https://www.tpri.go.tz/storage/app/media/uploaded-files/Registered%20Pesticides%20for%20use%20in%20the%20United%20Republic%20of%20Tanzania%202020.pdf
(ii) https://www.kilimo.go.tz/uploads/statistics/Revised_Final_IPMP_for_SAGCOT_March_12_2014.pdf
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ANNEXES

ANNEX 1: Some photographs on products and practices deployed by farmers

Photo 1: IMARA organic farming group in Mlali village pause for photo after discussion with AGENDA staff. On the table are some products produced from organic crops such as sweet potatoes.

Photo 2: Some products from organic potatoes produced that promote the value chain and improve the livelihood of the community.

Photo 3: Beans at an organic farm owned by IMARA group

Photo 4: From left are Mlali Ward, Agriculture Officer, AGENDA staff and IMARA group Member in the IMARA Group's organic beans farm.

Photo 5: Some techniques for water conservation - used for growing vegetables.

Photo 6: Vegetables and fruits sun drier

Photo 7: Tomato farm owned by Umoja ni Nguvu from Kimambila Village.

All photo credits to AGENDA

ANNEX 2: Selected crops diseases and the IPM methods used to manage them

Table A1: Cotton pest problems and recommended management practices in the Western Cotton Growing Area

Pest		**Recommended management practices**
Insects	Jassids (*Empoasca* sp)	• Plant recommended UK varieties (resistant plant varieties) • Spray in case of a severe attack at seedling stage
	American bollworm *(Helicoverpa armigera)*	• Plant recommended UK varieties (indeterminant varieties) • Early planting • Carry out regular scouting, preferably once a week • Use scouting records to make spraying decision. Spray with recommended insecticides after scouting
	Aphids *(Aphis gossypii)*	• Effectively controlled by indigenous natural enemies • Populations often washed off by rain • In case of severe outbreaks, spray with recommended Insecticides
	Spiny bollworm (*Eariasinsulana and E.biplaga*)	• Early planting • Frequent crop scouting and using the information to make decisions • Observe the close seasons (uproot and burn all crop residues) • Uproot all ratoon cotton to deprive the pest of food
	Lygus *(Lygus vosseleri)*	• Spray with insecticides in case of an early season attack
	Cotton stainers (*Dysdercus*spp)	• Observe the close season • Early and frequent picking to avoid build-up of stainers • Sanitation in and around cotton ginneries and buying posts • Uproot and destroy all ratoon cotton • Apply 1 to 2 sprays of recommended insecticides if necessary (inspect the crop before spraying)
	Blue bugs *(Calidea dregii*)	• Observe the close season • Early and frequent picking avoid build-up of blue bugs • Sanitation in and around cotton ginneries and buying posts • Apply 1 to 2 sprays of recommended insecticides if necessary (inspect the crop before spraying)
Diseases	Bacterial blight	• Rotation

	(*Xanthomonas malvacearum)*	• Plant recommended UK varieties (these are resistant to the disease) • Observe the close season • Crop sanitation
	Fusarium wilt (*Fusarium Oxysporum* f.sp. *vasinfectum)*	• Rotation • Crop sanitation • Plant recommended UK varieties for the area
	Alternaria leafspot (*Alternaria macrospora)*	• Rotation • Field sanitation
Weeds	All types	• Proper land preparation • Early clean weeding • Use recommended herbicides
Vermin	Field rats, monkeys and baboons	• Scaring • Trapping

Source: https://www.kilimo.go.tz/uploads/IPMP_Plan.pdf

Table A2: Coffee pest and disease problems and recommended management practices

Zone	**Pest**		**Recommended management practices**
Ruvuma sub-zone	Insects	Antestia bugs (*Antestiopsis*spp.)	• Pruning • Coffee cherry stripping • Apply recommended insecticides at recommended dosage if necessary
		White stem borer and yellow headed stem borer	• Sanitation and crop hygiene • Stem cleaning • Mechanical (hook the larvae out if possible)
		Mealybugs and scale insects	• Proper planting depth • Build the plant "skirt" soon after the first harvest to deter ants from climbing through branches to enhance build up of natural enemies
	Diseases	CBD & CLR	Management as for the northern zone

		Fusarium wilt	• Plant recommended tolerant varieties e.g. KP 423 (locally known as "nylon") • Field sanitation • Proper pruning
	Weeds	All types	• Clean hand weeding • Apply herbicide if necessary. Use recommended herbicides

Source: https://www.kilimo.go.tz/uploads/statistics/Revised_Final_IPMP_for_SAGCOT_March_12_2014.pdf

Table A3: Banana major pestproblems and recommended management practices for Lake and Northern Zones

Pest		**Recommended management practices**
Insects	Banana weevil (Cosmopolites sordidus) (Temnoschoita delumbrata) Kiswahili name: *Funza ya migomba*)	• Practice crop rotation • Intercropping with legumes that reduce weevil movement • Sanitation/crop hygiene • Use healthy planting material (use a combination of corm paring and hot water (at 55^0C for 20 minutes or solarisation) treatment • Sequential planting to avoid nematode infested areas • Rational use of weevil trapping with using bait (split pseudostems or discs and corns) • Use of repellent botanicals, such as Tephrosia, tobacco, Mexican marigold, Neem and *Iboza multiflora* • Improved soil fertility management and crop husbandry • Mulching • Deep planting to discourage egg-laying • Application of high quantities of manure to improve soil fertility • Harvest hygiene
	Ants	• Trapping
Diseases	Panama disease or Fusarium wilt (Fusarium oxysporum f.sp.	• Grow banana cultivars with resistance to pest and disease like the East African Highland bananas (*Matoke*)

	cubense) Kiswahili name: *Mnyauko panama*	• Fallow or rotation • Sanitation/crop hygiene • Planting of clean suckers • Establish new crop on disease-free sites • Mulching • Application of high quantities of manure • Destroy debris of wilted plants by burning
	Black and yellow sigatoka (Mycosphaerellafijiensis) Kiswahili name: *Sigatokanyeusi*	• Resistant cultivars • Uproot and burn the affected parts • Use of large quantities of farmyard manure • Plant and field sanitation • Use disease-free seeds • Prune, remove suckers and weed frequently • Avoid close spacing • Avoid transfer of seeds from affected areas to unaffected areas
Nematodes	Burrowing nematodes, e.g. Pratylenchus goodeyi, Radophilus similis, Meloidogyne spp. and Helichotylenchus multicintus	• Improved farm management, including sequential replanting and soil fertility • Practice crop rotation • Sanitation/crop hygiene • Farmer training in disease identification and control measures • Use healthy planting material • Establish new crop on disease-free sites • Mulching to enhance beneficial soil organisms to suppress nematodes • Treatment of infested suckers with hot water • Application of high quantities of manure • Sterilise planting material through solarization and/or the hot water method as for weevil control
Vermin	Rodents	• Trapping by using local methods • Cleanliness of the farm

Source: https://www.kilimo.go.tz/uploads/statistics/Revised_Final_IPMP_for_SAGCOT_March_12_2014.pdf

Table A4: Cassava major pests and recommended management practices

Pest			**Recommended management practices**
Insects	Pre-harvest	Cassava mealybugs (*Phenococcus manihot)*	• Improve the soil fertility by manuring, mulching and intercropping

			• Practice crop rotation • Use clean planting material • Resistant varieties • Plant healthy stem cuttings • Plant at the beginning of the wet season
		Cassava green mites (Mononychellus tanajaa)	• Improve the soil fertility by manuring, mulching and intercropping • Practice crop rotation • Use clean planting material • Resistant varieties • Plant healthy stem cuttings • Plant at the beginning of the wet season
		Cassava root scale (Stictococus vayssierra)	• Plant healthy stem cuttings • Plant at the beginning of the wet season
		Cassava white scale *(Aonidomytilus albus)*	• Plant healthy stem cuttings • Plant at the beginning of the wet season
		Variegated grasshopper (Zonocerus variegates)	• Destroying the breeding sites • Dig egg-laying sites of variegates grasshopper in the wet season to expose and destroy egg pod of the pest • Biological control: use fungal pathogens, e.g. *Metarliziumspp*
		Spiralling whitefly (Aleurodicus dispersus)	• Crop rotation • Plant healthy stem cuttings • Plant at the beginning of the wet season
		White fly *(Bemisia tabaci*)	• Eliminate the sources of the virus • Plant healthy stem cuttings • Plant at the beginning of the wet season
	Post-harvest	LGB, Weevils and Red flour beetle	• Use of botanicals, e.g. Neem or pili-pili • Bio-control (use of natural enemies)
Diseases		Cassava mosaic disease (CMD)	• Improve the soil by manuring, mulching and intercrops • Plant healthy stem cuttings • After harvesting destroy infected

			cassava stems • Use resistance varieties that tolerate CMD like Kibaha, Msitu Zanzibar, Aipin Valencia, Kigoma nyekundu and Mzungu • Manipulate sowing date and planting spacing to reduce incidence of the disease • Plan resistance varieties against TMS 4(2) 1425, TMS 81983, TMS 83/01762
		Cassava bacterial blight (Xanthomorias ampestris)	• Plant cuttings from healthy plants without leaf chlorosis • After harvesting destroy discarded infected cassava stems • Cleansing of farmers' tools • Crop rotation • Avoid growing cassava consecutively on the same field • Check field regularly • Fallow practice • Use of resistant varieties • Identifying and removing/destroy plants with undesirable characteristics
		Cassava Anthracnose (*Colletotrichum graminiocola*)	• Plant cuttings from healthy plants without leaf chlorosis • After harvesting destroy discarded infected cassava stems • Cleansing of farmers' tools • Crop rotation • Avoid growing cassava consecutively on the same field • Check field regularly • Identifying and removing/destroy plants with undesirable characteristics
		Cassava brown streak disease	• Plant cuttings from healthy plants without leaf chlorosis • After harvesting destroy discarded infected cassava stems

			• Cleansing of farmers' tools • Crop rotation • Harvest early • Grow resistance varieties like Mzungu
		Cassava root rot disease (*Phytophtora, Pithium and Fusarium spp)*	• Harvest early • Plant cuttings from healthy plants without leaf chlorosis • After harvesting destroy discarded infected cassava stems • Cleansing of farmers' tools
Weeds		Acanthospermum spp	• Cultural methods
Vermin		Baboons,monkeys and rats (Lake Zone)	• Hunting farmer groups • Use of traps

Source: https://www.kilimo.go.tz/uploads/statistics/Revised_Final_IPMP_for_SAGCOT_March_12_2014.pdf

Table A5: The major pest problems of beans and recommended management practices

Zone	**Pest**			**Recommended management practices**
Southern Highlands	Insects	Pre-harvest	Bean stem maggot (*Ophiomyias*pp)	• Seed dressing • Apply recommended insecticide or botanical extracts within five days after emergence • Plant tolerant/resistant varieties if available • Improvement of soil fertility through application of manure and/or fertilisers

			Bean aphids (*Aphis fabae*)	• Practice early planting • Apply recommended insecticides or botanical extracts if necessary
			Bean leaf beetle (*Ootheca benningseni*)	• Observe recommended time of planting • Practice good crop rotation • Post-harvest ploughing where possible • Apply recommended insecticides
			Bean pod borer (*Helicoverpaarmigera*)	• Apply recommended insecticides or botanical extracts
		Post-harvest	Bean bruchids (*Acanthoscelide sobtectus*)	• Ensure the beans are dry and well cleaned before storage • Apply recommended storage insecticide/botanical extracts
	Diseases		Bean anthracnose	• Practice good crop rotation • Sanitation and crop hygiene • Use certified seed • Observe recommended time of planting • Plant tolerant/resistant varieties e.g. Uyole 98, Uyole 84 & Kabanima
			Angular leaf spot	As above
			Rust (*Uromyces appendiculatus*)	• Avoid planting beans in high altitude areas • Practice good crop rotation • Sanitation and crop hygiene • Plant tolerant/resistant varieties, e.g. Ilomba, & Uyole 90 • Observe recommended time of planting

				• Spray with recommended fungicide when necessary
			Haloblight (*Pseudomonas* sp)	• Plant tolerant/resistant varieties, e.g. Uyole 84 • Spray with recommended fungicide when necessary • Use certified seed
			Ascochyta (*Phoma*sp)	• Avoid planting beans in high altitude areas • Spray with recommended fungicide when necessary • Plant tolerant/resistant varieties, e.g. Ilomba & Uyole 98 • Sanitation and crop hygiene
			Bean common mosaic virus (BCMV)	• Plant tolerant/resistant varieties if available • Effect good control of aphids
			Angular leaf spot	As above
			Rust (*Uromyces appendiculatus*)	• Avoid planting beans in high altitude areas • Practice good crop rotation • Sanitation and crop hygiene • Plant tolerant/resistant varieties, e.g. Ilomba, & Uyole 90 • Observe recommended time of planting • Spray with recommended fungicide when necessary
			Haloblight (*Pseudomonas* sp)	• Plant tolerant/resistant varieties, e.g. Uyole 84 • Spray with recommended fungicide when necessary • Use certified seed
			Ascochyta (*Phoma*sp)	• Avoid planting beans in high altitude areas • Spray with recommended fungicide when

				necessary • Plant tolerant/resistant varieties, e.g. Ilomba & Uyole 98 • Sanitation and crop hygiene
			Bean common mosaic virus (BCMV)	• Plant tolerant/resistant varieties if available • Effect good control of aphids

Source: https://www.kilimo.go.tz/uploads/statistics/Revised_Final_IPMP_for_SAGCOT_March_12_2014.pdf