(Photo credit: David Onyango)

Study on crop protection where the ‘Green Innovation Centres for the Agriculture and Food Sector’ (GIAE) initiative is being implemented

Kenya

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KNOWLEDGE FOR LIFE

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Executive Summary

This study covered the legal framework for pesticide management as well pest management practices for the major pests of sweet potatoes. Data for the study were collected through individual interviews with 20 farmers and 20 extension officers, focus group discussions and key informant interviews. The study established that the following organisations exist in Kenya for pests and pesticide management: Pest Control Products Board (PCPB), Kenya Plant Health Inspectorate Service (KEPHIS), Kenya Agricultural and Research Organisation (KALRO), National Environment Management Authority (NEMA), Government Chemists Department, Kenya Medical Research Institute (KEMRI), Directorate of Occupational Safety and Health Services (DOSHS), Kenya Ports Authority (KPA), Kenya Airports Authority (KAA), Export Processing Zones Authority (EPZA) and Kenya Bureau of Standard (KEBS). There is a legal framework including national regulations for pest and pesticide management in Kenya and this is complemented by adherence to and implementation of international agreements relating to pesticides. Regulations and policies pertaining to the manufacture of pesticides, price and trade as well as the registration of synthetic pesticides and biopesticides also exist. More than 319 Active ingredients (AI) are registered in Kenya and differ in terms of their overall hazard level. Sixty-one of the AIs allowed for use meet one or more of the highly hazardous pesticide (HHP) criteria; 81 AI were categorised as “danger”, 118 AI were categorised as “warning”; 31 AI were categorised as “low hazard” and key human health hazard data was missing for 28 AI. No AI was specifically registered for use on sweet potato. However, given that sweet potatoes are grown under a farming system that involves other crops, farmers occasionally used pesticides meant for other crops on sweet potatoes. The major pests of sweet potatoes at both the nursery and field stages were mole rats, sweet potato weevils, aphids, fungi and viruses. There was limited use of synthetic pesticides in the management of pests in sweet potatoes. The use of synthetic pesticides for the management of sweet potato pests was most pronounced at the nursery stage. However, at the field and post-harvest (storage) stages, more farmers (55% and 80% respectively) preferred the use of non-chemical practices for the management of sweet potato pests. Use of chemicals was the preferred practice of a majority of the farmers for the management of mole rats, aphids and virus while non-chemical practices were preferred by a majority of the farmers for the management of sweet potato weevils and fungi. Farmers did not demonstrate a comprehensive understanding of sweet potato pests or their management practices. Farmers and extension agents had varied levels of awareness about the meaning of different pesticide safety labels. There was a divergence in what was prescribed by extension officers and what was practiced by farmers with respect to storage and pre-entry intervals, which calls for training as appropriate. There only was limited use of personal protection equipment (PPE) by the farmers, and where used it was mainly gloves and boots. There is a need for more training and creation of awareness amongst the farmers with respect to pests in sweet potatoes as well as pest management practices. There was a drive towards the use of integrated pest management (IPM) practices, but only limited efforts to achieve this were demonstrated by extension officers and farmers. Exchange of information among organisations involved in pest and pesticide management should be enhanced to enforce safe and economical use where needed. A high potential exists for sweet potato production in Kenya. This is due to favourable cultivation conditions, increasing demand for the product and a relatively unsaturated market.

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Disclaimer

The views expressed in this document are those of the authors and do not necessarily reflect the views of GIZ and BMZ.

Acronyms

ADS	Anglican Development Services
AI	Active ingredient
ASDS	Agricultural Sector Development Strategy
BCA	Biological control agent
CABI	Centre for Agriculture and Bioscience International
CBO	Community Based Organisation
CREADIS	Community Research in Environment and Development Initiatives
DDT	Dichlorodiphenyltrichloroethane
EMCA	Environmental Management and Coordination Act
EPZA	Export Processing Zones Authority
FAO	Food and Agriculture Organisation of the United Nations
FAW	Fall armyworm
FBOs	Farmer Based Organisations
FFS	Farmer Field Schools
FGD	Focus Group Discussion
GAP	Good agricultural practices
GDP	Gross Domestic Product
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
GIAE	Grüne Innovationszentren in der Agrar-und Ernährungswirtschaft (in English: “Green innovation centres for the agriculture and food sector”)
GIZ	Gesellschaft für Internationale Zusammenarbeit (in English: “Corporation for International Cooperation”)
GoK	Government of Kenya
HHP	Highly hazardous pesticide
ILO	International Labour Organization
IPM	Integrated Pest Management
IPMF	Integrated Pest Management Framework
ISO	International Organization for Standardization
KAA	Kenya Airports Authority
KALRO	Kenya Agricultural and Research Organisation
KEBS	Kenya Bureau of Standard
KEMRI	Kenya Medical Research Institute
KEPHIS	Kenya Plant Health Inspectorate Service
KES	Kenya Shilling
KII	Key Informant Interview
KPA	Kenya Ports Authority
MENR	Ministry of Environment and Natural Resources

MOALF	Ministry of Agriculture, Livestock & Fisheries
MOH	Ministry of Health
NALEP	National Agriculture and Livestock Extension Programme
NEMA	National Environment Management Authority
NFNP	National Food and Nutrition Security Policy
NGO	Non-governmental organizations
NIP	National implementation plan
NPPO	National Plant Protection Organisation
OECD	Organization for Economic Cooperation and Development
OFSP	Orange-Fleshed Sweet Potato
PAN	Pesticide Action Network
PCPB	Pest Control Products Board
PHI	Pre-harvest interval
PIC	Prior informed consent
POP	Persistent organic pollutant
PPE	Personal protective equipment
PRA	Participatory Rural Appraisal
REFSO	Rural Energy and Food Security Organization
RRI	Rapid Results Initiative
SLM	Sustainable Land Management
SPS	Sanitary or Phytosanitary
SRA	Strategy for Revitalizing Agriculture
T&V	Training and Visits
UCRC	Ugunja Community Resource Centre
UN	United Nations
USA	United States of America
WHO	World Health Organization
WHH	Welthungerhilfe

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Introduction

Almost 3 billion people still suffer from malnutrition. In particular, smallholder farmers in underprivileged regions of the world are highly vulnerable. Yield losses to pests, diseases and weeds are estimated to be about 35% in major crops and may exceed 50% in developing regions where pest control options are limited. This clearly underlines the key role played by pest management in safeguarding yields and ensuring food security. Sustainable pest management methods include biological, cultural, mechanical and physical (non-chemical) control methods. These non-chemical methods contribute to reducing pest pressure and damage. However, farmers around the world still rely on pesticides to control pest outbreaks. The Green Innovation Centres programme, led by Gesellschaft für Internationale Zusammenarbeit (in English: "Corporation for International Cooperation") (GIZ) under the special initiative One World – No Hunger, aims at boosting smallholder farmer productivity and improving the whole value chain to maximize farmer's benefits. The programme is currently active in 14 countries: Benin, Burkina Faso, Cameroon, Ethiopia, Ghana, India, Kenya, Malawi, Mali, Mozambique, Nigeria, Togo, Tunisia and Zambia. In order to align its Green Innovation Centres to the best practices in pest and pesticide management, GIZ mandated the Centre for Agriculture and Bioscience International (CABI) to lead the present study.

The study covered the legal framework for pesticide management as well pest management practices for the major pests of the Green Innovation Centres focal crops. A desk study, including an analysis of the legal framework and a literature review of pest management practices for the focal crops, was conducted in all 14 countries. The International Code of Conduct on Pesticide Management, published by the Food and Agriculture Organisation (FAO) and the World Health Organisation (WHO), details the best pesticide management practices. These best practices are designed to minimize adverse effects that may result from pesticide use and to foster the use of sustainable pest management strategies. The analysis of the legal framework compared each country's regulations and policies against the best practices. The legal framework analysis also included an analysis of the registered pesticides and of the hazards linked to their use. For eight countries – Burkina Faso, Cameroon, Ghana, India, Kenya, Malawi, Mali, and Tunisia – the study was complemented by in-country data collection. This included key informant interviews and group discussion with each value chain's major stakeholders, including Government officials, as well as questionnaires with extension agents and farmers. The information gathered in-country complemented and validated the findings of the legal framework analysis and provided a snapshot of pest management knowledge and practice in each country. This covered non-chemical and chemical pest management practices, pesticide management, as well as knowledge of integrated pest management.

Based on the results of the study CABI drafted, for each country, actionable recommendations for implementation by the Green Innovation Centres. Additionally, CABI identified areas where further training of farmers or extension agents would be required and identified gaps in national regulations and policies. In all 14 countries, the results of the study and the recommendations were presented in stakeholder workshops. The stakeholders validated the recommendations and discussed their implementation. Overall, the present study contributes to food security by fostering the implementation of sustainable pest management practices and the establishment of an enabling environment in the countries where the Green Innovation Centre programme is active.

Methodology

Desk study

A review of literature from the public domain and to which CABI has access was conducted to provide an overview of the agriculture sector within the country, to map the sweet potato value chain and to assess the institutional and regulatory arrangements for pest and pesticide management. This included, where relevant, information regarding crop protection against Fall Armyworm (FAW, *Spodoptera frugiperda*). Existing literature on crop protection studies and advisory documents was also reviewed to identify the current crop protection methods being applied within the value chain for sweet potato.

Utilising a tool developed by CABI, the most up-to-date version of the national list of registered pesticides was analysed to identify the full list of active ingredients (AI) and products registered for use in Kenya. For each AI registered, a profile was developed which includes the chemical class, use type, and associated hazards to human health and the environment. The *Guidelines on Highly Hazardous Pesticides (FAO 2016)* defines highly hazardous pesticides (HHPs) as "pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems" and it lists criteria for determining whether or not an AI is an HHP. The HHPs registered for use in the country were identified using these criteria, as the toxicological profiles and information on target pests were also used to assess the availability of lower toxicity alternatives to the HHPs for specific crop pests. With the support of national partners, the Pest Control Products Act, subsidiary legislation and other policies relating to pests and pesticides management were identified, and an analysis of the existing legal framework for pest and pesticides management was carried out. A cross comparison was made with international guidelines (e.g. from the FAO and the ILO) and other regulatory best practices, e.g. from the Organisation for Economic Cooperation and Development (OECD).

The desk study information was used to compile a preliminary description of the policy setting process in Kenya. The status of implementation and the adequacy of enforcement of the regulations was then confirmed and complemented by data gathered through in-country interviews with representatives of the pesticide regulatory authorities, ministries and other stakeholders.

In-country data collection

A standardized approach was devised by CABI for the in-country data collection in order to enable cross-country comparison. The activities included key informant interviews (KII), focus group discussions (FGD) and questionnaires. The planning was then discussed and agreed with Grüne Innovationszentren in der Agrar-und Ernährungswirtschaft (in English: "Green innovation centres for the agriculture and food sector") (GIAE) staff. In Kenya, all organisational aspects were taken over by GIAE staff.

The KII were arranged with each value chain major stakeholder. These included representatives of the Ministry of Agriculture, Ministry of Health, Ministry of the Environment, research institutes, agro-input manufacturers and suppliers, voluntary certification standards or certification bodies as well as trade and processing sector actors. In Kenya, GIZ organized all representatives of the relevant stakeholders who participated in either individual interviews, workshops or both. All stakeholders were represented in interviews and workshops. The interviewees and their affiliations are listed in Annex V. The information gathered enabled validation of the results of the desk study and also provided a better understanding of the interests and roles played by each stakeholder regarding pest and pesticide management.

Detailed questionnaires and FGDs with extension agents and farmers provided information about their knowledge, attitude and practice relating to the management of pests and pesticides. The non-chemical and chemical control methods recommended by extension agents or implemented by farmers were listed. Finally, knowledge of safe pesticide handling and management were assessed and the current practices documented. The questionnaires comprised structured and closed questions. Additionally, open-ended questions were included so respondents could provide more information about specific issues. Twenty farmers and 20 extension officers were

interviewed. For sweet potatoes, the information gathered through questionnaires was complemented with FGDs conducted separately with farmers and extension agents. These FGDs were designed to foster discussion on issues related to crop protection, and to provide a better understanding of the challenges faced by farmers and extension agents. GIAE activities are currently located Bungoma, Kakamega and Siaya Counties in Kenya, and these were selected as the study area, as they also have suitable climatic conditions for sweet potato production. Kakamega County was selected for individual farmer and extension officers' interviews as well as the FGDs. Key informants were selected from all the counties. A map of the study area is provided in Figure 1.

Limitations of the methodology and data

There was political tension following elections in Kenya during the data collection period. The GIAE office in Kisumu restricted the movement of staff and vehicles to avoid injury and other consequences to staff. Data collection was temporarily suspended during this period.

Results/Findings

Agriculture sector characteristics and key stakeholders

Agriculture is the mainstay of Kenya's economy, accounting for 32.6 per cent of the country's Gross Domestic Product (GDP), which is valued at 7.2 trillion Kenya Shillings (KES) (Table 1). The sector provides more than 13 per cent of formal employment (Kenya National Bureau of Statistics, 2017). In addition, the sector accounts for more than 60 per cent of the country's total domestic exports, with tea and horticulture remaining the leading export commodities (Table 2).

In 2016, activity in the agriculture sector was depressed compared to the performance recorded in 2015 (Table 3). This decline in performance was attributed to unfavourable weather conditions, particularly in the second half of the year when the country experienced a near failure of short rains (Kenya National Bureau of Statistics, 2017). Whilst there were significant growths in production of tea and coffee, the sector's growth as a whole was impeded by notable declines in the production of food crops. Maize production decreased from 42.5 million bags in 2015 to 37.1 million bags in 2016, representing a 12.7 per cent decline. Production of beans declined by 4.7 per cent from 8.5 million bags in 2015 to 8.1 million bags in 2016. During the same period, production of potatoes and drought resistant crops such as millet and sorghum also recorded significant declines. Sweet potato production, for the third year running, stagnated at 1.2 million tonnes.

The main sweet potato producing areas in Kenya (namely Busia, Kabondo area, Siaya, Kericho and Migori) are marked by considerable differences in terms of their socio-ecological and climatic features, the role the crop plays in their food systems, whether the farmers cultivate Orange-Fleshed Sweet Potato (OFSP) or not and the presence of OFSP processing-related activities (Tedesco and Stathers, 2015). In these areas, the roots of the crop are harvested almost year round, with farmers commonly planting sweet potato twice per year (Tedesco and Stathers, 2015).

Upon harvesting sweet potato roots, farmers deliver the produce to roadside collection points or retail the produce in their local markets in order to access cash for household goods. Alternatively, brokers may arrange the transportation of the produce from the farmers' fields to traders. The traders sell the sacks of sweet potatoes to retailers in rural and urban markets, where sacks of the fresh sweet potato roots are converted into small piles of roots for sale to the final consumers.

In some sweet potato producing areas, a few of the farmers sell OFSP roots to local processors who then transform the produce into a variety of processed products, including flour, bread and biscuit, which are then sold to both urban and rural consumers through a number of different channels.

The sweet potato value chain in the GIAE programme sites (Figure 1), an initiative that seeks to reach 30,000 farmers by March 2022, is shown in Figure 2. Sweet potato production is small-scale with farmers involved mainly being adult women who produce individually or collectively in groups and rely on rainfall for production. Production is both for subsistence and income (GIZ, 2016). The list of key stakeholders and key domestic markets involved in the value chain is provided in Table 4 and Table 5, respectively.

Globally, China is the world's leading sweet potato producer and consumer, accounting for two-thirds of the global sweet potato production and consumption (Table 6). The bulk of the sweet potato produced in China is used as animal feed (IndexBox, 2017).

Table 1: Contribution to Gross Domestic Product by Activity (per cent)

Industry	2012	2013	2014	2015	2016
Agriculture	**26.2**	**26.4**	**27.4**	**30.4**	**32.6**
Crops (food crops, industrial crops & horticulture)	18.0	18.4	19.7	23.1	25.9
Livestock	5.5	5.3	5.1	4.7	4.4
Fishing & aquaculture	0.7	0.7	0.7	0.6	0.5
Forestry & logging	1.4	1.4	1.3	1.3	1.3
Support activities to agriculture	0.7	0.6	0.6	0.6	0.6
Manufacturing	11.0	10.7	10.0	9.4	9.2
Transport and storage	8.0	8.0	8.6	8.3	7.9
Real estate	8.0	7.9	7.7	7.6	7.4
Other industries	66.3	66.1	65.5	63.4	61.8
Financial Intermediation Services Indirectly Measured	-2.6	-2.6	-2.5	-2.6	-2.8
All economic activities	89.9	89.9	90.4	91.2	91.6
Taxes on products	10.1	10.1	9.6	8.8	8.4
GDP at market prices	100	100	100	100	100

Source: Kenya National Bureau of Statistics, 2017

Table 2: Values of Principal Domestic Exports, 2012 – 2016

					KES Million
Commodity	**2012**	**2013**	**2014**	**2015**	**2016**
Tea	101441	104648	93996	123025	124497
Horticulture	81129	89339	97105	100963	110338
Articles of apparel and clothing accessories	20676	24379	28948	28226	30741
Coffee, unroasted	22271	16328	19913	20580	21371
Tobacco and tobacco manufactures	16615	13709	16827	15757	14574
All other Commodities	183817	168874	176379	177415	175417

Source: Kenya National Bureau of Statistics, 2017

Table 3: Estimated Production of Selected Agricultural Commodities, 2012 – 2016

Crop	Unit	2012	2013	2014	2015	2016
Cereals						
Maize	Million bags	41.9	40.7	39.0	42.5	37.1
Wheat	'000 tonnes	162.7	194.5	228.9	238.6	222.4
Millet	Million bags	0.8	1.4	1.4	1.1	0.6
Sorghum	Million bags	1.9	1.7	1.9	2.1	1.3
Rice	'000 tonnes	80.2	90.7	96.0	116.5	101.5
Pulses						
Beans	Million bags	6.8	7.9	6.8	8.5	8.1
Starchy roots						
Potatoes	Million tonnes	1.5	2.1	2.3	2.0	1.3
Sweet potatoes	Million tonnes			1.2	1.2	1.2
Horticulture						
Cut flowers	'000 tonnes	108.3	105.6	114.8	122.8	133.7
Vegetables	'000 tonnes	66.4	77.2	70.3	69.7	78.8
Fruits	'000 tonnes	31.1	31.1	35.1	46.2	48.7
Temporary industrial crops						
Sugar cane	Production area ('000 Ha)	204.1	213.9	211.3	223.6	221.0
	Million tonnes	5.8	6.7	6.4	7.2	7.1
Permanent crops						
Coffee	Production area ('000 Ha)	109.8	109.8	110.0	113.5	114.0
	'000 tonnes	49.0	39.8	49.5	42.0	46.1
Tea	Production area ('000 Ha)	190.6	198.6	203.0	209.4	218.5
	'000 tonnes	369.4	432.4	445.1	399.1	473.0

Source: Kenya National Bureau of Statistics, 2017

Table 4: Stakeholders involved in the GIAE sweet potato value chain

Role	Name of organisation
Training and extension services	Ministry of Agriculture, Livestock & Fisheries (MOALF)
	Anglican Development Services (ADS – Western)
	Rural Energy and Food Security Organization (REFSO)
	Community Research in Environment Development Initiatives (CREADIS)
	Ugunja Community Resource Centre (UCRC)
	Free Kenya
	Welthungerhilfe (WHH) – strengthening farmer organisations through training on organisational development
Suppliers of agricultural inputs	Private vine multipliers
Research	Kenya Agricultural & Livestock Research Organization
	The International Potato Centre
Private sector stakeholders	CREADEV sweet potato factory – Kimwanga, Bungoma
	Khwisero sweet potato factory – Khwisero, Kakamega
	Organi Ltd – Ringa, Homa Bay
	Pride Bakeries Ltd – Oyugis, Homa Bay

Source: GIAE, Kenya, 2017

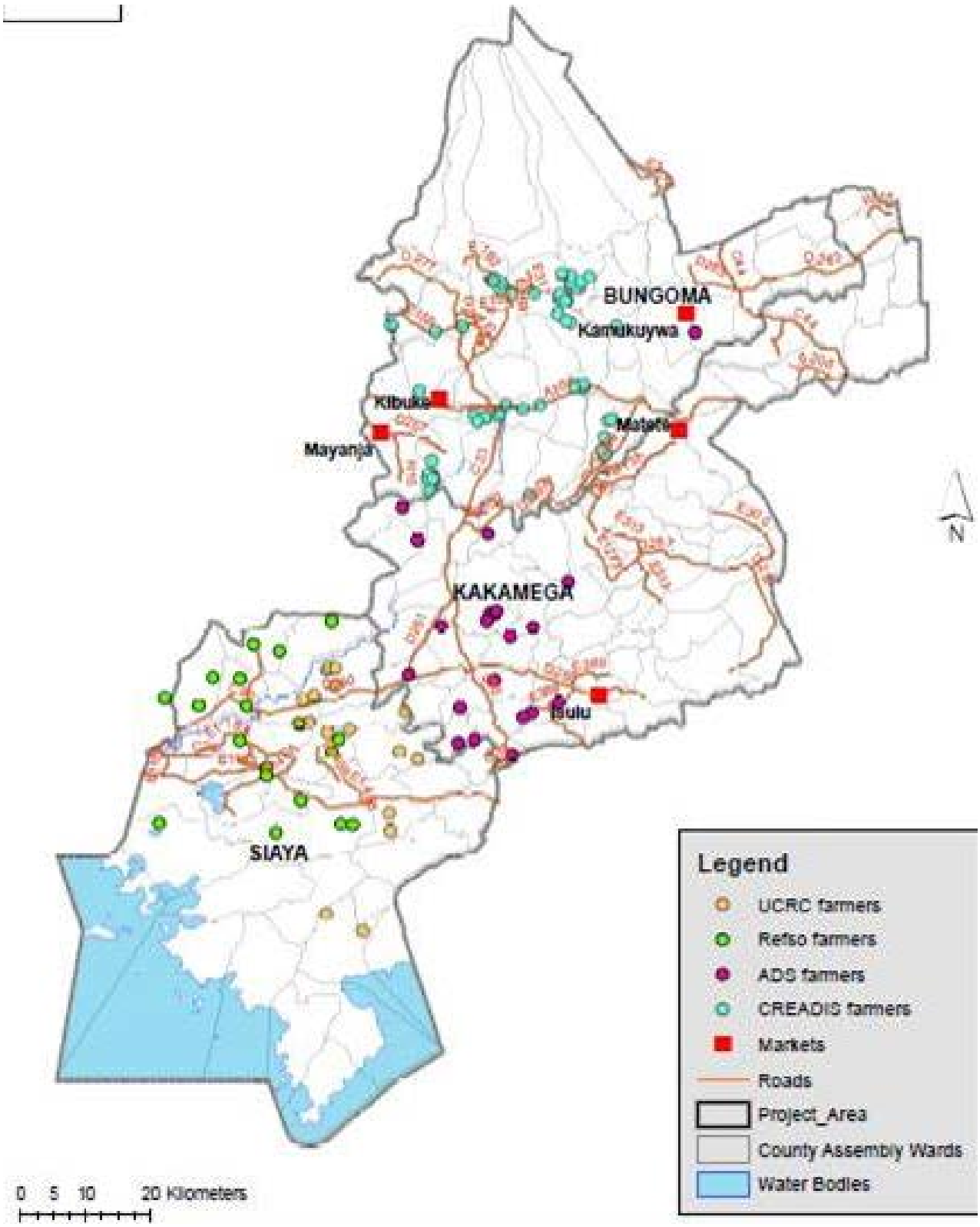
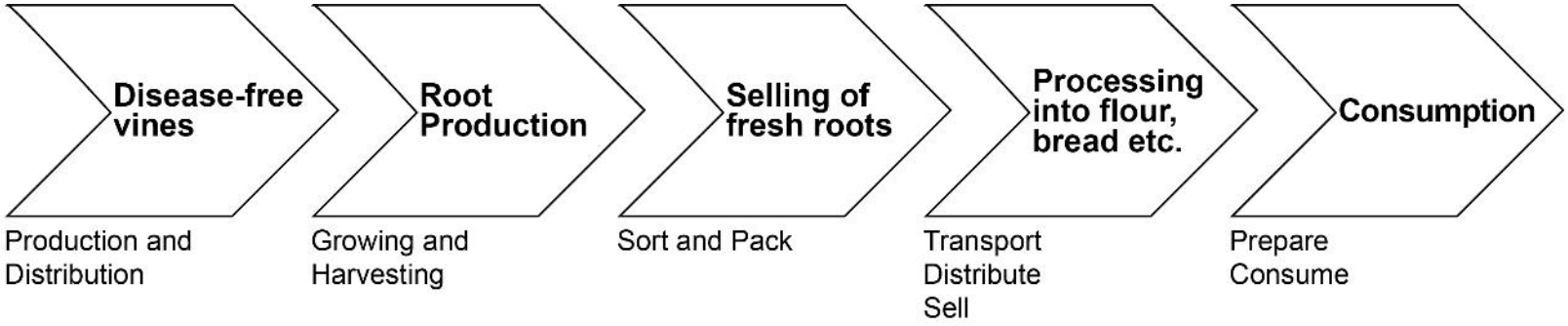


Figure 1: GIAE project sites

Source: GIAE Kenya, 2017



Categories of operators in the sweet potato value chains and their relations

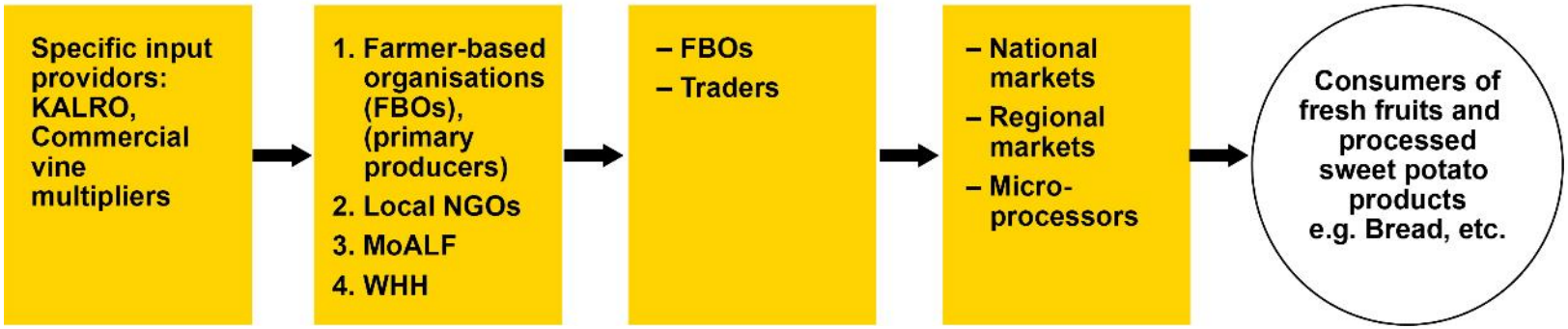


Figure 2: GIAE – Sweet potato value chain map

Source: GIAE Kenya, 2017

Table 5: Major markets for sweet potato in the study area

County	Market	Characteristics
Kisumu	Kibuye	Mostly sell white and yellow-fleshed sweet potato Retailers prefer to buy roots in Prim bags Peak supply of sweet potato roots is from January to April
	Jubilee supermarket	
	Kiboswa	
Siaya	Siaya	Mostly sell white and yellow-fleshed sweet potato Retailers prefer to buy roots in *debes*, 2kg tins Peak supply of sweet potato roots is from January to April
	Ting'wangi	
Bungoma	Bungoma	Mostly sell white and yellow-fleshed sweet potato Retailers prefer to buy roots in Prim bags, *debes* Peak supply of sweet potato roots is from January to April
	Webuye	
	Chwele	
	Kimilili	
	Miyanga	
Kakamega	Kakamega	Mostly sell white and yellow-fleshed sweet potato Retailers prefer to buy roots in small polythene bags
	Butali	
	Mbande	

Source: Stakeholder workshop

Table 6: Global sweet potato production, 2010 – 2014

					'000 Tonnes
Country	**2010**	**2011**	**2012**	**2013**	**2014**
China, mainland	74,172	75,362	71,195	70,526	71,305
Nigeria	3,385	3,531	3,604	3,690	3,775
United Republic of Tanzania	2,424	3,573	3,018	3,470	3,501
Indonesia	2,051	2,196	2,483	2,387	2,383
Uganda	2,838	2,554	1,852	1,810	1,863
Mozambique	1,380	1,641	2,655	1,469	2,400
Vietnam	1,319	1,362	1,427	1,358	1,401
Ethiopia	736	390	1,185	1,783	2,702
United States of America	1,082	1,223	1,201	1,124	1,342
Angola	987	1,045	645	1,200	1,929
Kenya	821	759	860	730	764
Other countries	12,547	12,863	13,197	13,836	13,238

Source: FAO, 2017

The share of sweet potato produce traded on the world market is relatively small. Only 0.3 per cent of the amount produced globally is exported (IndexBox, 2017). Europe is a large importer of sweet potato. In 2016, Europe imported 229,008 tonnes of sweet potatoes, most of which was supplied by the USA (Table 7). During the same period, Kenya accounted for only 0.001 per cent of the imports to Europe.

Africa has the potential to gain a greater share in the global sweet potato market owing to its favourable cultivation conditions, an increasing demand for the product, and a relatively unsaturated market. Africa accounts for 17 per cent of global consumption, with per capita consumption of sweet potato in individual African countries exceeding the global average (IndexBox, 2017). Kenya is one of the largest sweet potato producers in sub-Saharan Africa with an output of 1.2 million tonnes in 2016 (Table 3).

In Kenya sweet potato is an important food security crop and a ready source of income (Ndolo, 2017)). As a food security crop, sweet potato can be harvested piecemeal as required, thus providing a flexible source of food and income to rural households most prone to crop failure and fluctuating cash income. In addition, sweet potato is also processed into a number of industrial

products, providing incomes to the primary stakeholders in the sweet potato value chain (GIZ, 2017).

Table 7: Sweet potato exports to Europe (tonnes), 2012 - 2016

Country	2012	2013	2014	2015	2016
United States of America	57,063	74,909	85,576	127,006	172,823
Honduras	7,185	5,208	8,103	10,014	12,725
Israel	2,962	3,962	6,339	8,991	8,612
Egypt	3,436	3,584	9,958	9,567	11,297
China	4,768	4,179	6,803	10,577	13,122
South Africa	1,689	1,179	1,413	1,905	1,708
Kenya	1	1	5	-	3
Other countries	3,479	6,069	5,681	7,392	8,721

Source: European Commission Market Access Database, 2017

Sources of agro-inputs

Kenya is not a major chemical manufacturing country, so agriculture and most other enterprises use chemicals imported mainly from Organisation for Economic Cooperation and Development (OECD) countries (Government of Kenya, 2011). Quantities of selected export and import commodities are presented in Table 8. There was a marked increase in the quantities of chemical fertilizer imports from 568.6 thousand tonnes in 2015 to 671.8 thousand tonnes in 2016. The volumes of insecticides and fungicides also increased, albeit at a much slower rate, from 15.3 thousand tonnes in 2015 to 16.8 thousand tonnes in 2016.

In terms of expenditure on imports, expenditure on insecticides and fertilizers continued to increase for the second year in a row to KES 11.4 billion and contributed 0.8 per cent of the total expenditure on imports in 2016. However, expenditure on chemical fertilizers declined by 1.7 per cent to KES 23 billion in 2016, accounting for 1.6 per cent of the total import bill.

Domestic exports of insecticides and fungicides rose from 2,209 tonnes in 2015 to 2,314 tonnes in 2016 reflecting a 15 per cent increase. In terms of revenue from exports, earnings from the sale of insecticides increased from KES 1.5 billion in 2015 to KES 2 billion in 2016 and contributed 0.4 per cent of the total export revenue.

The use of improved seed in Kenya remains relatively low, highlighting the existence of a vast crop yield potential that could be exploited through the promotion of an increased use of these inputs. As observed in Table 8, the annual volume of locally produced and imported seed certified by the Kenya Plant Health Inspectorate Service (KEPHIS) is approximately 4.2 thousand tonnes. Of these, imported seed accounts for 9% of the total. Also, the bulk of the seed is maize seed, accounting for 83% of the total. For sweet potato production, farmers in Kenya have been cultivating traditional varieties. Introduced varieties, however, have also contributed to the assortment of varieties cultivated by farmers (GIZ, 2017). The majority of sweet potato varieties cultivated in Kenya are white and yellow-fleshed. Additionally, there are the orange-fleshed varieties containing beta carotene and a few other varieties with pigmented flesh colour (GIZ, 2017).

The use of personal protective equipment (PPE) among smallholder farmers in Kenya is not common (Kariuki, 2015).

Table 8: Quantities/values of domestic exports and imports, 2012 – 2016

Commodity			2012	2013	2014	2015	2016
Chemical fertilizers	Import quantity	Tonnes	425,840	688,436	496,057	568,600	671,781
	Import value	KES Million	20,184	27,957	19,331	23,468	23,064
Insecticides and fungicides	Import quantity	Tonnes	13,050	14,761	15,232	15,342	16,781
	Import value	KES Million	8,828	10,879	10,797	11,335	11,381
	Export quantity	Tonnes	1,709	1,416	1,597	2,209	2,314
	Export value	KES Million	801	771	805	1,546	2,034
Seeds							
Maize	Import quantity	Tonnes	4,176	4,061	2,757	4,947	-
	Local	Tonnes	36,578	31,188	28,364	28,521	-
Beans	Import quantity	Tonnes	495	667	95	449	-
	Local	Tonnes	820	492	425	639	-
Others	Import quantity	Tonnes	142	75	102	1,400	-
	Local	Tonnes	7,127	7,111	3,510	5,924	-

Source: Kenya National Bureau of Statistics, 2017 and KEPHIS, 2016

Organisational arrangements within the national governments for pest and pesticide management

Agriculture is a key sector for Kenya's economic growth. The government of Kenya has put in place measures to ensure improved crop productivity as well as safeguarding the health of people involved in crop production and related actions. This is facilitated by many organisations that work individually or as teams to ensure that the specific components of good agricultural practices (GAP) are followed. Table 9 provides details of government agencies in Kenya together with their roles and functions in pests and pesticide management.

Table 9: Institutions and their roles in pest and pesticide management

Institutions	Role	Specific functions list (relating to pest and pesticide management)
Ministry of Agriculture		
Pest Control Products Board (PCPB)	Regulates the importation, exportation, manufacture, distribution, transportation, sale, disposal and use of products used for the control of pests and mitigate potential harmful effects to the environment. Source: PCPB Website	Enhance compliance of pest control products to set standards and facilitate trade. Ensure safe, quality and efficacious pest control products are available to users Enhance responsible use of pest control products and food safety Improve management of pest control products lifecycle
KEPHIS	Assures the quality of agricultural inputs and produce. Also, KEPHIS is Kenya's National Plant Protection Organization (NPPO) Source: KEPHIS Website	Support compliance to market requirements • Certification of the quality of seeds and fertilizers • Testing and monitoring the presence of harmful residual agro-chemicals on agricultural produce, soils and water systems • Preventing introduction into the country of harmful foreign weeds, pests and diseases through adherence to strict quarantine regulations and procedures • Inspecting and grading agricultural produce for import and export Implementing the national policy on the introduction and use of genetically modified plant species, insects and microorganisms
KALRO	Research in plant health issues related to pesticide Source: KALRO Website	Efficacy trials of agricultural pesticides for field and stored crops and fertilizers

Institutions	Role	Specific functions list (relating to pest and pesticide management)
Ministry of Environment and Mineral Resources		
National Environment Management Authority (NEMA)	Manage the environment through supervision and coordination of the lead agencies – concerned ministries, government departments and agencies Source: NEMA Website	Focal point in the implementation of the Stockholm Convention on Persistent organic pollutants (POPs) Chemical management through enforcement of Environmental Impact Assessments and audits where a threat to the environment is anticipated by the use of chemicals listed in the second schedule of the Act
Ministry of Health		
Government Chemists Department	Provision of laboratory services in the fields of public and environmental health	Test substances and materials for chemical composition, compliance with legal specifications and their suitability for various uses Analyses of samples for compliance to public health requirements
Kenya Medical Research Institute (KEMRI)	Research in public health issues related to pesticide Source: KEMRI Website	Research on effects of pesticides among formulators/store-men and farm workers Research portfolio on chemical including POPs Regular surveillance of POPs pesticide Efficacy trials
Directorate of Occupational Safety and Health Services (DOSHS)	Ensures safety, health and welfare of workers predisposed to pesticides. Source: DOSHS Website	Identify, evaluate and control biological and chemical factors in the work environment which may affect the safety and health of employed persons and the general environment.
Ministry of Industry, Investment and trade		
Kenya Bureau of Standard (KEBS)	Prepare standards relating to pesticides and their promotion at all levels Source: KEBS Website	Develop pesticide standards Testing pesticide residues, and toxic elements in foods Certification of products
Export Processing Zones Authority (EPZA)	Promote and facilitate export-oriented investments and develop an enabling environment for such investments Source: EPZA Website	Incentivise export-oriented investors dealing in pesticides e.g. pyrethrum through provision of one-stop-shop service for facilitation and aftercare
Ministry of Transport, Infrastructure, Housing & Urban Development		
Kenya Ports Authority	Manages all the sea ports in Kenya	Enforcer and regulator
Kenya Airports Authority	Manages all the airports in Kenya	Enforcer and regulator

Analysis of existing legal framework for pest and pesticide management

Adherence to and implementation of international agreements relating to pesticides

Kenya is a party to the **Stockholm Convention** on POPs, having ratified the convention in September 2004. Following ratification, the country developed its National Implementation Plan (NIP) in 2007. Within the context of its obligations, Kenya has banned most of the POPs pesticides, apart from Dichlorodiphenyltrichloroethane (DDT), which is restricted for Public Health use only (Government of Kenya, 2014). Also, the country is presently engaged in the promotion and development of DDT alternatives that need to be up-scaled to the level of commercialisation.

Kenya is a party to the **Rotterdam Convention** on the "Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade", which it ratified in 2005. The country began implementing the provisions of the Convention long before the Convention came into force using various statutes, including the Pest Control Products Act, Cap 346 of 1982 and the Environmental Management and Coordination Act of 1999 (EMCA) (Secretariat of the Rotterdam Convention, 2006). As a party to the Convention, Kenya has so far submitted 28 import responses, the most recent being 12th December, 2009. It has failed to provide import responses for six pesticides. The country provided notice of final regulatory action for 26 pesticides (Rotterdam Convention, 2017). In Kenya, pesticides are regulated through registration, licensing of premises,

licensing of imports and exports, manufacture, storage, distribution, sale, labelling, use and disposal (Secretariat of the Rotterdam Convention, 2006).

Kenya is a party to the **Basel Convention** on the control of trans-boundary movements of hazardous wastes and their disposal, and the ban amendment of 1989. Kenya acceded to this Convention in 2000. The provisions of the Convention are described in EMCA section 141, which makes it an offence to import, dispose of, or otherwise manage hazardous wastes contrary to the provision of the Act. Regulations followed through the EMCA will ensure the implementation of the Convention (Government of Kenya, 2014).

In 2003 Kenya signed the **Bamako Convention** on the "Ban of the Import into Africa and the Control of Trans-boundary Movement and Management of Hazardous Wastes within Africa". However, the country is yet to ratify the Convention.

Kenya is a party to the **Vienna Convention** for the protection of the ozone layer. The country acceded to the Convention in 1988 and is therefore bound by the obligations prescribed therein. In the same year, Kenya ratified the **Montreal Protocol** on substances that deplete the ozone layer, and has ratified its four amendments, namely; the London (1990), Copenhagen (1992), Montreal (1997), and Beijing (1999) amendments, and is therefore in compliance. In this regard, Kenya has phased out methyl bromide use in soil fumigation and is in the process of phasing it out in the post-harvest sector.

Overview of national regulation related to pests and pesticides management

Plant Protection Act (Cap 324 Laws of Kenya) – this Act provides for the prevention of the introduction and spread of pests destructive to plants (Government of Kenya, 2015).

Seeds and Plant Varieties Act (Cap 326 Laws of Kenya) – enacted to regulate transactions in seeds, including provision for testing and certification of seeds (Government of Kenya, 2012a). The relevant provisions with regard to pest management are in Part II of the Act, where the Minister is accorded powers to make regulations relating to the prevention of the spread of plant disease by the sale of seeds.

Agriculture, Fisheries and Food Authority Act – enacted to provide for the consolidation of laws on the regulation and promotion of agriculture in general (National Council for Law Reporting, 2013).

The **Pest Control Products Act (Cap 346, Laws of Kenya)** – enacted to regulate the importation, exportation, manufacture, distribution and use of products that control pests and organic functions of plants and animals and for related purposes (Government of Kenya, 2012b).

The **Environment Management and Coordination Act, No. 8 of 1999** – establishes a legal framework for the management of pesticides, and toxic and hazardous chemicals (Government of Kenya, 1999).

The **Public Health Act (Cap 242 Laws of Kenya)** – enacted to provide for measures to secure and maintain the health of the public (Government of Kenya, 2012c). The relevant provisions with regard to pesticides management in general are in Part IX of the Act. Section 115 of the Act prevents any person from causing a nuisance, keeping any dangerous substances, or maintaining their premises in a condition which may be injurious to human health. Pesticides as well as other chemicals are captured within the scope of this section.

Food, Drugs and Chemical Substances Act (Cap 254 Laws of Kenya) – enacted to prevent the adulteration of food, drugs and chemical substances. Pesticides are covered by this Act as they fall within the definition of chemical substances (Government of Kenya, 2012d).

Devolved Government Act (Cap 265 Laws of Kenya), 2013 - this Act deals with the establishment of Local Authorities and defines their functions, powers and operations. Local

authorities have the power to impose, control and manage pesticides within their own jurisdictions. Additionally, by-laws can be developed to facilitate the implementation of laws that deal specifically with pesticides. The County Authorities are critical agents in this regard since they are able to reach communities at a grass roots level, as well as various stakeholders and the public at large (Government of Kenya, 2014).

Fertilizers and Animal Foodstuffs Act (Cap 345 Laws of Kenya) – this Act regulates the importation, manufacture and sale of agricultural fertilizers, animal foodstuffs and substances of animal origin intended for the manufacture of such fertilizers and foodstuffs (Government of Kenya, 2012e). Chemical management is reflected in the Minister's powers to make rules for the due implementation of the Act. A raft of rules and regulations has been promulgated in this regard, which for instance specify substances or a mix of substances for use as fertilizers. These substances are chemicals that may contain POPs that breakdown to have POP-like characteristics hence placing them within the realm of the Stockholm Convention (Government of Kenya, 2014).

The Crops Act (No. 16 of 2013)– provides for the grading and inspection of agricultural produce meant for exports and promotes the standardization of the specification of commodities from Kenya, as well as ensuring the implementation of codes of practice.

Policies to promote reductions in unnecessary pesticide use, such as policies on IPM, GAP, organic production and sustainable agriculture

The Strategy for Revitalizing Agriculture (SRA) – launched in 2004, the SRA set out the vision of the Government of Kenya (GoK) "to transform Kenya's agriculture into a profitable, commercially-oriented and internationally and regionally competitive economic activity that provides high quality gainful employment to Kenyans" (Government of Kenya, 2010). The vision of GoK pointed to a paradigm shift from subsistence agriculture to agriculture as an enterprise that is profitable and commercially oriented. Within the domain of GAP, the strategy identified the formulation of food security policies and programmes.

The Vision 2030 – launched in 2008 as a long-term development blueprint for Kenya. The strategy aims at transforming Kenya into "a newly industrializing, middle income country providing a high quality of life to all its citizens in a clean and secure environment" (Government of Kenya, 2010). The Vision 2030 has identified agriculture as one of the sectors to stimulate economic growth through, within the confines of crops, a strong focus across key strategic thrusts, including, increasing productivity through the provision of widely-accessible inputs and services to farmers.

Agricultural Sector Development Strategy (ASDS) (2009 – 2020) – this strategy outlines the agricultural policies, institutional reforms, as well as the programmes and projects the GoK will implement in both the short and long term in order to realize or achieve the goal of progressive reduction in unemployment and poverty.

National Food and Nutrition Security Policy (NFNP) – the policy addresses food security issues and outlines GoK intervention measures that ensure the country is food secure. This entailed:

- a review of the Sessional Paper No. 2 of 1994 on National Food Policy and setting up the National Food Safety Agency incorporating food traceability elements and international Sanitary or Phytosanitary (SPS) standards, and
- drafting of the Food Security and Safety Bill (Gitau et al., 2009)

Integrated Pest Management Framework (IPMF) - IPMF provides a strategic framework for the integration of climate change mitigation measures, smart agriculture, Sustainable Land Management (SLM) practices and technologies, together with environmental and pest management considerations (Government of Kenya, 2016).

Research

National Environment Policy, 2013 – The GoK, having recognised the central role scientific research technology and innovation play in sound environmental management, is committed to supporting research and development programmes and projects that transfer knowledge and technologies for environmental management and sustainable development (Government of Kenya, 2013).

Regulations related to the manufacture of pesticides

The Pest Control Products (Licensing of Premises) Regulations, 1984 [Section 15, L.N. 45/1984, L.N. 124/2006.] – Section 2 prohibits any person from using any premises for purposes of manufacturing, formulating, packaging and storing pest control products without a license issued under these regulations.

Price and trade policy, including subsidies

As detailed in the **National Trade Policy: Transforming Kenya into a Competitive Export-Led and Efficient Domestic Economy,** the government of Kenya is committed to make distribution and trade (including for pesticides) a market-driven supply process (Government of Kenya, 2017).

Registration (synthetic pesticides and biopesticides)

The Pest Control Products (Registration) Regulations, 1984 [L.N. 46/1984, L.N. 109/1984, L.N. 123/2006.] – defines the process of registering pest control products. Key features of the subsidiary legislation include:

- Section 5 - establishes the PCPB, whose functions include assessing and evaluating pest control products, and considering applications for the registration of pest control products
- Regulation 2 - provides definitions for various pest control products including biochemical pesticide and micro- and macrobial biopesticides
- Regulation 4 - outlines the procedure for the registration of pest control products including biopesticide-specific registration pathways
- Regulation 7 - provides for instances when the PCPB can issue or refuse to issue a certificate of registration
- Regulation 8 - stipulates the validity period for certificates of registration
- Regulation 10 - lists instances where the PCPB may refuse to register a pest control product
- Regulation 11 - states instances where the PCPB may suspend or revoke a certificate of registration
- Regulation 14 - provides that a holder of a certificate of registration is to keep a record of all the quantities of pest control products they store, manufacture or sell. This record is to be maintained for five years from the time it is made and must be made available to the PCPB at such times and in such manner as the PCPB may require.

The PCPB publishes the list of pest control products registered in the country on its website. This list is published to stakeholders in the plant health sector in order to easily identify the pesticides that have been evaluated by the PCPB for safety, efficacy, quality and economic value. By accessing the PCPB website, any person can access categorised downloadable list of registered products, including those for use in crop production, animal health and public health. Contained in the list is information on trade names of products, their registration numbers, the name(s) of active ingredient(s) and their concentrations, formulation type, authorized uses including crops and target pests, the name of the registrant and the period of registration. In addition, the document contains a separate list of banned products (Annex I). The list of registered pesticides by the PCPB is updated annually, with the last update being in 2017.

Analysis of registered pesticide list for highly hazardous pesticides and alternatives

The list of pesticides registered for use in Kenya was last updated in 2017 and contains more than 300 AI. A total of 1,244 products have been registered. Of these, 1,056 have been registered for use in crops, 128 for use in public health, and 40 for use in animal health.

The list of banned products was last updated in 2017. This list contains 33 products comprising insecticides, fungicides, herbicides, miticides, nematicides, rodenticides, and soil fumigants.

Biocontrol agents that are not covered by the national authority handling the registration of pesticides, e.g. macro-organisms

Guidelines for Introduction and Use of Bio-Products, Biological Control Agents (BCAs) and Related Products, KEPHIS (KEPHIS, 2016)

These guidelines contain provisions regarding the export, shipment, import and release of biological control agents and other beneficial organisms. In particular, the guidelines include the following requirements to be fulfilled by the exporter and the importer:

- carry out pest risk analysis of BCAs
- obtain, provide and assess documentation as appropriate, relevant to the export, shipment, import or release of BCAs and other beneficial organisms
- ensure that BCAs and other beneficial organisms are taken either directly to designated quarantine facilities or mass-rearing facilities or, if appropriate, passed on directly for release into the environment
- encourage monitoring of the release of BCAs or beneficial organisms in order to assess impact on target and non-target organisms

Packaging and Labelling

The Pest Control Products (Labelling, Advertising and Packaging) Regulations, 1984 [L.N. 89/1984, L.N. 127/2006.] – address the design of pesticide packages (packaging and labelling)

Regulation 3 requires all pest control products to bear a label which has been approved by the PCPB. In addition, the regulation specifies the information required on the label.

Regulation 9 provides for cases where the physical properties of a pest control product may not be recognized when it is being used. In such circumstances the pest control product must be denatured by means of colour, odour or other methods the PCPB may approve so as to provide a signal or warning of its presence.

Regulation 11 specifies the conditions under which a pest control product shall be distributed.

Regulation 13 specifies the technical requirements for packaging (e.g. packaging material shall be sufficiently durable and manufactured to contain the pest control product safely under practical conditions of storage, display and distribution).

Regulation 14 states the general prohibitions (e.g. words stating, implying or inferring that a pest control product is approved, accepted or recommended by the government shall not appear on a package or label in any advertisement respecting a pest control product).

Transport

The Pharmacy and Poisons Rules – address the transportation of pesticides. Specifically Rule 15 states:

- No person shall consign a poison for transport unless the outside of the package is labelled conspicuously with the name or description of the poison, and a notice indicating that it is to be kept separate from food and empty food containers.

- No person shall knowingly transport a poison in a vehicle in which food is being transported, unless the food is carried in a part of the vehicle effectively separated from that containing the poison, or is otherwise adequately protected from the risk of contamination.

Import and export

The Pest Control Products (Importation and Exportation) Regulations, 1984 [L.N. 146/1984, L.N. 125/2006.] – the regulations contain provisions specifically addressing the import and export of pesticides.

Regulation 2 prohibits the importation and exportation of pest control products unless licensed.

Regulations 4 and 5 establishes the application process for a license in respect of importation or exportation of a pest control product and how the PCPB will deal with applications and issue of licenses respectively.

Regulation 8 provides for instances where the PCPB may cancel or suspend a licence (e.g. where the licensee has been convicted of an offence/has committed a breach of any of the terms or conditions of the license).

Requirements for sale

Pharmacy and Poisons Act contains provisions addressing the sale of poisons for agriculture and horticulture.

Section 28 prescribes the manner in which a person intending to trade in pesticides may apply to the Pharmacy and Poisons Board for a licence to deal with pesticides. The section further prescribes instances when the Board may refuse to issue or renew, or may revoke a licence to trade in pesticides.

Section 13 prescribes the safe custody of poisons. The section provides that no person engaged in a trade, business or profession shall knowingly have in their possession or under their control a poison.

Pest Control Products (Licensing of Premises) Regulations, 1984 contains further provisions addressing the handling of pesticides - Regulation 7 requires that every person operating premises dealing with pesticides must have an adequate knowledge of the chemistry, toxicology, efficacy and general use of the pest control product.

Occupational Safety and Health Act, 2007 provides for the safe handling, transportation and disposal of chemicals and other hazardous substances (section 83).

Licensing

Pest Control Products (Licensing of Premises) Regulations, 1984 contains provisions identifying pesticide-related activities permissible only to operators holding a valid license.

Regulation 2 requires persons intending to use any premise for the purposes of manufacturing, formulating, packaging, selling or storing pest control products to obtain a licence from the PCPB.

Regulation 3 prescribes the application process for the licensing of premises intended to be used for manufacturing, formulating, packaging, selling or storing pest control products.

Regulation 7 requires persons intending to handle, use, distribute, transport or deal in a pest control product under restricted class to apply to the PCPB for a permit as per the prescribed Form D in the schedule.

Handling and use, including regulations on application equipment

Occupational Safety and Health Act, 2007 – Part XI – Health, Safety and Welfare – Special Provisions

Provisions of the Act include a requirement that employers Issue a 'permit to work' to workers likely to be exposed to hazardous work processes or hazardous working environments. Furthermore, the Act requires employers to provide and maintain adequate, effective and suitable protective clothing and appliances to workers exposed to injurious or offensive substances.

Restrictions related to vulnerable groups

Occupational Safety and Health Act, 2007 – Section 97 prohibits employers from allowing minors to be employed at any workplace or work process, or to perform work, which by its nature or the circumstances in which it is carried out, is likely to harm the person's safety or health.

Requirements for personal protection equipment

Occupational Safety and Health Policy Guidelines for the Health Sector in Kenya provide general guidelines for using PPE (Section 9.1.2).

Storage

Pest Control Products (Labelling, Advertising and Packaging) Regulations, 1984 - Regulation 10 requires pesticides be stored in accordance with the conditions described on the label.

Pest Control Products (Licensing of Premises) Regulations, 1984

Regulation 7 requires that persons owning, operating or in charge of premises licensed to deal in pest control products must ensure that the products are well packaged and labelled and to keep stock records for a minimum of five years. In addition, the regulation requires licensed premises to provide adequate water and maintain general cleanliness.

Regulation 5 requires premises used for storing of pest control products to be structurally sound and robust.

Occupational Safety and Health Act, 2007

Part VI – section 49 requires workplaces to have sufficient and constant ventilation.

Part VI – section 50 require workplaces to have sufficient illumination by natural and artificial lighting.

Part VIII – section 82 prescribes evacuation procedures (including first aid arrangements).

Disposal of unused pesticides

Pest Control Products (Disposal) Regulations, 2006 - Regulation 2 provides that those disposing pesticides for commercial purposes must be in possession of a license, and the use of any pesticide disposal method must be approved by the PCPB.

Guidelines for on-farm Disposal of Pesticide Wastes and Containers, PCPB - The guidelines prescribe best practice when it comes to the disposal of unwanted or unused pesticide concentrates (obsolete stock).

Disposal of empty pesticide containers

Guidelines for on-farm Disposal of Pesticide Wastes and Containers, PCPB. The guidelines prescribe that pesticide containers and packaging materials should never be used to contain water, food or feed stuffs for human or animal use. Additionally, while cleaning containers, the following guidelines must be noted:

- wear protective clothing
- avoid spillages and leaks
- completely empty containers and packages before disposing
- take care to avoid splashing or creating dust
- place cleaned containers in a dry secure compound prior to disposal
- At the container disposal site:
- Containers should be punctured after rinsing to make them unusable, and crushed to reduce bulk
- Combustible packaging materials should be burnt in a licensed incinerator. If not possible, containers should be made unusable, reduced in bulk and buried
- Integrity of containers to be buried should be destroyed
- Aerosols should not be punctured

Other relevant human health and environmental protection regulations

Kenya Health Policy 2014 – 2030

Policy objective 5 (4.2.5). During the policy period, the following key policy strategies should be employed to minimise health risks:

- Promotion of a healthier environment and intensification of primary prevention of environmental threats to health;
- Strengthening mechanisms for the screening and management of conditions arising from health-risk factors at all levels;
- Strengthening of intersectoral collaboration mechanisms for regulation of the food industry to promote healthy products and responsible marketing;
- Developing and facilitating the implementation of a prioritised national health research agenda.

Compliance and enforcement

Food, Drugs and Chemical Substances Act. The legislation contains provisions aimed at deterring:

- Adulteration of pesticides (section 20)
- Deception when it comes to trading in pesticides (section 21)
- Improper disposal of pesticides (section 24)
- Sale of prohibited pesticides (section 25)
- Preparation of pesticides under insanitary conditions (section 26)

Pest Control Products Act

- Section 8 confers powers to the Minister to appoint suitably qualified persons as inspectors
- Section 9 defines the powers of the inspectors
- Section 4 of subsidiary legislation (Pest Control Products (Registration) Regulations, 1984) contains provisions for the designation of official laboratories for the analysis of samples
- Section 10 provides clear and effective procedures for intervention if irregularities are found during inspection, including forfeiture of pest control products
- Section 12 defines actions that will be considered as offences, and determines proportional and deterrent fines.

Farm characteristics and production practices in sweet potato

Sweet potato biotic constraints and preferred management practices in the study area

At both the nursery and field stages, a majority of the farmers interviewed identified mole rats, sweet potato weevils, aphids, fungi and viruses as being the major pests of sweet potato (Figure 3). Minor pests of the crop at these stages include mites, whiteflies, cutworms and squirrels. At the post-harvest (storage) stage however, rot pathogens (35%), sweet potato weevils (15%) and rats (15%) were identified as being the major pests of stored sweet potato.

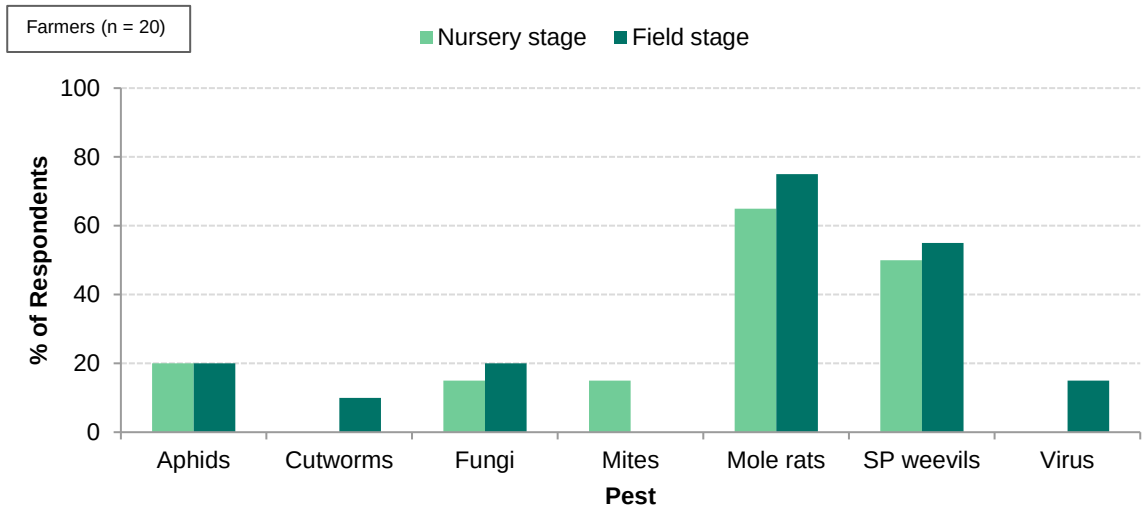


Figure 3: Major sweet potato pests identified by farmers

Interviews with extension agents revealed that there was agreement about the major pests of sweet potato (Figure 4). Like the farmers, most of the extension agents identified mole rats, sweet potato weevils, aphids, thrips and mites as being the major pests of sweet potato at both the nursery and field stages. At the post-harvest (storage) stage, extension agents identified sweet potato weevils (35%), rats (25%) and rotting pathogens (20%) as being the major pests of sweet potato.

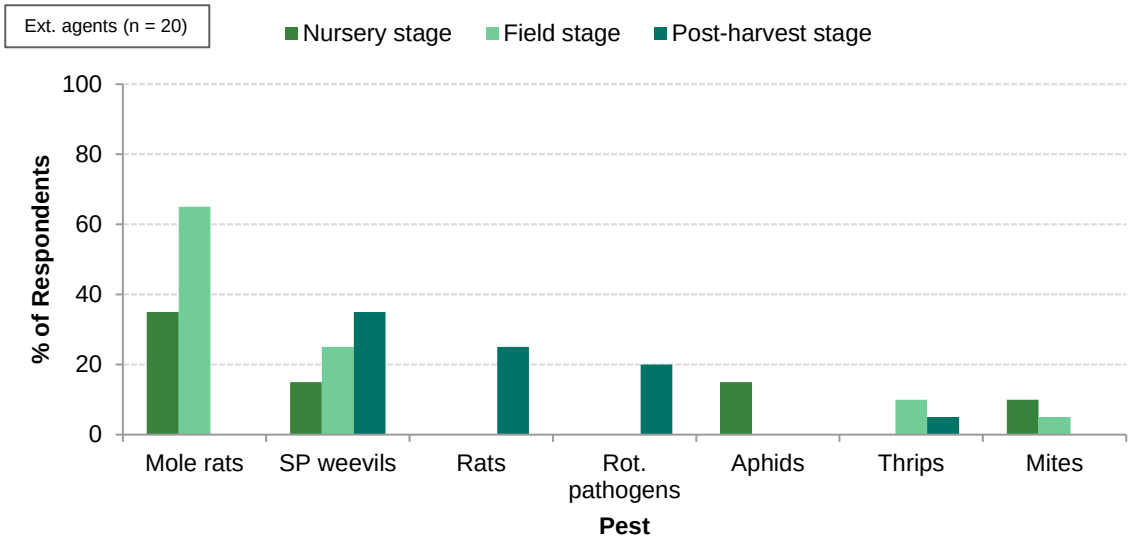


Figure 4: Major sweet potato pests identified by extension agents

The majority of the farmers preferred to use chemicals in the management of mole rats, aphids and viruses, while non-chemical practices were preferred for the management of sweet potato weevils and fungi (Figure 5).

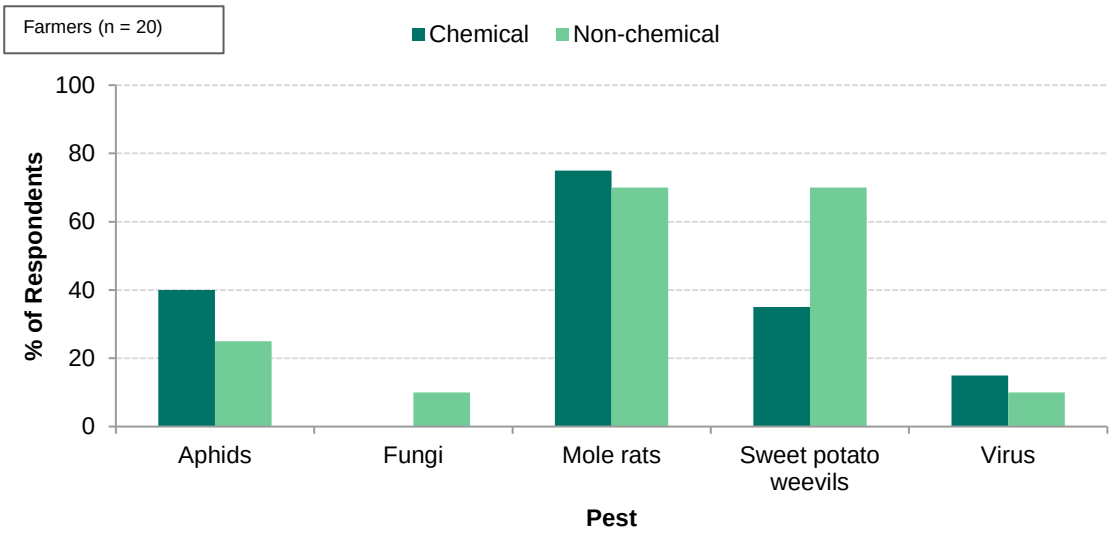


Figure 5: Pest management practices for sweet potato

Pesticide handling and use in the study area

The use of synthetic pesticides for the management of sweet potato biotic pests was most pronounced in, and was the preferred option of, half of the farmers interviewed at the nursery stage. However, at the field and post-harvest (storage) stages, more farmers (55% and 80%, respectively) preferred the use of non-chemical practices for the management of sweet potato biotic pests (Figure 6).

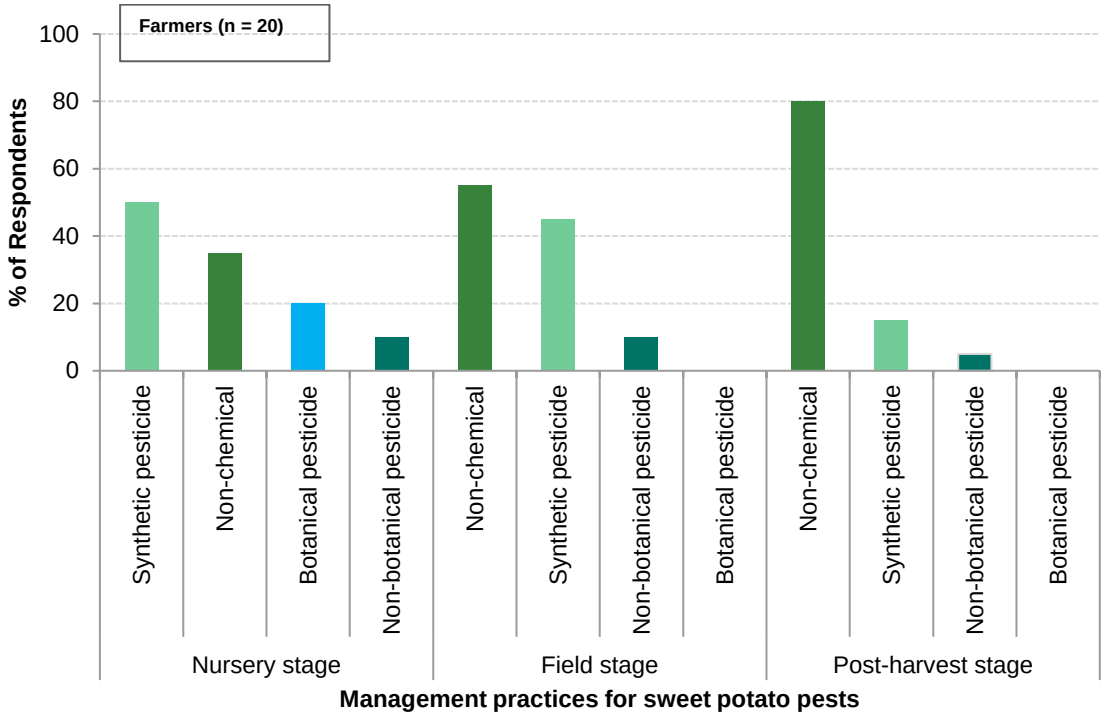


Figure 6: Management practices for sweet potato biotic pests

Among the farmers who used synthetic pesticides for the management of biotic pests in the project area, the study established that a wide range of pesticides were used. These included insecticides (Karate, Duduthrin, Diazol and Thunder) and a rodenticide (Fuko-kill). Fuko-kill was preferred for the management of mole rat at both nursery and field stages (Figure 7). For the management of sweet potato weevils, Karate was preferred at the nursery stage, and Duduthrin and Thunder preferred at the field stage.

An analysis of the AIs of the synthetic pesticides: Diazol (Diazinon), Fuko-kill (Zinc phosphide), Duduthrin (Lambda-cyhalothrin), Karate (Lambda-cyhalothrin) and Thunder (Imidacloprid) indicated that two of the four AIs, namely Diazinon and Zinc Phosphide, fall into GIZ procurement category A. On the other hand, the other two AIs, namely Lambda-cyhalothrin and Imidacloprid, fall into GIZ procurement categories B and C, respectively.

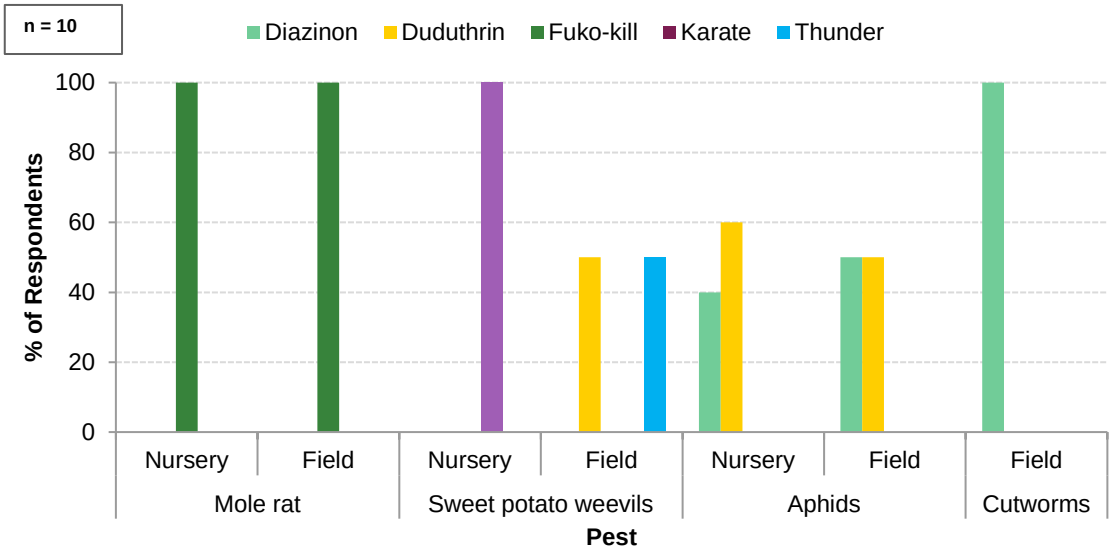


Figure 7: Pesticides used against various sweet potato pests

The decision for the farmer about which pesticide to use was largely influenced by the price of the pesticide (45%), recommendation from someone (45%), availability (40%) and effectiveness (40%) of the pesticides. In terms of finding out which pesticides are available for use, most farmers reported that they relied on guidance from extension agents (76%), agro-input retailers (59%) and neighbours (47%) (Figure 8). On the other hand, nearly all the farmers (94%) reported that they obtained pesticides from agro-input dealers/retailers. Only a handful of the farmers reported obtaining the same from extension agents and government agencies (17% and 6% respectively).

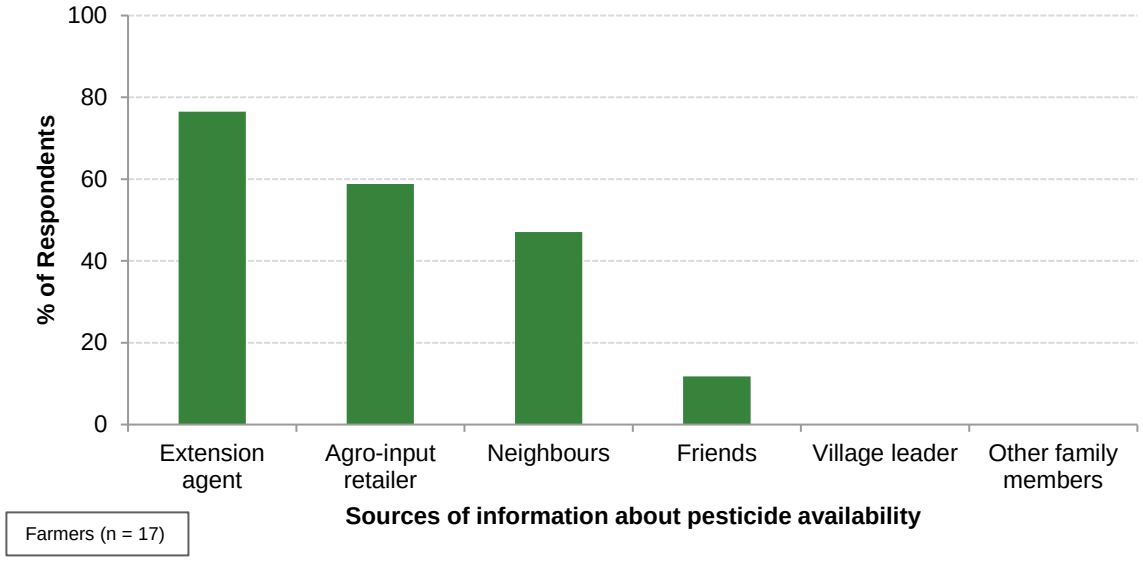


Figure 8: Sources of information to farmers on pesticide availability

When asked to describe issues relating to the general use of pesticides (not exclusive to sweet potato production) in the study area, most of the extension agents identified pesticides being applied at the wrong timing, wrong dosage, use of counterfeit/low quality pesticides and environmental contamination as being the major problems (Figure 9).
The bulk of the farmers interviewed (94%) considered weather conditions before spraying. In particular, rain (83%), wind (61%), sun (50%) and temperature (11%). Also, a majority of the

farmers (94%) reported that they were the ones responsible for applying pesticides in their crop/field. When asked whether they had been trained on pesticide application, 78% reported they had been trained.

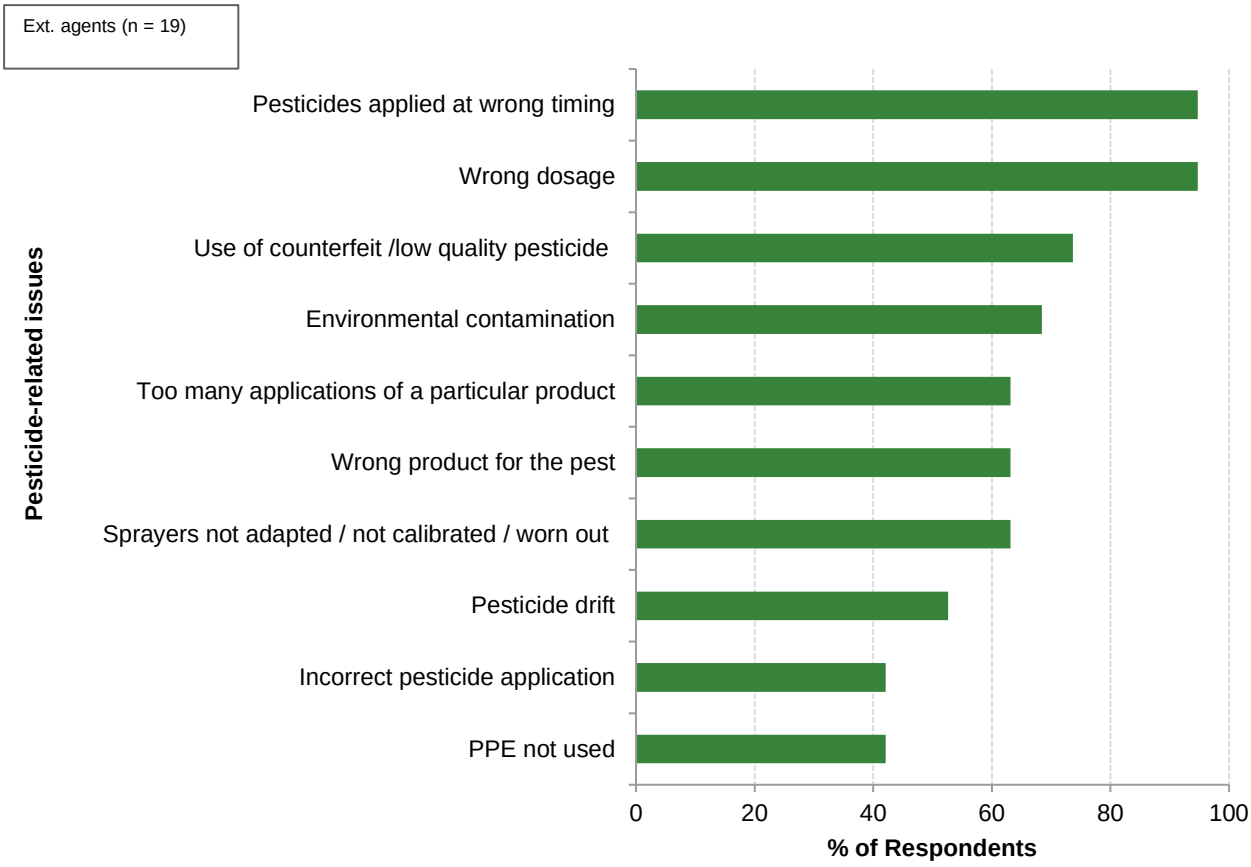


Figure 9: Pesticide-related issues identified by extension agents

State of the implementation of international agreements relating to pesticides, including the FAO's IPM Concept and FAO's International Code of Conduct on Pesticide Management, and regulations related to the national implementation of these treaties at all levels

Assessed against sections of the International code of conduct on pesticide management, published by FAO and WHO, a legal framework seems to exist for pest and pesticide management at the national level. A number of specific points addressed by the Kenya legal framework in the International code of conduct on pesticide management, split by section, is provided in Table 10 and Annex I.

Level of awareness about pesticide safety labels by farmers and extension agents in the study area

The farmers and extension agents had varied awareness levels about the meaning of different pesticide safety labels. A higher proportion of farmers (compared to extension agents) successfully identified pictograms on the need to use face protection, apron and coverall while applying pesticides (Figure 10). Also, a higher proportion of farmers were able to identify pictograms relating to toxicity and impact of pesticides on human health. Conversely, a higher proportion of extension agents were able to identify a pictogram on environmental toxicity. The pictogram of "Use Boots" was recognised by all the interviewed farmers and extension agents. On the other hand, the pictogram of "Corrosive" received the least correct responses.

Table 10: Number of specific points addressed by the Kenya legal framework per section of the International Code of Conduct on Pesticide Management*

Section / aspect 263 sub-points	Number of specific points addressed per section of code of conduct	%
Adherence to and implementation of international agreements relating to pesticides	8/10	80
Policies to promote reductions in unnecessary pesticide use, such as policies on IPM, GAP, organic production and sustainable agriculture	2/4	50
Research	0.5/1	50
Regulations relating to the manufacture of pesticides	6.5/7	93
Legal framework for non-chemical preventive and direct control measures	1/2	50
Price and trade policy, including subsidies	1/8	13
Registration (synthetic pesticides and biopesticides)	38.5/47	82
Analysis of registered pesticide list for highly hazardous pesticides and alternatives	4.5/5	90
Biocontrol agents which are not covered by the national authority handling the registration of pesticides, e.g. macro-organisms	5/5	100
Packaging and labelling	23/29	79
Marketing	2/6	33
Transport	4/4	100
Import and export	6.5/10	65
Requirements for sale	5.5/9	61
Licensing	11.5/12	96
Availability	0/5	0
Handling and use, including regulations on application equipment	4/16	25
Requirements for training	0/5	0
Requirements for personal protection equipment	1/7	14
Storage	7.5/17	44
Disposal of unused pesticides	4/8	50
Disposal of empty pesticide containers	11/18	61
Post-registration monitoring	0/5	0
Residue monitoring in food and Maximum Residue Levels	0/6	0
Other relevant human health and environmental protection regulations	1/4	25
Compliance and enforcement	10/13	77

*NB: these points are not weighted in any way, so findings only indicate how many points and sub-points are covered in legislation, not the 'quality' of the points covered.

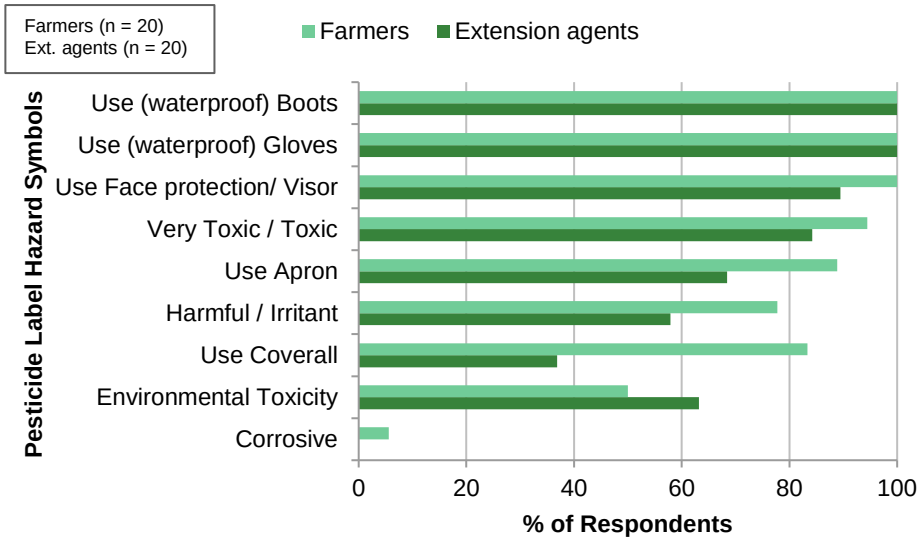


Figure 10: Level of awareness displayed by farmers and extension agents about pesticide label hazard symbols

Of the farmers who procured pesticides (not specifically for the management of sweet potato pests), 83% indicated they read the information on the label of the pesticide. However, the farmers had limited comprehension of some terms relating to pesticide use (namely active ingredients, residues, colour codes on pesticide labels, pre-harvest interval (PHI) and re-entry interval). Among extension agents, 10% of those interviewed had never heard of the same critical terms. Of those who had heard of them, there were variations in their levels of understanding (

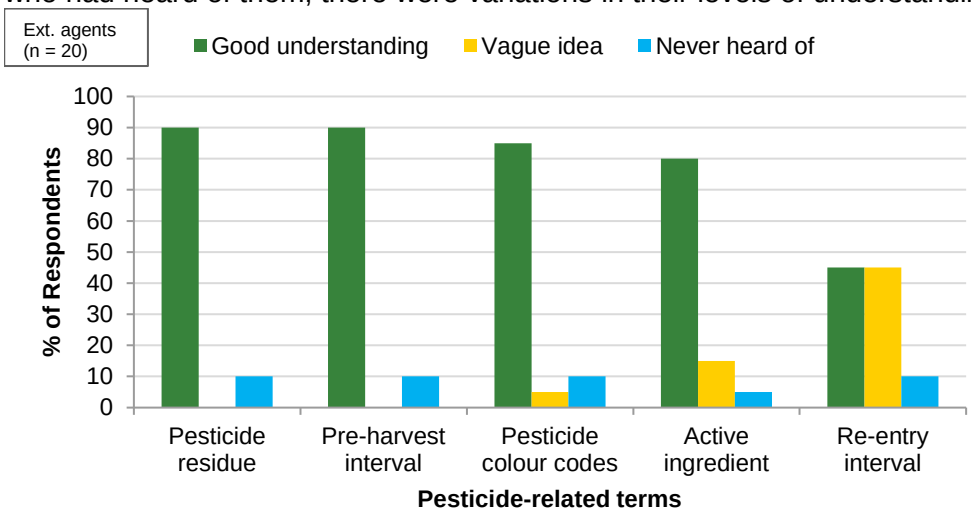


Figure 11). All the extension officers who had heard of those terms had a good understanding of pesticide residue and PHI. The least understood term was re-entry interval, with only half the

number of the respondents indicating they had a good understanding of the term (

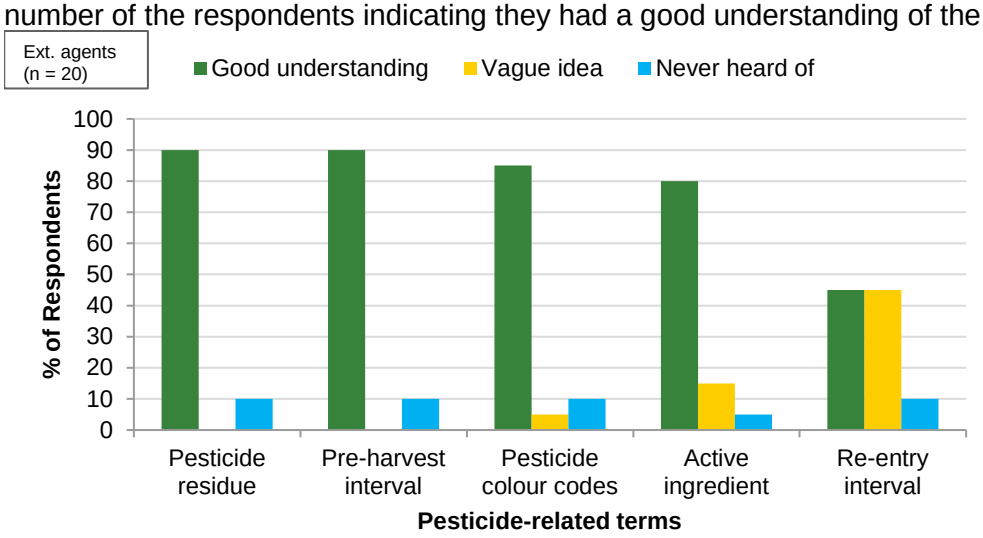


Figure 11).

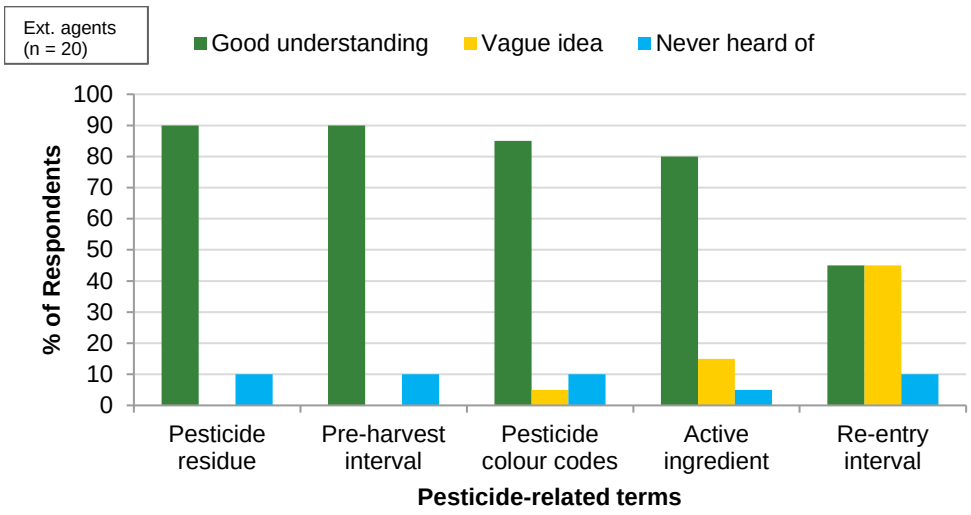


Figure 11: Knowledge of pesticide-related terms by extension agents

Pesticide storage sites in the study area

Farmers and extension agents were asked about their options for pesticide storage. Among the options were: in the house, shed, garage, clearly labelled location, a location inaccessible to children, original containers and in a locked location. Results revealed that there was some disconnect between the practices prescribed by extension agents to farmers and the practices actually adopted by farmers regarding pesticide storage sites. While a majority of the extension agents advocate for pesticides to be kept away from houses, in clearly labelled locations and in their original containers, a majority of the farmers do not seem to carry out these recommendations (Figure 12). However, there is concurrence between the two groups about the need to store pesticides in locations inaccessible to children.

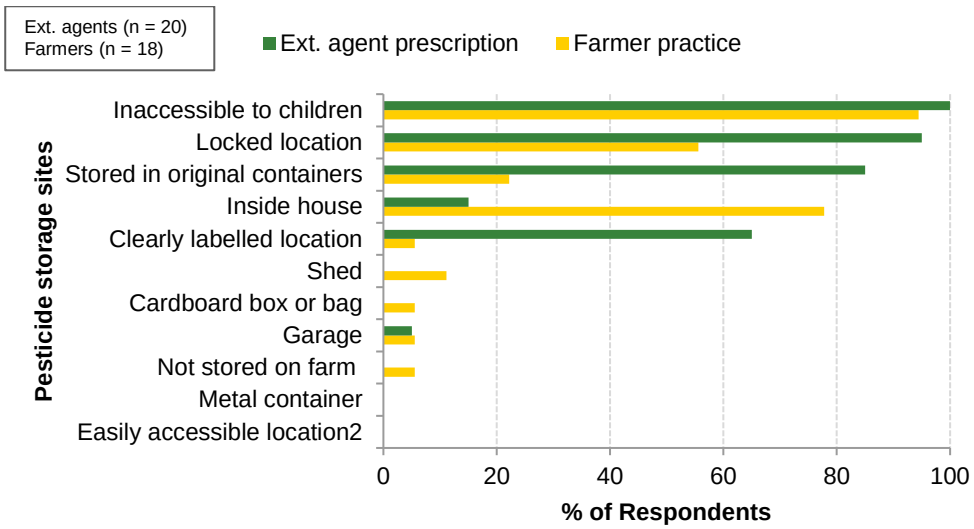


Figure 12: Preferred storage sites for pesticides by farmers and extension agents

Disposal of empty pesticide containers in the study area

As in the case of pesticide storage sites, there also seems to be a mismatch between what is prescribed by extension agents to farmers and the practices adopted by farmers regarding disposal of empty pesticide containers. While a majority of the extension agents favoured empty pesticide containers being disposed of in one of the following ways: buried, disposed through container collection system or being punctured, a majority of the farmers preferred instead, to throw the empty pesticide containers in pit latrines (Figure 13).

Use of PPE in the study area

Even though a majority of the farmers (83%) reported using PPE when handling pesticides, further questioning of the same farmers indicated an inadequate use of PPE in practice (Figure 14). The most commonly used PPE were gloves (rubber/non-rubber) and boots (rubber/non-rubber), and just over half of the farmers wore masks. However, not many farmers prioritized wearing of coverall/apron, long pants, long-sleeved shirts and goggles/glasses. The main deterrents to farmers wearing full PPE, as identified by both farmers and extension agents, were the cost of the PPE together with their availability (Figure 15). A majority of the farmers and extension agents reported that the cost of PPE was beyond the reach of most farmers. Furthermore, according to the same respondents, PPE is not readily available in the shops. A small percentage of the extension agents also commented that some farmers find the wearing of PPE cumbersome and generally do not regard PPE to be useful, all of which adds to the low usage figures of full PPE observed.

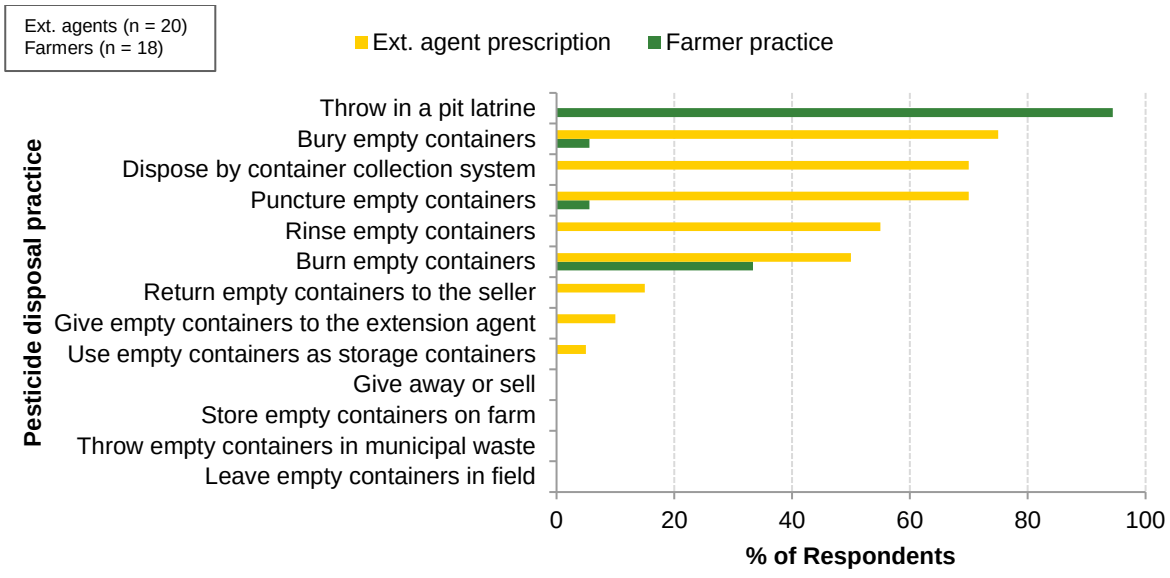


Figure 13: Preferred methods for the disposal of empty pesticide containers by farmers and extension agents

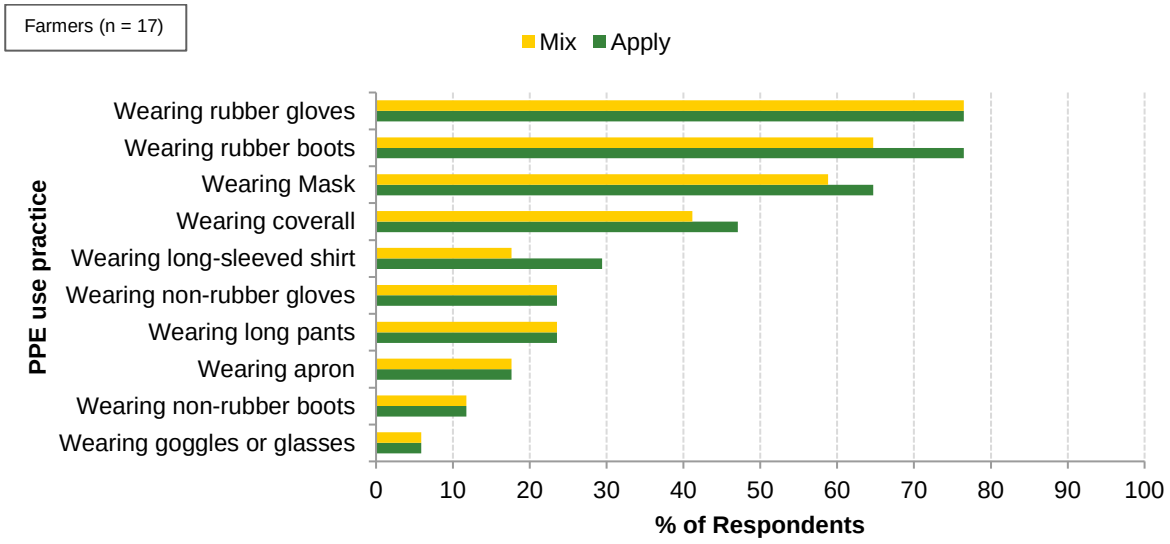


Figure 14: PPE use by sweet potato farmers

Reported cases of pesticide poisoning

Nearly 90% of the farmers reported having experienced pesticide poisoning while handling pesticides. Among those who had experienced pesticide poisoning, the most reported effects were skin irritation (61%), eye irritation (56%), and headache (50%) (Figure 16).

Integrated pest management

Compared to the farmers, nearly all the extension agents interviewed (90%) reported having had a good understanding of IPM. On the other hand, only 28% of the farmers reported having a good understanding of the same with a majority (56%) only having a vague idea of IPM. Among the farmers, 17% had never even heard of IPM (Figure 17).

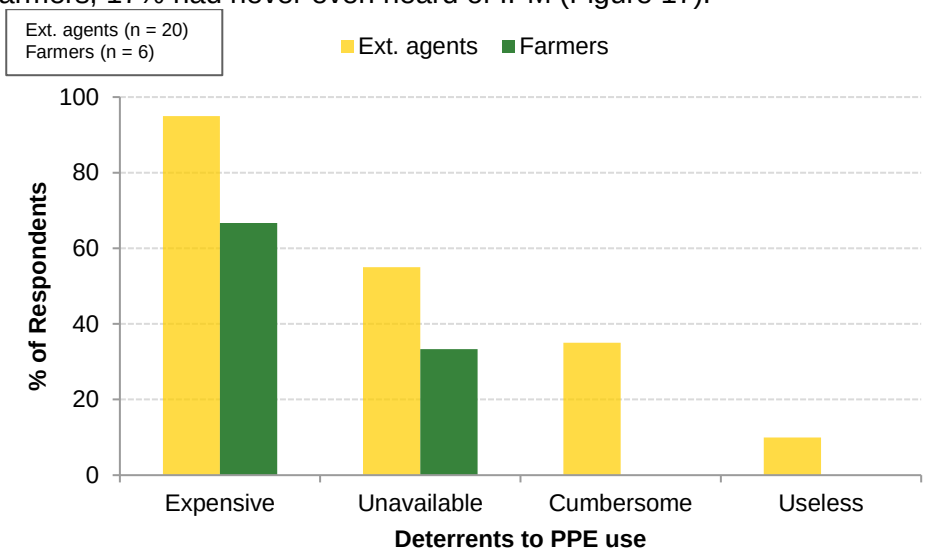


Figure 15: Deterrents to PPE use identified by farmers and extension agents

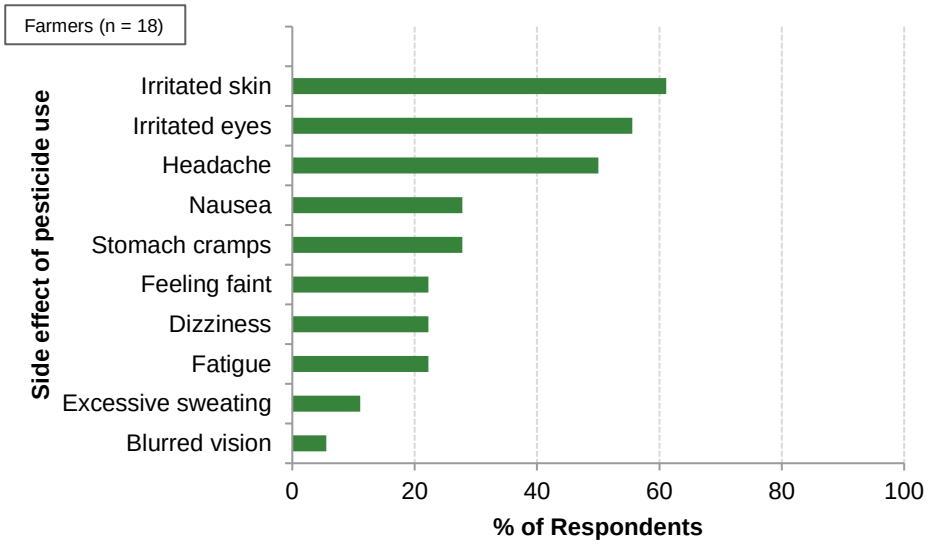


Figure 16: Percentage of farmers reporting side effects from the use of pesticides

When asked what specific aspects of IPM practices they were aware of, and which of those they were implementing, a majority of the farmers identified field sanitation (95%), use of certified planting material (89%), planting at the appropriate time (84%) and removal and destruction of affected plant parts (84%) (Figure 18). Very few farmers were aware of any other IPM practices, including the use of biological control agents, mass trapping, pheromone monitoring traps and observance of pest thresholds. The main challenges identified by extension agents to the implementation of IPM are: lack of knowledge among farmers (95%), lack of inputs (60%), lack of support by research (60%) and lack of extension material (55%) (Figure 19).

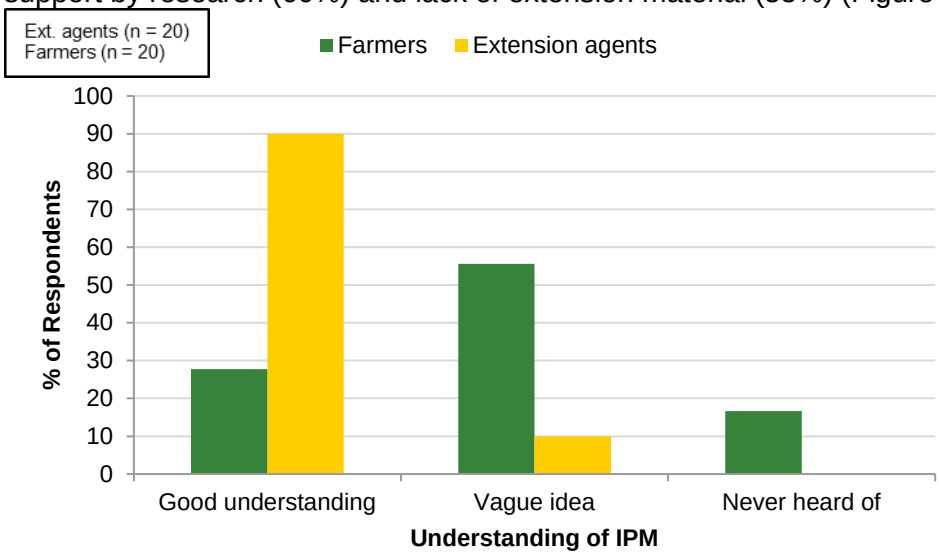


Figure 17: Levels of understanding of IPM reported by extension agents and farmers

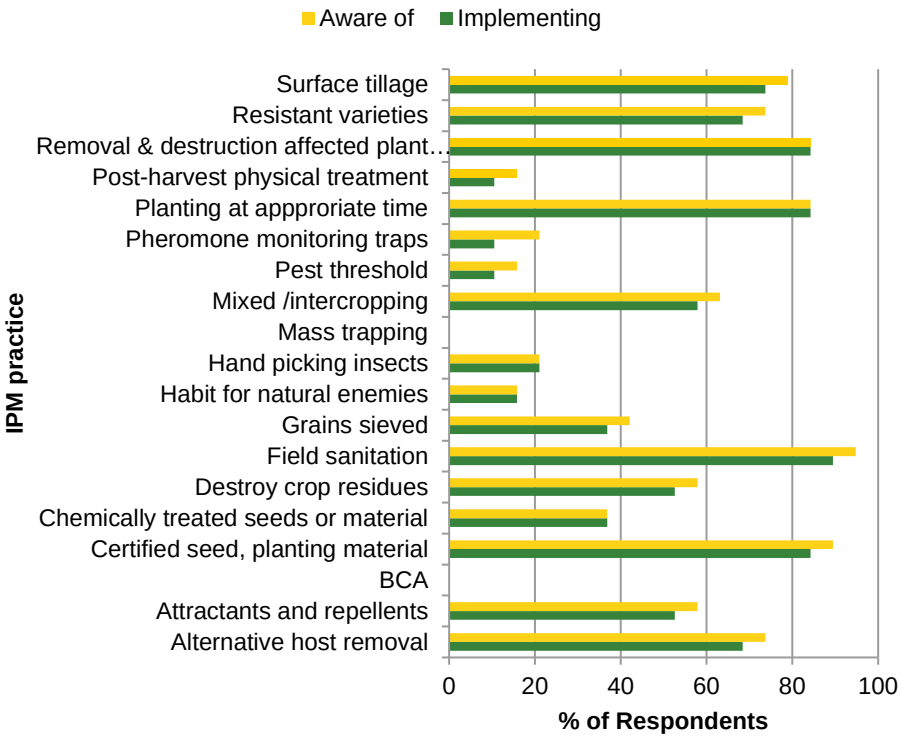


Figure 18: Familiarity with, and implementation of IPM practices by farmers

When it comes to the application of traditional practices, 84% and 68% of the farmers reported field application of non-botanical homemade pesticides (e.g., ashes, dust or soap) and botanical (plant-based) homemade pesticides respectively (Figure 20). However, there was only a minimal use of homemade botanical and non-botanical pesticides at the post-harvest stage.

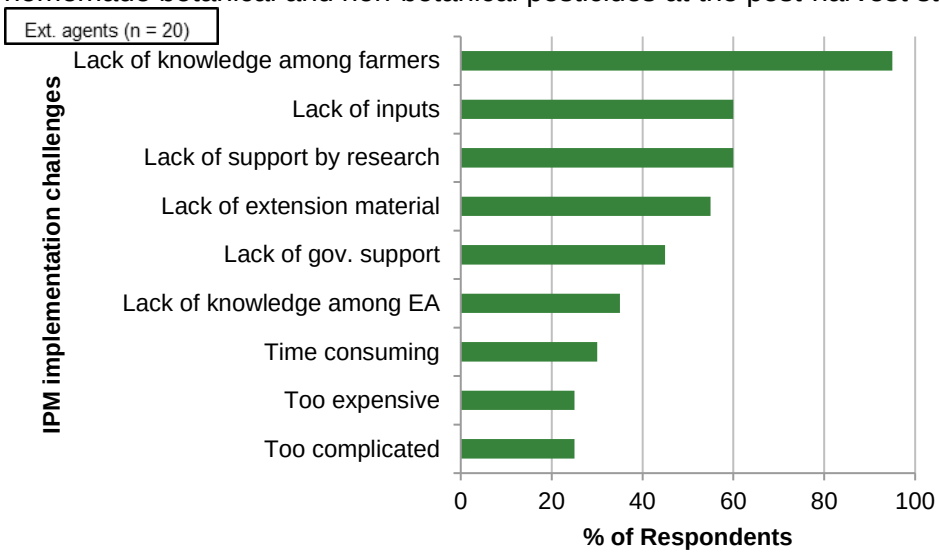


Figure 19: Challenges to the implementation of IPM in the study area

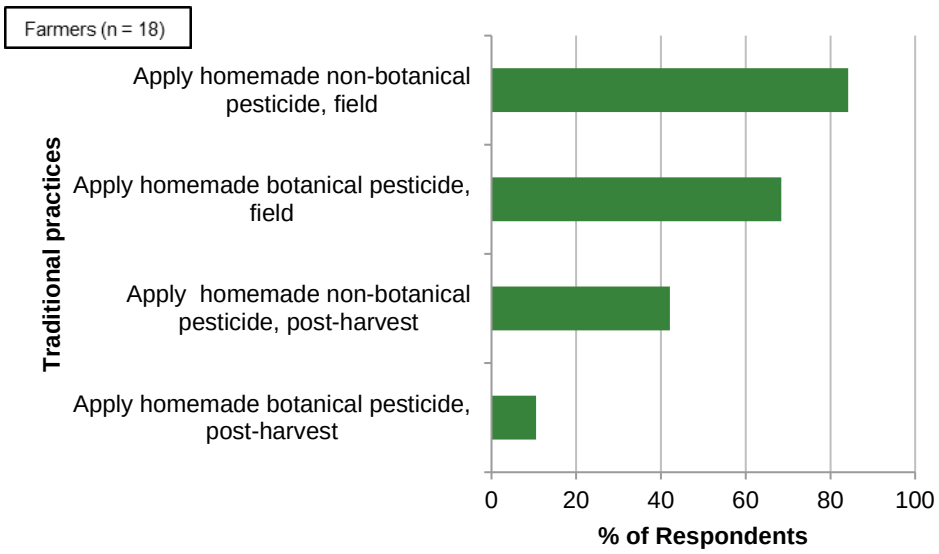


Figure 20: Reported use of traditional practices by farmers

All the farmers reported growing sweet potato in rotation. Among the crops grown in rotation, maize was cultivated by all the farmers, followed by beans, soybeans, vegetables, groundnuts, sorghum and Napier grass in that order (Figure 21). The main pests associated with these pests are listed in

Table 11. According to extension agents, various pests attack the crops grown in rotation with sweet potato at different stages. For maize, the main pest attacking the crop at the field stage is fall armyworm while weevils are the main pest attacking the crop at the post-harvest (storage) stage. For beans, the main pests include bean fly (seedling/field stage) and weevils (post-harvest stage). Pests reported for vegetables include aphids (field stage), cutworms (field stage) and rotting pathogens (post-harvest stage)

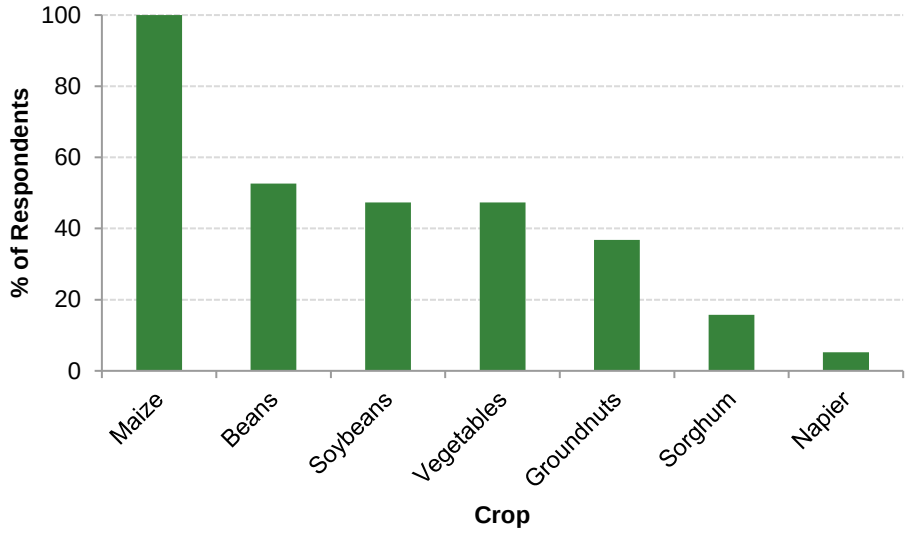


Figure 21: Crops grown in rotation

Table 11: Major pests associated with crops grown in rotation with sweet potato in the study area

	Seedling stage	Field stage	Post-harvest stage
Maize			
Fall armyworm	✓	✓	×
Maize stalkborer	✓	✓	×
Maize streak virus	×	✓	×
Striga weed	✓	✓	×
Weevils	✓	✓	✓
Beans			
Bean fly	✓	✓	×
Anthracnose	✓	✓	×
Aphids	✓	✓	×
Mites	✓	✓	×
Bean weevil	×	×	✓
Vegetables			
Aphids	✓	✓	×
Cutworms	✓	✓	×
Thrips	×	✓	×
Whiteflies	×	✓	×
Rotting pathogens	✓	×	✓
Groundnut			
Mole rat	✓	✓	×
Squirrel	×	✓	×
Rat	×	×	✓

Pest/SWOT matrix of IPM use in sweet potato production in the study area

Using survey results and discussions with key informants, the management of sweet potato pests in the context of IPM was analysed and the main issues that came up are summarised in Table 12.

Table 12: Pest/SWOT matrix of IPM use in sweet potato production

Strengths	Weaknesses	Opportunities	Threats
• Acknowledgement of IPM by GIAE, MOALF and collaborating institutions and organisations involved in the project • Existence of projects within and outside the project area with IPM focuses, which can serve as learning points • Emerging consciousness about food safety by retail sector • Existing farmer groups which can be used to promote IPM concept training • Sufficient coverage of the project sites by GIAE Kenya partnering organisations' staff • Presence of a technical training manual on GAP directed at sustainable production and which includes IPM	• Limited knowledge about IPM principles among farmers and some extension personnel involved in the project • Lack of appreciation by farmers about the risks associated with handling and use of pesticides • In some instances, no well-defined partnerships amongst value chain actors and supporters (as evidenced by lack of supporting documents to indicate the same) • Absence of functional producer organisations for policy advocacy	• Presence of agricultural research and training institutions with the requisite expertise and infrastructure • Existing GAP standards, which can be benchmarked • Local policies that support IPM from which policy formulation guidance may be obtained	• Limited awareness on the part of consumers • Absence of price differentials between IPM/organically and conventionally produced crops • Absence of laboratories for testing pesticide residues in the project area

Preferred sources of information by farmers

When asked about their preferred sources of information on farming related issues, the respondents overwhelmingly reported radio (95%) and extension agents (89%). A few of the respondents also mentioned mobile phone (42%) and agro-input retailers (37%) (Figure 22).

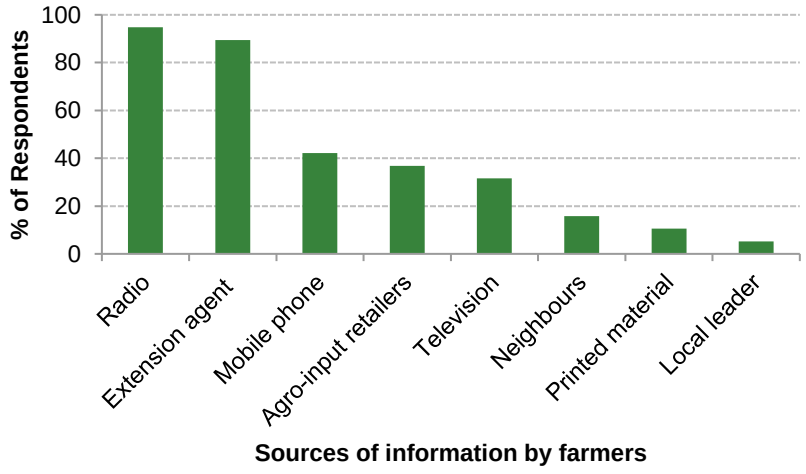


Figure 22: Preferred sources of information identified by farmers

Analysis of GAP/GCM and other voluntary standards applied to sweet potato

Table 13 outlines some of the GAP/GCM and voluntary standards that currently apply for the cultivation of sweet potato in Kenya, together with the relevant certification body.

Table 13: Voluntary standards applied to sweet potato

Crop	Voluntary standard	Certification body
Fruit, vegetables and flowers	Kenya-GAP	AfriCert
Fruit and vegetables	KS 1758 (part 2)	Horticulture Crop Directorate
Horticulture	GLOBALG.A.P. Fruit & Vegetables Standard	AfriCert
Crop products	Rainforest Alliance (Sustainable Agriculture Network Standard, SAN)	AfriCert
Export commodities	Fairtrade	Eastern and Central Africa Network (FTA-ECAN)
Fruits and vegetables	Organic	
Food crops	BRC Global Standard for Food Safety	SGS Kenya
Food crops	Hazard Analysis and Critical Control Points (HACCP)	SGS Kenya
Food crops	Global Food Safety Initiative Certification	SGS Kenya
Food crops	Non-GMO Certification	SGS Kenya
Food crops	Kosher Certification	SGS Kenya
Sweet potato	United Sates Standards for Grades of Canned Sweet Potatoes	U.S. Department of Agriculture

An overview of the requirements of major voluntary standards applicable to sweet potato is provided in Figure 23. In the figure, the black colour in the corresponding square indicates that the point is not addressed by the standard. The colour red indicates a high-level guidance (e.g. prevention [of pests] by implementing GAP). The aqua (greenish-blue) colour indicates that the requirements are detailed but soft, i.e. major GAP are lacking. Where this is the case, the points that are not addressed are indicated below. The tan (pale brown) colour indicates that the requirements are detailed and that major GAP are followed.

Not addressed:	High level guidance:	Soft detailed requirements:	Strict detailed requirements:

	Point /criteria	Organic	Fair Trade	RFA	Kenya-GAP	Global GAP
Integrated pest management	Site selection					
	Preventative measures (e.g. resistant planting material, crop rotation) should be implemented					
	Cultivation techniques and mechanical control should be implemented where applicable					
	Pest control interventions should be based on monitoring					
	Strategies to prevent the build-up of resistance to pesticides should be implemented where applicable					
Pesticide management	[i]Highly hazardous pesticides are banned (click below for details)					
	[ii]Adequate storage of pesticides					
	[iii]Adequate disposal of pesticide containers					
	Adequate disposal of surplus spraying mixture					
Safety	People involved in handling/application of pesticides should have received training					
	The use of personal protective equipment is an explicit requirement					
	Observance of re-entry intervals					
	Observance of PHI					
	Bathing facilities are provided to workers applying pesticides					
Environmental protection	Fertilizer and nutrient management					
	Conservation of soil					
	[iv]Conservation of water					
	[v]Biodiversity					
	[vi]Waste disposal					
	[vii]Energy conservation and carbon footprint					
	[viii]Farm economic sustainability					
	[ix]Provision of capacity building and training, access to information and support services					

Figure 23: Overview of the requirements of major voluntary standards

[i] RTRS: Restrictions limited to the pesticides banned by the Stockholm and Rotterdam Convention
[ii] RFA: Requirement limited to: Storage in a locked facility, access limited to the trained staff; Fair Trade: Soft requirements for central storage (pesticide may be stored in containers other than the original container). High level requirements for cooperative members.
[iii] Fair Trade: Contains guidance to prevent reuse, but does not address final disposal of containers. RTRS: Does not address final disposal of containers
[iv] GlobalGAP: No requirement related to the application of pesticides near water bodies
[v] RTRS: Only addresses the protection of waterbodies/watercourses
[vi] Fair Trade: No indication on final disposal, small amounts of hazardous wastes may be burned
[vii] RTRS: Contains measures to prevent the increase of the footprint, not to reduce it.
[viii] Fair Trade: Limited to business planning and review.
[ix] [1] Fair Trade : Training limited to IPM and agrochemical management; GlobalGAP: limited to health and safety

Pesticide hazards, assessment of risks and documented harmful effects of pesticides

Stock taking of registered HHP, and their uses

The more than 319 AIs registered in Kenya differed in terms of their overall hazard level (Figure 24): 61 of the AIs allowed for use met one or more of the HHP criteria; 81 AIs were categorised as “danger” (one or more of the associated human health hazard statements indicated that the AI is “toxic” or “fatal if inhaled”); 118 AIs were categorised as “Warning”; 31 AIs were categorised as “Low hazard” (there were no known human health hazard statements associated with the AI); and key human health hazard data was missing for 28 AIs. The AIs identified as HHPs are listed in Annex II.

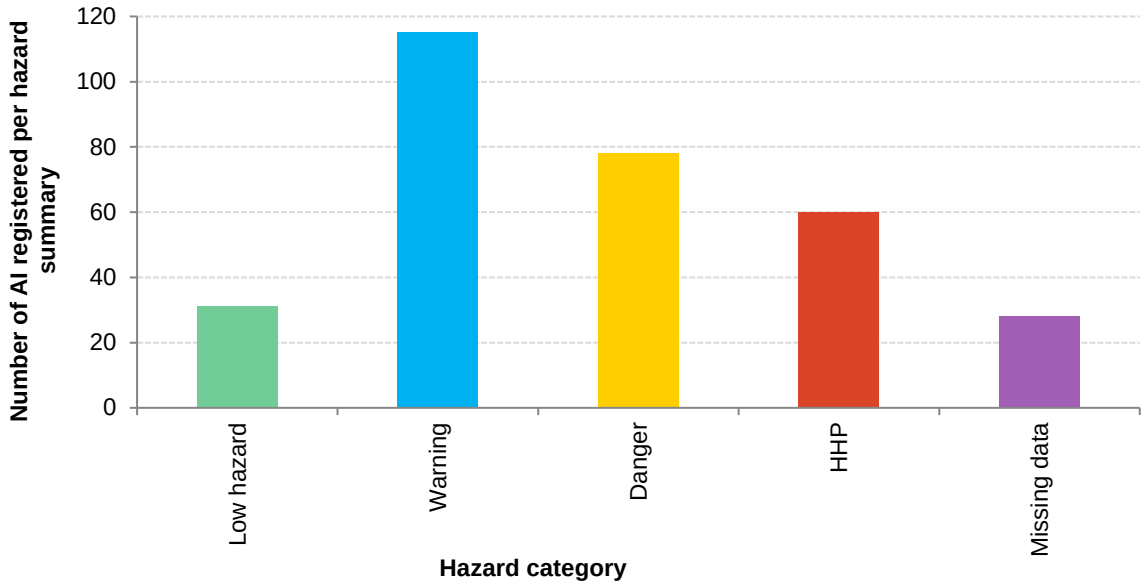


Figure 24 Number of AI in each hazard category

Of the HHPs identified, 56% were carcinogens, 26% were either extremely or highly acutely toxic, 25% were reproductive toxins and 3% were mutagens (Figure 25). Carbofuran requires prior informed consent under the Rotterdam Convention, and DDT is a POP listed in the Stockholm Convention, requiring prior informed consent under the Rotterdam Convention. More than one of the HHP criteria were met in the case of the following AIs: carbendazim, carbofuran, DDT, diazinon, diclofop-methyl, epoxiconazole, ethoprop and thiabendazole.

In addition to the information on the HHP criteria, the compiled Globally Harmonized System of Classification and Labelling of Chemicals (GHS) hazard statements identified other human health and environmental hazards. Irritation to the skin, eyes or respiratory tract were frequently listed as potential health effects (101 AIs). Other human health effects identified included endocrine disruption (29 AIs), allergic reactions (81 AIs), the potential for serious eye damage (87 AI) and the potential for organ damage (both specific and general, 90 AIs). The human health hazard statements covering health effects were included in the determination of hazard category. With respect to environmental hazards, 73 AIs were found to be very toxic to aquatic organisms, often with the potential for long lasting effects. Data on pollinator hazards was available for 81 AIs, and, of those that were assessed, 16 AIs were found to be very toxic or very highly toxic to bees. None of the AIs are listed as candidate POPs. Forty-four of the identified AIs are currently listed in the Rotterdam database of notifications of final regulatory action. One hundred and one of the AIs are included in the PAN HHP list (2016). On an AI basis, 63% of the AI are allowed for use in the EU (192 AI) or pending approval for use in the EU (3 AIs) whereas the other 37% are not allowed for use in the EU (68 AIs), are not classified as plant protection products in the EU (1 AI) or otherwise not listed (45 AIs). Annex III provides further information about these specific AIs.

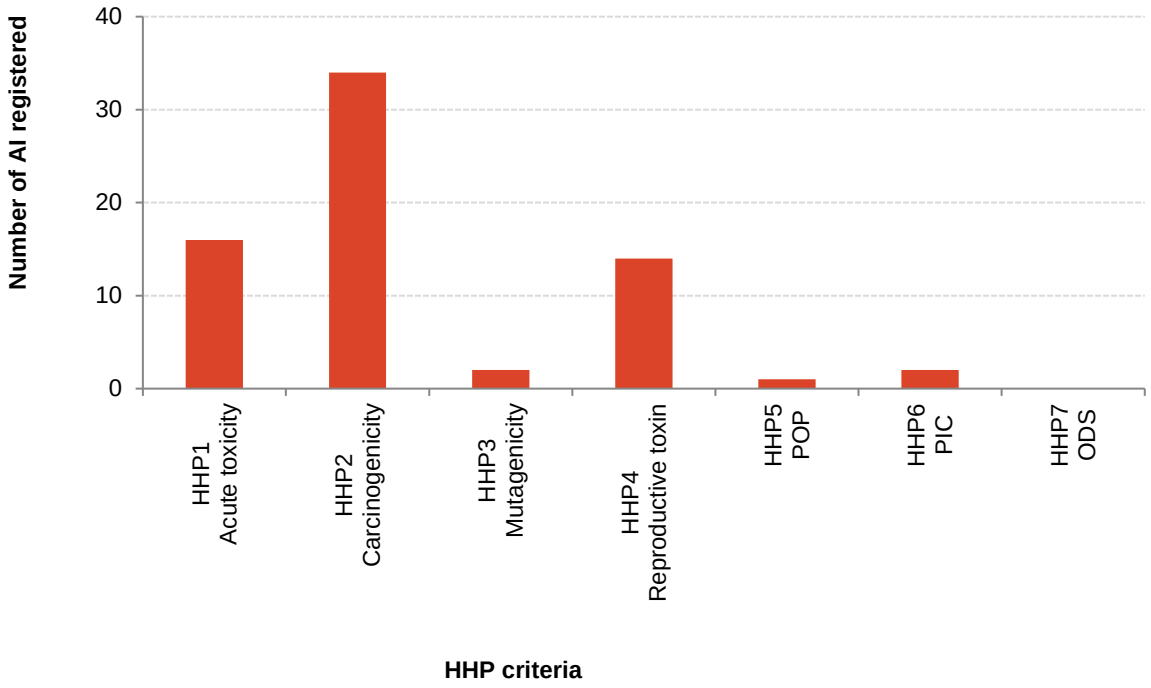


Figure 25 Number of HHP AI allowed for use split by HHP criteria

Twenty-one of the identified AIs are allowed for use in organic agriculture and are listed as such in Annex II of Commission Regulation (EC) 889/2008. Fifty-three of the AIs are classified as U (unlikely to cause acute hazard under conditions of normal use) in the *WHO Recommended Classification of Pesticides by Hazard* (2009). Of the AIs identified through this study, 126 are not listed in the 2009 classification. Based on the LD_{50} of the AI, six of the AIs which are not listed in the 2009 classification can also be considered to be class U: *Aspergillus flavus*, *Bacillus subtilis*, *Beauveria bassiana*, chromafenozide, sulfosulfuron and *Trichoderma aspellerum*.

According to the GIZ procurement policy, 23 AIs fall into procurement category A (not allowed), 118 AIs fall into procurement category B (only as exception, elaborate verification needed), 30 AIs fall into procurement category C (only by authorised staff with strict protection; not for small farmers) and 89 AIs fall into procurement category D (appropriate precaution) (Figure 26). Forty-five of the AIs have not been classified by GIZ.

There are no AIs specifically registered for use on sweet potato. Among the 54 AIs registered for use on a wide range of crops (e.g. vegetables, horticultural crops), 12 are HHP and five are biological control agents (low hazard AI). The current study identified 18 non-HHP AIs registered to manage pests which already have HHPs registered for use against them. Non-HHPs were identified for only 36% of the key pests for which HHP are being used, recommended or registered. The full list of pests and the lower toxicity alternative pesticides that are registered to manage them is given in Annex IV. The pests for which no effective HHP alternative AI was registered for use were fusarium root rot, fusarium surface rot, leaf rust, mole rat, nematodes, sweet potato black rot and sweet potato scurf.

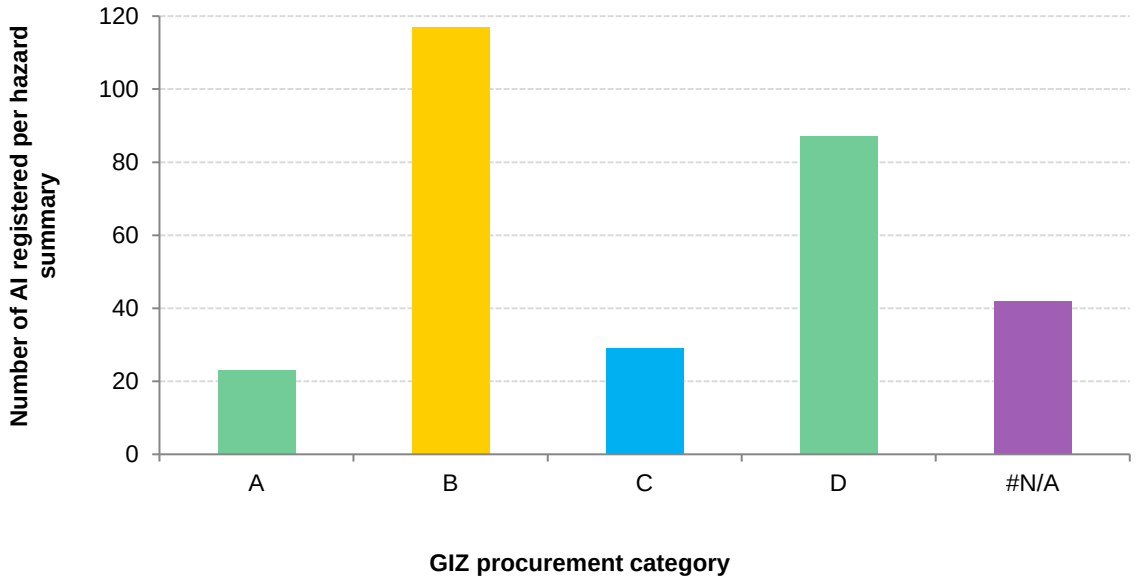


Figure 26: Number of AI per GIZ procurement category

State of science on crop protection

Many practices are recommended for the management and control of pests in sweet potato, although the specific practices applied in each case will depend on farmer capacity, type of pest and availability of the recommended practices. Table 14 provides a list of the recommended practices for different pests in sweet potato.

Table 14: Management practices for pests in sweet potato

Pest	Management practice
Sweet potato weevil	Field sanitation ▪ Remove and destroy (through burying, burning or feeding to livestock) any crop residues left in the field after harvest (Stathers et al, 2005). ▪ Infested roots must be completely buried (over 15cm deep); avoid cracks, which allow emerging weevils to reach the soil surface.(Infonet Biovision, 2017) ▪ If vines are left in the field to improve soil fertility, care should be taken to ensure they are dead and not able to sprout (Stathers et al, 2005). ▪ ***Potential***: high potential, widely practised – 95% of the interviewed farmers reported practising field sanitation. The practice, however, is limited in areas where crop residues are important for maintaining soil fertility.(Smit, 1997) Crop rotation ▪ Avoid planting sweet potatoes in the same area for two to three successive seasons (Stathers et al, 2005). ▪ Rice and sorghum are often used in rotation with sweet potatoes (Infonet Biovision, 2018). ▪ ***Potential***: high potential, widely practised – 100% of the interviewed farmers reported practising crop rotation. The practice is more pronounced in areas with high land pressure and few crops.(Smit, 1997) Monitoring ▪ At the beginning of the growing season, the adult weevils are commonly found on the foliage, but quickly drop to the ground if disturbed (Infonet Biovision, 2017). ▪ Most of the larvae are found in the upper 15cm of the tubers and basal 10cm of the vine. ▪ Select storage roots that appear soft, that smell, or have external scarring or small, darkened holes. Cut these open and look for tunnelling and larvae. ▪ ***Potential***: not widespread – according to the extension agents interviewed only 22% of farmers in the study area carry out pest monitoring. Intercropping ▪ Reduced sweet potato weevil damage has been observed when intercropped with coriander, proso millet and sesame (Infonet Biovision, 2017). Other crops involved in mixed cropping systems with sweet potato are ginger, okra, maize, colocasia and yam (Salum, 2015). ▪ ***Potential***: high potential, often practised - 60% of the farmers interviewed reported practising mixed cropping systems. Planting time

- Plant early or plant early-maturing varieties, thus ensuring harvesting before the end of the growing season. This minimises the risk of drought and the damaging effect of weevils, which enter the soil through cracks (which are more common during drought) (Infonet Biovision, 2017).
- ***Potential***: high potential, widely practised – 95% of the interviewed farmers reported observing timely planting. The practice, however, is limited in areas where staggered planting is practised as a means of ensuring a fresh supply of roots over a longer period (Smit, 1997).

Use of clean cuttings

- Carefully select fresh cuttings for planting a new crop to avoid carrying-over weevils from an infested crop to the new planting.
- Use clean (insect-free) vines as planting material, in particular the tender vine tips (the top 25-50cm). Weevils tend to lay eggs in the older, woodier parts of the vine, so if the tender tips are used for planting they are less likely to be infested by weevils (Stathers et al, 2005).
- Using a pre-plant dip to treat the cuttings can provide control against sweet potato weevil for the first few months of the growing season. Dip the cuttings into a solution of the fungus *Beauveria bassiana* for 10-15 minutes before planting (Africa Soil Health Consortium, 2013).
- ***Potential***: high potential, widely practised – 88% of the interviewed farmers reported using clean planting material obtained using conventional and rapid multiplication techniques. However, in areas where planting material is limited, farmers end up having little choice about what material to use (Smit, 1997).

Maintain a distance from infested fields

- Plant away from weevil-infested fields.
- Use barrier crops such as cassava, maize, bananas or sorghum planted around the field perimeters in strips at least 3 to 5m wide (Infonet Biovision, 2017).
- ***Potential***: the close proximity of farms in some parts of the study area makes planting away from weevil-infested fields unpractical. However, in less-populated areas this practice has a high potential (Smit, 1997).

Avoid soil cracking

- Avoid or minimise cracks in the soil through:
    - Planting cuttings deep in the soil and using deep-rooted cultivars with long necks as these are less vulnerable since adult sweet potato weevils cannot burrow deeper than 1cm (Africa Soil Health Consortium, 2013).
    - Ridging – this works to prevent the entry of sweet potato weevils into the tuber and prevents oviposition by female weevils (Hue and Low, 2015).
    - Mulching – mulching materials such as rice straw or black polythene minimise soil cracking and conserve soil moisture, as well as providing a physical barrier that curtails the movement of sweet potato weevils (Hue and Low, 2015).
    - Routine irrigation.
- ***Potential of mulch***: the availability of mulch is a problem particularly in dry-lands experiencing with high temperatures. In addition, termites are a menace during hot weather as they devour the dried grasses (Salum, 2015). The potential of this method is low.
- ***Potential of ridging***: works best when performed at the tuber formation stage (Hue and Low, 2015). This method has some potential

Flooding of fields

- Flooding of infested fields for at least 48 hours after completing the harvest drowns weevils and induces rotting of the leftover plant materials, thereby reducing weevil densities from one planting to the next.

Early harvesting

- Harvest the crop as soon as it has developed roots of acceptable size.
- In instances where piecemeal harvesting is done, once harvesting has removed the largest storage roots most at risk from sweet potato weevil attack, the soil around the remaining roots should be hilled up to prevent sweet potato weevils from accessing the roots through cracks in the soil (Stathers et al, 2005).
- ***Potential***: some potential, but limited in areas where piecemeal harvesting is practised (Smit, 1997).

Control of alternative hosts

- Removal of any sweet potato weevil alternative hosts (e.g. morning glory, water spinach, wild Ipomoea etc.) that may be growing in the vicinity of sweet potato plantings (Infonet Biovision, 2017).

Hilling up

- Hill up soil around the base of the plants with a hoe and re-ridge about 30 days after planting. This buries the roots deeper and minimises cracks in the soil where the weevils can enter (Africa Soil Health Consortium, 2013).
- ***Potential***: labour intensive. Often already practised during piecemeal harvesting (Smit, 1997).

Chemical approaches

- Use of chemicals to control sweet potato weevils is difficult since the insect pest's larvae feed on the storage roots in the ground or inside the woody base of stems (Africa Soil Health Consortium,

	2013). ▪ There are many natural enemies of sweet potato weevil, including ants (predators of eggs), earwigs, ground beetles and spiders. Minimal use of chemicals will ensure the preservation of these natural enemies (Africa Soil Health Consortium, 2013).
Rats and mole rats	Planting time ▪ Alter the time of planting so that harvest occurs before maximum rat populations occur. In localities where rats are a recurring problem, select early-maturing varieties (Africa Soil Health Consortium, 2015). ▪ ***Potential***: high potential, widely practised – 95% of the interviewed farmers reported observing timely planting. The practice is limited, however, in areas where staggered planting is practised as a means of ensuring fresh supply of roots over a longer period (Smit, 1997). Setting traps ▪ Setting traps (snap, snare or live) is likely to reduce rat and mole rat populations and protect the growing crop. However, care must be taken to protect livestock and children from being hurt by the traps (Africa Soil Health Consortium, 2015). ▪ ***Potential***: some potential, but limited since traps can only be placed in certain locations. Weed control ▪ Remove weeds from within and around sweet potato fields. Nile rats forage during daytime and nest above ground. Removing weeds therefore exposes the rats to their predators (Africa Soil Health Consortium, 2015). ▪ ***Potential***: some potential, but this is limited since scarcity of labour limits mechanical weed control. In addition, the sowing time of sweet potato usually coincides with, or just precedes, periods of heavy rain. The rain soaks the soil, and soaked soils mean that efficient mechanical weed control is not possible. Application of homemade botanicals and non-botanicals 1. Plant the legume *Tephrosia vogelii* (commonly known as fish bean) throughout the sweet potato field and along the borders (Africa Soil Health Consortium, 2015). ▪ ***Potential***: high potential, often practised. However, the shrub contains rotenone, which is a fish poison and insecticide, so care should be taken when handling it. Also, some species are invasive, so biosafety procedures that apply to the planting site must be followed (Africa Soil Health Consortium, 2015, World Agroforestry, 2009). 2. Place a mixture of cow dung and pepper in the burrows and burn to smoke the rodents (Africa Soil Health Consortium, 2015). ▪ ***Potential***: high potential, often practised 3. Pour one-week old fermented cattle urine into the burrows to drive away mole rats (Africa Soil Health Consortium, 2013). ▪ ***Potential***: high potential, often practised

NB: Biological control: the study deliberately excluded this intervention practice for the following reasons:

- Awareness - much as the GIAE technical manual makes reference to biological control (borrowing a lot from Infonet Biovision), none of the farmers interviewed made reference to the same.
- Augmentative biological control has been more successful in greenhouse vegetable production than in outdoor crops. In the study area, sweet potato is produced outdoors.
- Cost – the cost associated with biological control agents may well be beyond what smallholder farmers in the study area could afford. And if per chance GIAE is considering supporting farmers in the purchase of BCAs, then the question of sustainability of such a move will still need to be answered since the project has a limited life span.
- Availability of BCAs – BCAs are not readily available.

Pest management practices prescribed by the GIAE's Technical Training Manual for Trainers on Good Agricultural Practices on Sweet Potato Production in Western Kenya - Review

GIAE Kenya has undertaken measures to ensure farmers have access to GAP for sweet potato pest management. This has been put into operation by the production of a technical training manual for trainers on GAP in sweet potato farming in Western Kenya. The manual was produced by GIAE in collaboration with the Kenya Agricultural and Livestock Research Institute (KALRO). A review of the manual with specific reference to effectiveness, safety and practical application is provided in Table 15.

Table 15: A summary of the pest management practices in the GIAE sweet potato production manual.

Pest management practices	Characteristics		
	Effective	Safe	Practical
Viral diseases (e.g. Sweet potato feathery mottle virus; sweet potato sunken vein virus; mild mottle virus)			
Use of clean planting material	✓	✓	✓
Field sanitation	✓	✓	✓
Use of resistant/tolerant varieties (*not specified)*	✓	✓	✓
Crop rotation (not specified)	✓	✓	✓
Monitoring/scouting (*not specified)*	✓	✓	✓
Roguing	✓	✓	✓
Vector control (aphids and whiteflies)			
Use of botanical pesticides (e.g. neem oil) and non-botanical pesticides (e.g. soap)	✓	✓	✓
Natural enemies (e.g. *Chrysoperla* spp., *Aphidius colemani*)	✓	✓	×
Sticky traps			
Bacterial diseases (e.g. bacterial stem and root rot)			
Use of clean cuttings	✓	✓	✓
Use of resistant/tolerant varieties (*not specified)*	✓	✓	✓
Vector control			
Biological/ chemical control (*not specified)*	✓	×	×
Weed control		✓	✓
Fungal diseases (Alternariosis, anthracnose, blight)			
Use of clean planting material	✓	✓	✓
Use of resistant/tolerant varieties (*not specified)*	✓	✓	✓
Nematodes			
Use of clean planting material	✓	✓	✓
Use of resistant varieties (*not specified)*	✓	✓	✓
Mites (Eriophyid mites)			
Use of clean planting material	✓	✓	✓
Field sanitation	✓	✓	✓
Roguing	✓	✓	✓
Use of acaricide (*not specified)*	✓	×	✓
Insects (e.g. weevils; whitefly,			
Natural enemies (predatory ants, earwigs, spiders, ground beetle)	✓	✓	×
Biorational (Beauveria bassiana)	✓	✓	×
Pheromone traps	✓	✓	×
Indigenous technical knowledge (use of repellents - *Lantana camara*)			
Crop rotation (*not specified)*	✓	✓	✓
Field sanitation	✓	✓	✓
Early planting	✓	✓	✓

Hilling up	✓	✓	✓
Roguing	✓	✓	✓

Note: Not specified means that types of resistant varieties, crops used in crop rotation, monitoring plans and examples of biological/chemical control were not provided in the manual

Advisory service characteristics and the advice they provide

Kenya's smallholder farmers have benefitted from three major types of extension systems, provided by a number of players. These three agricultural extension systems are; the government extension system spearheaded by county governments; a commodity-based extension system run by numerous cash crop programmes under various state corporations, outgrower companies, and cooperatives; and private agricultural extension systems comprising private companies, non-governmental (NGOs), community-based organisations (CBOs), and faith-based organisations (Chimoita, 2014, Muyanga et al., 2006). Over the years, some of the programmes implemented by the government of Kenya, and which were interventions in the revitalization of extension services include, Training and Visits (T&V), National Agriculture and Livestock Extension Programme (NALEP), Participatory Rural Appraisal (PRA), Rapid Results Initiative (RRI), Farmer Field Schools (FFS) and Plantwise.

When asked about the highest level of education they had attained, half of the extension agents interviewed indicated they possessed a diploma in an agricultural-related field. Of the remaining respondents, the majority had a bachelor's degree while one of the respondents had a master's degree (Figure 27). In terms of the methods employed by extension agents to train farmers, no single method was preferred. Instead, as occasion demanded, they used direct exchange, field days, group training, and demonstration farms to train farmers (Figure 28).

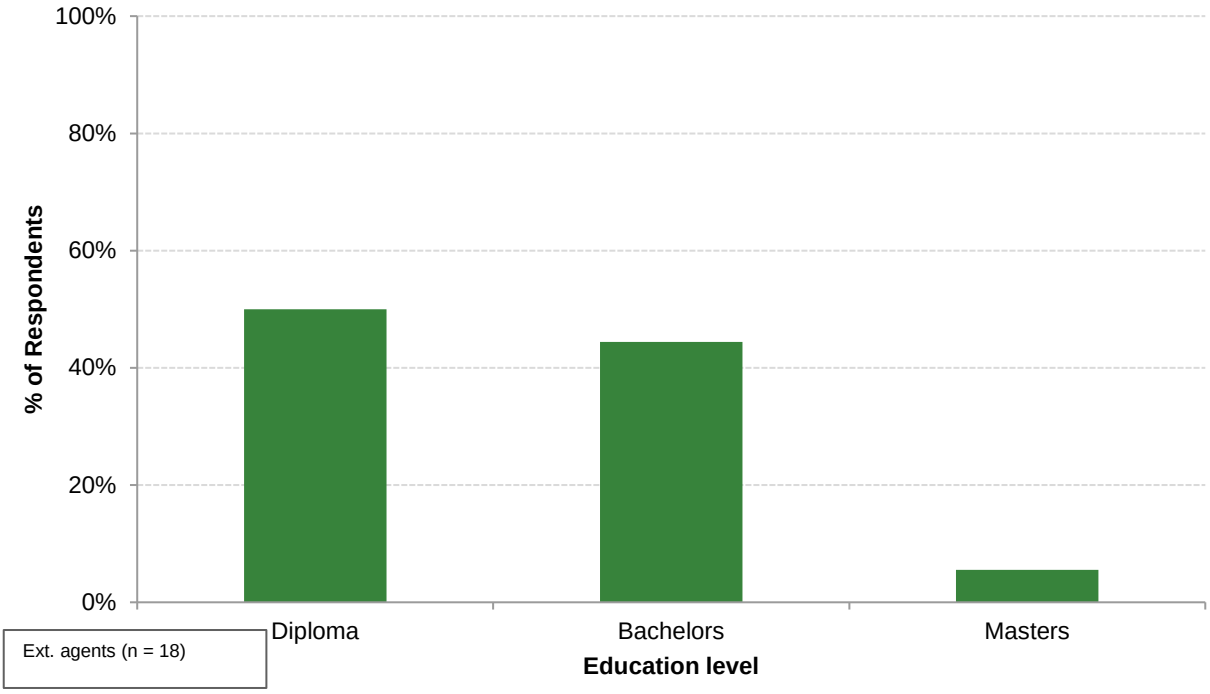


Figure 27: Level of education of extension agents in the study area

A majority of the extension agents interviewed (55%) meet with farmers on a need basis. Others, however, have scheduled meeting days with farmers. Of these, 25% meet with farmers at least once a week, 15% once a month and 10% fortnightly (Figure 29). When asked with whom they communicate on the farm, the extension agents in the study area do not seem to discriminate based on either gender or on-farm roles (Figure 30).

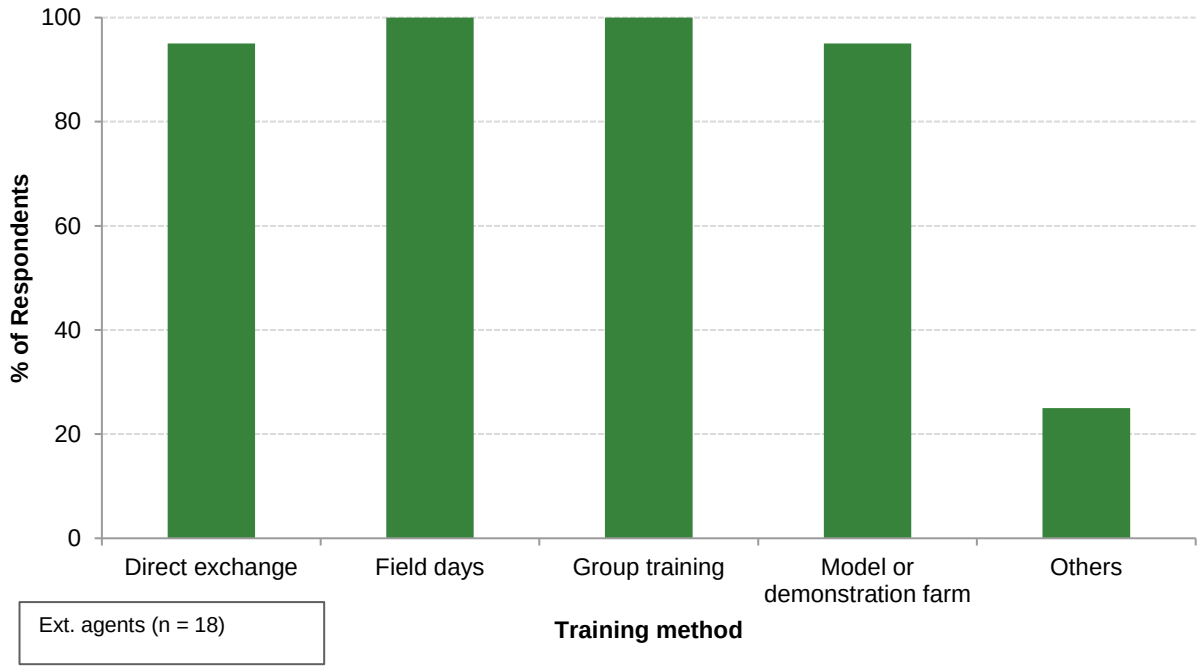


Figure 28: Training methods employed by extension agents in the study area

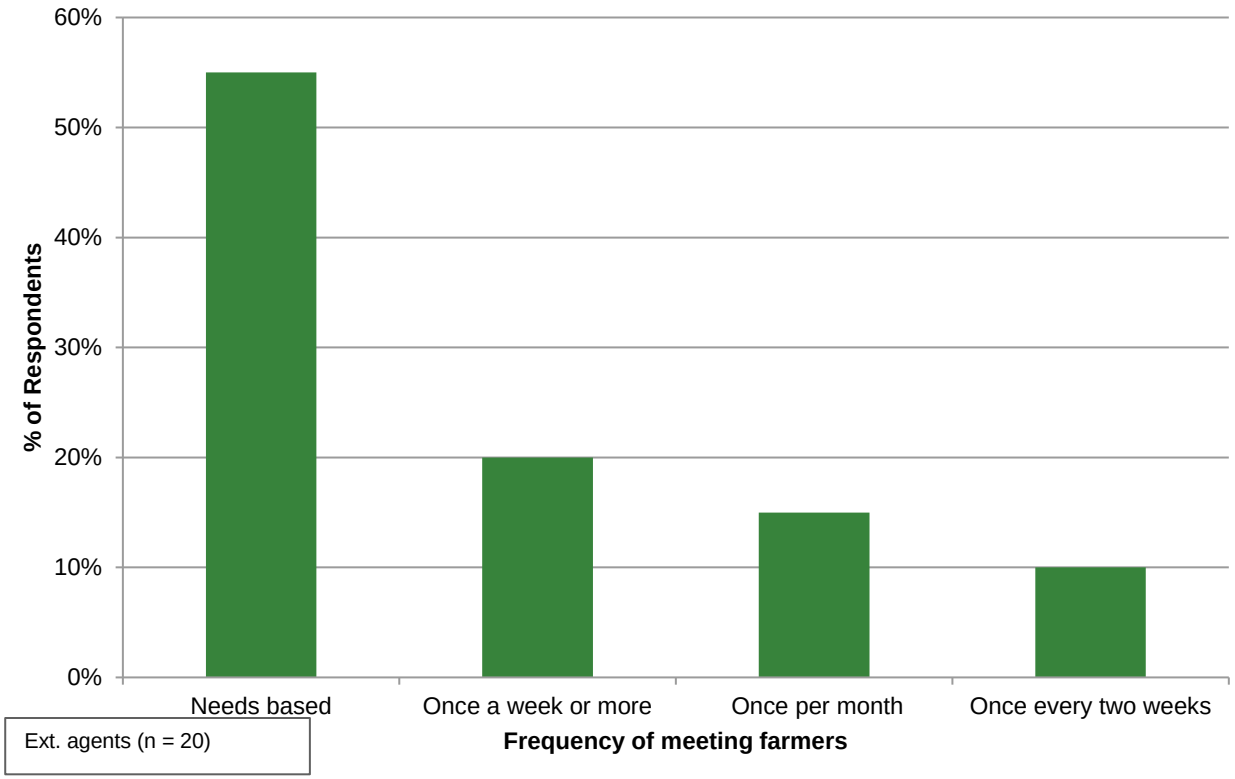


Figure 29: Frequency of meetings held by extension agents with farmers

Other than sweet potato, the extension agents in the study area reported working on other crops, including maize (85%), beans (70%), vegetables (65%), banana (45%) and cassava (45%) (Figure 31). Three of the major crops that the extension agents reported working on, , namely sweet potato, vegetables and beans, were predominantly grown by female farmers, while sugarcane and banana were predominantly cultivated by male farmers. On the other hand, maize was cultivated equally by farmers of either sex (Figure 32).

Regarding the national laws and regulations relating to pesticide use, a majority of the extension agents seemed aware of their existence. In particular, most of the extension agents indicated knowledge of the existence of a number of regulations, including a regulation limiting the

availability of pesticides that are sold to the general public through non-specialised outlets, a regulation prohibiting the repackaging of pesticides in inappropriate containers, a regulation prohibiting the sale of pesticides that are not properly labelled, and a policy promoting the use of suitable PPE (Figure 33). On the other hand, most of the extension agents were not aware of the existence of subsidy schemes for pesticides, PPE, BCAs, and lower-risk pesticide alternatives. On the implementation front, most of the extension agents felt a lot still needs to be done, particularly when it comes to the implementation of policies and subsidy schemes relating to pesticide use and handling.

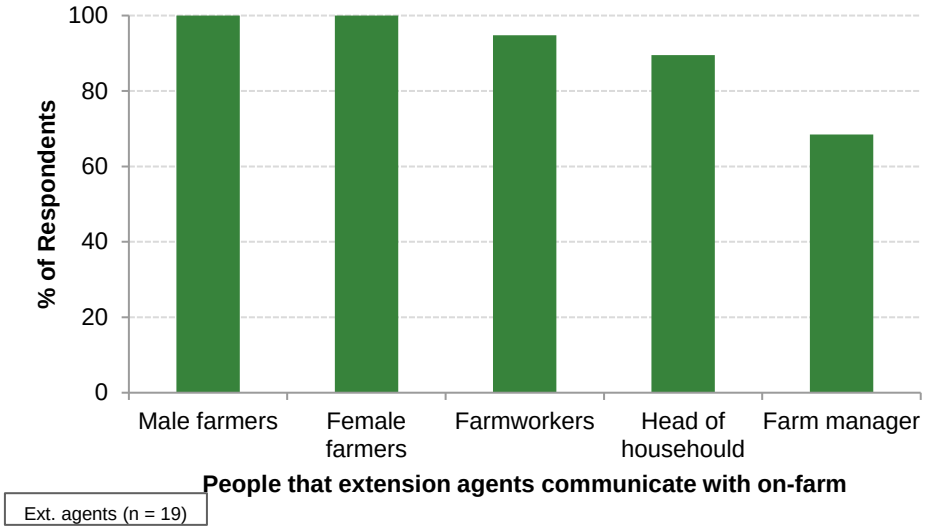


Figure 30: People that extension agents communicate with on-farm

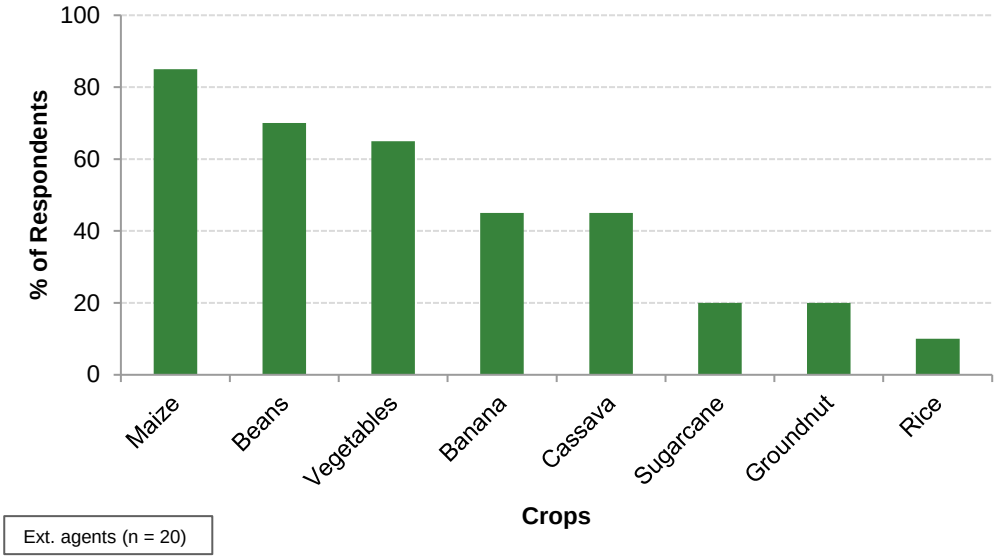


Figure 31: Crops that extension agents work with in the study area

Figure 32: Crops grown by gender

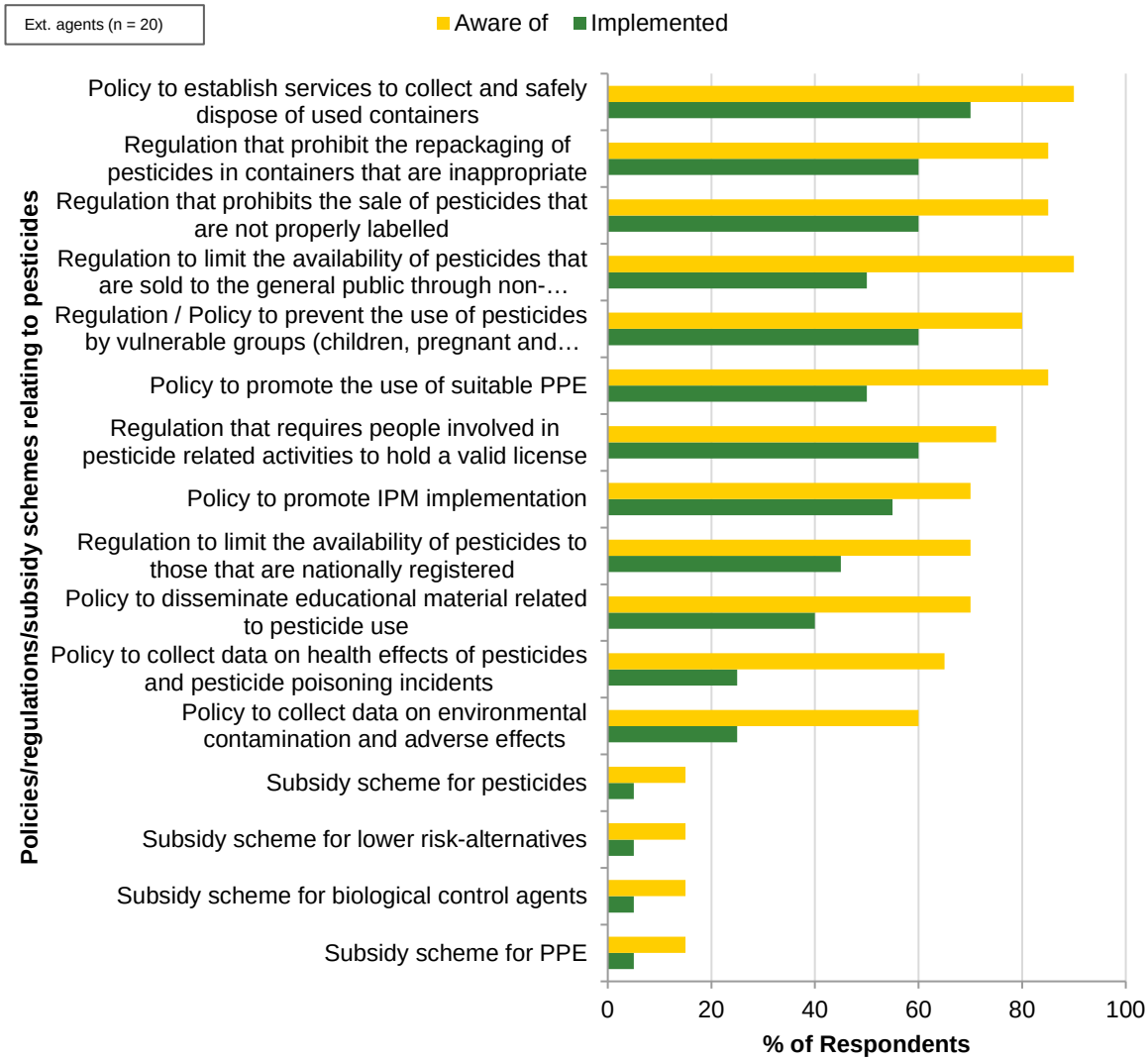


Figure 33: Awareness of, and implementation of policies/regulations/subsidy schemes relating to pesticides

Conclusions and recommendations

A legal framework exists for pest and pesticide management at the national level, but its application in specific circumstances and with particular reference to sweet potatoes was not clear. In order for efforts aimed at improving sweet potato production to succeed, stakeholders must be encouraged to uphold the existing policies. This could encourage sweet potato production that meets national and international standards, such as Kenya GAP and Global GAP.

The use of improved sweet potato production materials/seeds was limited in the study area. It is necessary to facilitate the use of improved seeds to mitigate some biotic constraints. This could be through enhanced collaboration with other institutions and stakeholders involved in production. GIAE Kenya is working with KALRO-Kakamega to provide high quality planting materials. To promote this ideal, farmer seed producers should be encouraged through the requisite trainings.

Farmer knowledge of pests and pesticides as well as their management practices was limited. This calls for more training and/or awareness creation amongst the farmers with respect to pests and diseases in sweet potatoes together with pest and disease management practices. Although GIAE Kenya in collaboration with KALRO have developed a technical training manual for trainers on good agricultural practices on sweet potato production, more efforts are required to impart the necessary skills to the farmers. To help address this issue, a possible collaboration could be sought between GIAE Kenya and Plantwise Kenya.

Plantwise is a global program led by CABI, which works to help farmers lose less of what they grow. The program, working closely with national agricultural advisory services, supports the establishment of networks of community-based plant clinics where farmers can find practical plant health advice. Plant clinics, working in the same way as human health clinics, enhance the visibility of rural advisory services to farmers and can increase contact between farmers and advisors. Operating as a demand-driven extension tool, plant health clinics run either one day a week or fortnightly in locations readily accessible to smallholder farmers. The farmer brings a sample of the affected crop to the plant clinic, discusses the problem with an experienced agricultural extension officer (also referred to as a “plant doctor”) and receives a diagnosis of the plant health problem (including issues relating to soil fertility and plant nutrition) affecting his or her crop. In addition, the farmer receives a written and verbal recommendation for managing the problem. The plant doctors are trained to offer sustainable plant health management advice to farmers following the principles of IPM.

There was some limited use of pesticides in sweet potato production but this usage was not in accordance with the standards required for the economical and safe use of pesticides. This may be as a result of lack of awareness among farmers as well as those providing them with advice (extension agents, retailers etc.). This could therefore be addressed through targeted training of extension agents, farmers and agro-input suppliers in the study area. Additionally, since sweet potato farmers are also involved in the production of other crops, some of which are heavily dependent on pesticide use, it is not surprising that farmers transfer some of the practices of pesticide use employed in other production systems into sweet potato production. In light of all these issues, measures to promote safe use of pesticides are necessary both at the demand and supply side:

- Demand side interventions include the need for specialised farmer education relating to pesticide use. Alongside this there is also a need for consumer education, which could lead to increased consumer desire for and purchase of sweet potatoes that have been cultivated using pesticides appropriately. This in turn, will influence farmers’ choice and use of appropriate pesticides.
- Supply side interventions include those measures which would increase the availability of services to encourage the proper use of pesticides by farmers. These entail the requirement for quality control regimes to control the content of pesticides labels and the distribution of pesticides, including the format in which instructions are communicated to farmers.

Alongside all these measures, farmers must be encouraged to use personal protection equipment appropriately. Farmers and extension agents currently display a low awareness of the meaning of pesticide safety labels, and this warrants concerted training measures for both extension officers and farmers to ensure that they are using pesticides safely.

Information on GAP/GCM and other voluntary standards applied to sweet potato is low, suggesting that efforts should be focussed on creating awareness. This could lead to the creation of niche markets for sweet potato production undertaken according to these standards. There was a drive towards use of integrated pest management (IPM) practices but limited efforts were demonstrated by both extension officers and farmers. Among the pitfalls was the fact that some of the practices were considered to be cumbersome and slow acting. To combat these ideas training should be given to farmers on agro-ecological system analysis that will encourage timely monitoring and hence early control, which would in turn improve the effectiveness of IPM. Farmers should be trained in a variety of pest and disease management options to allow them to select the best methods according to their farm capacity and environmental conditions. This training should be aligned to the Integrated Pest Management Framework (IPMF).

Exchange of information among organisations involved in pesticide management should be enhanced to enforce safe and economical use where needed. As an example, the agrochemical association of Kenya has initiated a system on a trial basis to collect and incinerate or reuse empty pesticide containers. Such efforts could be complemented by further involvement of other institutions associated with pests and pesticide management.

There is high potential for sweet potato production in Kenya. This is due to favourable cultivation conditions, increasing demand for the product and relatively an unsaturated market. This warrants facilitating farmers to undertake good sweet potato pest management practices through training on identification of pests, integrated pest management and rational/safe use of pesticides where necessary to increase productivity.

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Annexes

Annex I. National overview of the legal framework for pesticide use

Adherence to and implementation of international agreements relating to pesticides	
The country is a party to the Montreal Protocol	✓
The country has enacted provisions relating to the implementation of the Montreal Protocol	✓
The country is a party to the Rotterdam Convention	✓
The country has enacted provisions relating to the implementation of the Rotterdam Convention	✓
The country is a party to the Stockholm Convention	✓
The country has enacted provisions relating to the implementation of the Stockholm Convention	✓
The country is a party to the Basel Convention	✓
The country has enacted provisions relating to the implementation of the Basel Convention	✓
The country is a party of the International Labour Organisation Safety and Health in Agriculture Convention (C184)	X
The country has enacted provisions relating to the implementation of the International Labour Organisation Safety and Health in Agriculture Convention (C184)	X
Policies to promote reductions in unnecessary pesticide use, such as policies on IPM, GAP, organic production and sustainable agriculture	
A policy is in place to develop and promote the use of IPM	✓
A policy is in place to promote the adoption of GAP, organic production and/or sustainable agriculture standards	✓
A policy is in place to facilitate access to information on matters including pesticide hazards and risks, residues in food, IPM/IVM, alternatives to highly hazardous pesticides and related regulatory and policy actions	X
The country's policies to achieve the sustainable use of pesticides include quantitative objectives, targets, measures, timetables or indicators to reduce risks and impacts in parallel with the requirements of the EU directive 2009/128/EC (National Action Plan for the Sustainable Use of Plant Protection Products/Biocides (NAPS)).	X
Research	
A policy is in place to encourage and promote research on alternatives to existing pesticides that pose fewer risks, such as non-chemical preventive and direct control measures.	✓
Regulations related to the manufacture of pesticides	

A regulation addressing the manufacture and packaging of pesticides exists:	✓
• It defines appropriate engineering standards and operating practices, including quality-assurance procedures.	✓
• It defines necessary precautions to protect workers	✓
• It ensures the proper siting of plants and stores, monitoring and control of wastes, emissions and effluents	✓
• It ensures that packaging or repackaging is carried out only on licensed premises that comply with safety standards	✓
• It contains provisions for poisoning cases	✓
• It ensures that lists of banned pesticides for manufacture are in harmony with the country's international obligations	✓
Legal framework for non-chemical preventive and direct control measures	
Registration is required for non-chemical preventive and direct control measures	✓
A subsidy scheme for non-chemical preventative and curative control methods is in place.	X
Price and trade policy, including subsidies	
Distribution and trade is a market-driven supply process / there is no government purchasing	✓
A subsidy scheme for pesticides is in place.	X
• The subsidy scheme could potentially lead to excessive or unjustified pesticide use and may divert interest from more sustainable alternative measures	X
• There are subsidies for pesticides for field applications	X
• There are subsidies for pesticides for treatment of seed/planting material	X
• There are subsidies for pesticides for treatment of seed/planting material and/or for post-harvest applications	X
• The subsidy scheme is restricted to lower risk alternatives	X
A subsidy scheme for personal protective equipment (PPE) is in place	X
Registration (synthetic pesticides and biopesticides)	
The legislation establishes a mandatory registration system for pesticides, tailored to national needs	✓
The registration process involves the risk-based evaluation of comprehensive scientific data demonstrating that the product is effective for its intended purposes and does not pose an unacceptable risk to human or animal health or the environment	✓
The legislation identifies the body responsible for registration	✓

The legislation sets out the powers and functions of the registration body	✓
There is a mechanism in place for regional coordination/harmonization for the registration of pesticides	X
The legislation indicates how the registration body will make its registration decisions	✓
The legislation lists the types of final decisions the registration body can take	✓
The legislation indicates that the decision must be communicated to the applicant, within a certain time period, and must include a justification based on the decision criteria	✓
The legislation clearly defines the activities and types of pesticides requiring registration (e.g. all pesticide uses, or a subset)	✓
• There are special requirements for products used on seed/plant material	X
• There are special requirements for products used for post-harvest application	X
• There are special requirements for non-chemical preventative and curative control methods	✓
• There are provisions for experimental permits for the importation of limited quantities of unregistered pesticides for research, education or registration purposes	✓
• There are provisions for use of unregistered pesticides in emergency situations	✓
Low toxicity/low risk pesticides are defined	✓
The regulation provides a definition for what biopesticides/biocontrol agents are	✓
The legislation addressing registration contains a system designed to encourage the use of fewer or less toxic pesticides	✓
• Fewer data requirements for less toxic products alternatives	✓
• Special process for biopesticides (or an equivalent grouping for pesticides of natural origin under a different name, e.g. “biocontrol agents”	✓
• Accelerated process or lower fees for registration of less toxic products	X
• New pesticides can only be registered if they replace more toxic pesticide products used for the same purpose	X
The legislation provides for distinct registration pathways for biopesticides or biological control agents and chemical pesticides	✓
• The data requirements for biopesticides / biological control agents include:	✓
o Identity, biology and ecology of the agent	✓
o Information for assessment of safety and effects on human health	✓
o Information for assessment of environmental risks	✓

o Information for assessment of efficacy, quality control and benefits of use	✓
o Toxicity for humans and the environments of additives (for microbial biological control agents only)	✓
The legislation contains other provisions aimed at facilitating the registration of biopesticides/biological control agents	✓
The legislation indicates the validity period for registrations	✓
The legislation describes procedures for denial of registration and appeal	✓
The legislation describes requirements for label extension	✓
The legislation provides for review of registered pesticides and empowers the registration body to impose new conditions in view of new information	✓
The legislation describes requires mandatory re-registration at specified intervals	✓
The legislation assigns responsibility for keeping records	✓
The legislation includes provisions ensuring confidentiality of trade secrets.	X
A pesticide register compiling all registered products is made publicly available by the responsible authority. It contains the following information:	✓
• Trade names of the products	✓
• Registration numbers	✓
• Name(s) of the active ingredient(s)	✓
• Concentration of the active ingredient(s)	✓
• Formulation type	✓
• Authorized uses including crops and target pests	✓
• The name of the registrant	✓
• The period of registration	✓
• User groups are identified (e.g. use of some pesticides is restricted, e.g. to certified professionals);	✓
A separate list containing the pesticide products that are banned or severely restricted is published by the national authority. Likewise, biopesticides are identified in a separate list.	✓
Analysis of registered pesticide list for highly hazardous pesticides and alternatives	
List the time of last update	✓

The number of AI registered	✓
The number of products registered	✓
The number of registrants	✓
For the banned list, the last time it was updated, the number (and identity) of the banned pesticides	✓
Biocontrol agents which are not covered by the national authority handling registration of pesticides, e.g. macro-organisms	
The legislation contains provisions addressing export, shipment, import and release of biological control agents and other beneficial organisms. It contains the following requirements:	✓
• To carry out pest risk analysis of biological control agents	✓
• To obtain, provide and assess documentation as appropriate, relevant to the export, shipment, import or release of biological control agents and other beneficial organisms	✓
• To ensure that biological control agents and other beneficial organisms are taken either directly to designated quarantine facilities or mass-rearing facilities or, if appropriate, passed directly for release into the environment	✓
• To encourage monitoring of release of biological control agents or beneficial organisms in order to assess impact on target and non-target organisms	✓
Packaging and Labelling	
The legislation specifies the products to which the packaging and labelling requirements apply (e.g. apply equally to imported and domestically manufacturer products)	X
The legislation specifies the technical requirements for packaging and re-packaging	✓
The legislation incorporates requirements for packaging and labelling into the registration process	✓
The legislation requires packaging that is safe	✓
The legislation requires packaging which will not degrade under normal conditions (e.g. packaging material should be impermeable to contents)	✓
The legislation requires packaging which does not resemble common packaging of consumable goods,	X
The legislation requires that packaging or re-packaging only takes place on licensed premises where staff are adequately protected	X
The legislation bans re-packaging when effective controls are not possible in the national context	X
The legislation prohibits the re-packaging or decanting of pesticide into food or drink or other inappropriate containers	✓
The legislation prohibits reuse of containers except under exceptional circumstances (e.g. where there is a programme in place to refill containers)	X
The legislation requires that an officially approved label is a mandatory part of the product package	✓

The legislation lists the information which is required on the label	
• Product name	✓
• Use type	✓
• Type of formulation	✓
• Active ingredient name	✓
• Active ingredient concentration	✓
• Co-formulants	✓
• Net content	✓
• Name of supplier	✓
• Manufacturer	✓
• Batch number	✓
• Registration number	✓
• Hazard and safety information following the Globally Harmonized System of Classification and Labelling of Chemicals (GHS)	✓
• Directions for use	✓
• Warning against container reuse, instructions for storage and disposal	
• Legal requirement that pesticides be used in a way consistent with the label	✓
The legislation lists how the information in the label should be communicated (languages, system of weights and measures…)	✓
The legislation outlines physical requirements of the label, e.g. minimum size of packaging, use of a durable material, fade resistant ink	✓
A handbook or manual is available to guide label design and/or review	✓
Marketing	
The legislation contains provisions specifically addressing pesticide advertising	✓
• It defines pesticide advertising broadly to cover all forms;	X
• It prohibits the advertising of unregistered or illegal pesticides	X

• It prohibits false or misleading advertising of pesticides	✓
• It prohibits advertising contrary to approved uses or label instructions	X
• It designates the authority responsible for enforcement	X
Transport	
A regulation addressing the transport of pesticides is in place	✓
• It sets out requirements for vehicles and containers	✓
• It prohibits the transport of pesticides in the same vehicle as passengers, animals, food or feed	✓
• It requires physical separation in cases where joint transport or storage is unavoidable	✓
Import and export	
The legislation contains provisions specifically addressing the import and export of pesticides	✓
• It prohibits the import/export of pesticides that have not been registered	✓
• It prohibits import/export of counterfeit, substandard or outdated pesticides, or of pesticides otherwise not meeting the prescribed requirements	✓
• It establishes application procedures for a pesticide import permit	✓
• It develops procedures and criteria for decisions on import permits	
• It requires inspection of pesticides at the point of entry	✓
• It fosters collaboration between the competent national authority and the customs department at points of entry	✓
• It establishes exceptions for donations or imports by public entities for specific purposes	✓
• It requires that exported pesticides meet the same quality standards as comparable domestic ones	X
• It requires the use of Harmonized System customs codes on shipping documents	X
Requirements for sale	
The legislation contains provisions specifically addressing the sale of pesticides	✓
• It sets requirements so that only those with competency and training may be licensed to sell pesticides	✓
• It includes among the decision-making criteria for the grant of a licence issues such as storage, display, training, knowledge, record-keeping, safety equipment and emergency plans.	✓

• It prescribes the separation of pesticides from food and medicine	✓
• It prescribes that a pesticide may only be sold in its undamaged original container	X
• It prescribes that pesticides may only be sold with a readable label	✓
• It prescribes that pesticides must not be sold to minors	X
• It prescribes that shops that sell pesticides must have firefighting equipment	X
• It prescribes that shops that sell pesticides must have a warning board	✓
Licensing	
The legislation contains provisions to identify which pesticide-related activities are permitted only to operators that hold a valid license	✓
• It prescribes that a valid license must be held for manufacture and packaging	✓
• It prescribes that a valid license must be held for sale	✓
• It prescribes that a valid license must be held for transportation, import and export	✓
• It prescribes that a valid license must be held for special applications	✓
• It imposes specific and more restrictive requirements for severely restricted pesticides	✓
• It provides for back up inspections	✓
• It establishes a system to receive and evaluate applications, in order to assess risk	✓
• It sets out clear criteria for the grant or denial of the licence, as well as provisions for imposition of conditions, suspension and revocation	✓
• It establishes the term of validity and the procedures for the renewal of the licence	✓
• It enables the authority to impose fees for services associated with licensing; and	✓
• It sets out an appeal process linked to the licensing scheme	✓
Availability	
The legislation contains provisions to regulate the availability and use of pesticides in accordance with the hazards involved and the existing levels of user training	X
• It takes into account the type of formulation, method of application and its uses when determining the risk and degree of restriction appropriate to the product	X
• It contains provisions to limit the availability of pesticides that are sold to the general public through non-specialized outlets	X

• It contains restrictions which specifically target products used on seed/planting material.	X
• It contains restrictions which specifically target products used for post-harvest applications	X
Handling and use, including regulations on application equipment	
The legislation contains provisions to prohibit the use of pesticides for a purpose, or in a manner, other than that prescribed on the label	X
Responsibilities of pesticide operators (farmers and farmer workers) are identified in national regulations, e.g. to follow safety and hygiene norms, to follow recommendations relating to PPE use, to take reasonable precautions, to report risks	X
The legislation requires employers to take the necessary measures to protect the health of workers and the environment.	✓
• The required measures include provision of training	✓
• The required measures include provision of protective equipment	✓
• The required measures include health monitoring of the workers	✓
The legislation ensures that all workers, including those in agriculture, are protected under the legal framework	X
The legislation contains provisions to promote the use of pesticide application methods and/or equipment that minimize the risks	X
The legislation contains provisions to permit pesticide application equipment and PPE to be marketed only if they comply with established standards	X
The legislation contains provisions to prescribe the use of proper application equipment	X
• Ensuring the recommended application is used	X
• Appropriate calibration of the spraying equipment for the pesticides to be applied	X
The legislation contains provisions to prescribe the responsible cleaning of application equipment	X
• To rinse the content of the tank with fresh water and to apply the remaining liquid on the treated field	X
• Application equipment must be rinsed externally in the field	X
The legislation contains any other provision to prohibit the use of pesticides in an unsafe manner that poses a threat to human health or the environment	X
Requirements for training	
A policy is in place to produce and disseminate relevant and clear educational materials on pesticide use and management	X
The legislation requires pest control operators to hold a license or permit	X
• For all products and application methods	X

• Only for specific products application methods	X
The content of the mandatory trainings is described in the law	X
Restrictions related to vulnerable groups	
The legislation contains any provision to prevent the use of pesticides by, and sale of pesticides to, children or pregnant and nursing women	X
The legislation requires employers to take the necessary measures to prevent use by children and other vulnerable groups	✓
Requirements for PPE	
A policy is in place to place to promote the use of PPE which is suitable.	✓
The legislation prescribes the use of PPE for the application of pesticides	X
• Operator risk and exposure is assessed at the time of registration in order to determine the PPE performance requirements	X
• Application of international standards (e.g. ISO 27065) or national standards for the classification of PPE by performance requirements (level of chemical resistance or some other measure to differentiate the level of protection provided by PPE)	X
• Only PPE which has met national standards may be marketed	X
• The label is required to list the elements of PPE (e.g. gloves, protective footwear, face protection, apron) and their performance requirements	X
• Responsibilities of pesticide operators (farmers and farm workers) are identified in national regulations, e.g. to follow safety and hygiene norms, to follow recommendations relating to PPE use, to take reasonable precautions, to report risks	X
Storage	
The legislation makes provisions for the safe storage of pesticides	X
• It differentiates between private, end-user or home storage and bulk or commercial storage	X
• It imposes record-keeping requirements on those storing pesticides	✓
• It prohibits the reuse of a pesticide container for any non-pesticide storage reason	X
• It indicates the type of containers required	✓
• The legislation specifies how and where pesticide products may be stored	✓
o The plant protection products are stored in their original containers and packs	X
o The plant protection products are stored according to label storage requirements	✓
o The plant protection products that are liquid formulations are stored on shelving that is never above those products that are powder or granular formulations	X

o The plant protection product storage facilities are built in a manner that is structurally sound and robust	✓
o The plant protection product storage facilities have sufficient and constant ventilation of fresh air to avoid a build-up of harmful vapours	✓
o The plant protection product storage facilities have, or are located in areas with, sufficient illumination by natural or artificial lighting to ensure that all product labels can be easily read while on the shelves.	✓
o The plant protection product storage facilities are equipped with shelving that is not absorbent, in case of spillage	X
o The plant protection product storage facilities have retaining tanks or products are bundled according to 110% of the volume of the largest container of stored liquid, to ensure that there cannot be any leakage, seepage or contamination to the exterior of the facility	X
o The plant protection product storage facilities and all designated fixed filling/mixing areas are equipped with a container of absorbent inert material, such as sand, a floor brush and dustpan, and plastic bags that must be in a fixed location to be used exclusively in case of spillage of plant protection products	X
o An accident procedure including emergency contact telephone numbers shall visually display the basic steps of primary accident care and must be accessible by all persons within 10 meters of the plant protection product/chemical storage facilities and designated mixing areas	✓
o All plant protection product/chemical storage facilities and all filling/mixing areas have eye washing amenities, a source of clean water at a distance no farther than 10 meters, and a first aid kit containing the relevant aid material	✓
Disposal of unused pesticides	
A policy is in place to prevent the accumulation of obsolete pesticides and used containers	✓
A policy is in place to inventory obsolete or unusable stocks of pesticides and used containers, and to establish and implement an action plan for their disposal	X
The legislation contains provisions to ensure that disposal of hazardous pesticide waste is carried out in an environmentally sound manner	✓
The legislation bans certain types of activities in relation to pesticide waste (e.g. pouring it down drains or into water sources, burying it in unapproved sites and burning it in unapproved incinerators)	X
The legislation places affirmative duties on industry to assist in proper disposal	X
The legislation requires any person or entity seeking to dispose of pesticides or pesticide waste to seek authorization from the competent authority	✓
The legislation contains provisions for the implementation of a toxic waste collection scheme	X
The legislation contains provisions for the establishment of facilities for the management of bulk quantities of toxic waste	✓
Disposal of empty pesticide containers	
The regulation addresses the disposal of pesticide containers	✓
• The regulations governing disposal of empty pesticide containers is the same across the country	✓
• Appropriate PPE is required when handling empty pesticide containers	✓

• Cleaning the container before final disposal is the responsibility of the person disposing of the container	X
• When a metal, plastic or glass pesticide container is empty, it should be immediately triple-rinsed (or pressure washed) with the resulting residue from the pesticide container being added to the spray tank for application	✓
• After rinsing, the container should be rendered unusable by puncturing, crushing or breaking	✓
• The regulation contains specifications for the storage conditions of empty pesticide containers (e.g. bagged, stored in secure, ventilated location)	X
• The regulation bans the re-use of empty pesticide containers	X
• Burying empty pesticide containers is prohibited. Or, if burying is allowed, specifications are provided for how the empty containers should be buried.	✓
• Burning empty pesticide containers is prohibited. Or, if burning is allowed, specifications are provided for how the empty containers should be burned (e.g. to stay out of smoke, information on what should be done with the ash)	✓
• Empty containers are classified as hazardous waste regardless of whether or not they have been decontaminated	✓
• Empty containers must be transported in specially licensed vehicles	X
• Empty containers may not be transported with food, beverages, medicines, feed, animals or people	X
• Users must return containers to the manufacturer, to the place of purchase, or to the place indicated on the invoice issued at the time of purchase	X
• Final disposal of empty pesticide containers must be carried out by authorized companies. Containers must be destroyed at a specialized facility	✓
• The procedure for disposal is described in legislation (recycling (if available), in a sanitary landfill, by incineration…)	✓
• Pesticide waste generators (pesticide users) are required to establish waste management plans for harm reduction	✓
The legislation contains dispositions to establish a container management system	X
Post-registration monitoring	
A policy is in place to collect reliable data and maintain statistics on health effects of pesticides and pesticide poisoning incidents, and on environmental contamination and adverse effects, including the monitoring of pesticide residues in feed, drinking water and/or the environment.	X
• It assigns responsibility for mandatory monitoring and data collection with respect to pesticides	X
• It sets out the powers and responsibilities of the responsible body and the inspection corps with regard to information-gathering	X
• It imposes reporting requirements on manufacturers, importers, distributors and sellers of pesticides	X
• It requires reporting of pesticide-related incidents to the competent authority	X
Residue monitoring in food and Maximum Residue Levels (MRLs)	

The legislation contains provisions to regulate and/or monitor pesticide residues in food	X
• It defines which authority is in charge of the monitoring	X
• It defines which authority is in charge of setting the MRLs	X
• It applies for domestic production for national consumption as well as for imports/exports	X
• It applies only for a limited number of export crops	X
• It prescribes to follow the MRLs set by the *Codex Alimentarius*	X
Other relevant human health and environmental protection regulations	
A policy is in place to raise awareness among users about the importance and ways of protecting health and the environment.	✓
A policy is in place to carry out health surveillance programmes of those who are occupationally exposed to pesticides.	X
A policy is in place to provide guidance and instructions to health workers on the diagnosis and treatment of suspected pesticide poisonings.	X
A policy is in place to establish national or regional poisoning information centres	X
Compliance and enforcement	
The legislation contains provisions to prohibit the import, packaging, repackaging, transportation, distribution or sale of a pesticide unless it is packaged in accordance with criteria provided in the law	✓
The legislation contains provisions to detect and control counterfeiting and illegal trade in pesticides	X
The legislation contains provisions to facilitate the exchange of information (e.g. actions taken to ban or severely restrict a pesticide; scientific, technical, economic, regulatory and legal information; the availability of resources and expertise; cases of counterfeit and illegal pesticides being traded; poisoning and environmental contamination incidents data) between regulatory and implementing authorities	X
The legislation designates the national authority responsible for inspection	✓
• It defines the powers of the inspectors	✓
The legislation provides procedures and criteria for inspections	✓
• It provides procedures and requirements for sample taking	✓
• It contains provisions for the designation of official laboratories for analysis of samples	✓
• It provides clear and effective procedures for intervention if irregularities are found during inspections	✓
• It defines the actions that will be considered as offences, including special offences for public officials	✓

• It determines which offences will be criminal and which administrative	X
• It determines proportional and deterrent fines and includes mechanisms to adapt the fines if their value declines	✓
• It defines other consequences of the infringement, such as the revocation of a licence or forfeiture of materials used in connection with the commission of the offence	✓

Annex II. List of HHP AI registered for use in Kenya

Highly Hazardous Pesticide Active Ingredients	Chemical class	Use Type	HHP1 Acute toxicity	HHP2 Carcinogenicity	HHP3 Mutagenicity	HHP4 Reproductive toxin	HHP 5 POP	HHP 6 PIC	HHP 7 ODS	PAN HHP	EU Approved	GIZ Classification	Number of products registered
Abamectin	Macrocyclic Lactone - avermectin	Insecticide	1	N	N	2	N	N	N	Y	Approved	B	81
Aluminum Phosphide	Fumigant	Insecticide, Rodenticides	1	N	N	N	N	N	N	Y	Approved	B	36
Beta-Cyfluthrin	Pyrethroid	Insecticide	1B	N	N	2	N	N	N	Y	Approved	A	27
Bromadiolone	Coumarin	Rodenticide	1A	N	N	N	N	N	N	Y	Approved	A	4
Cadusafos	Organophosphorus	Insecticide	1B	N	N	N	N	N	N	Y	Not listed	A	1
Captan	Phthalimide	Fungicide	U	1B	N	N	N	N	N	N	Approved	B	8
Carbaryl	Carbamate	Insecticide	2	1B	N	N	N	N	N	Y	Not Approved	B	12
Carbendazim	Benzimidazole	Fungicide	U	2	1A / 1B	1A / 1B	N	N	N	Y	Not Approved	A	38
Carbofuran	Carbamate	Insecticide, Nematicide	1B	N	2	N	N	Y	N	Y	Not Approved	A	4
Chlorothalonil	Aromatic fungicide	Fungicide, Oomycide	U	1B	N	N	N	N	N	Y	Approved	B	41
Citric Acid	Biopesticide - botanical	Fungicide, Insecticide, Repellant	3	1A / 1B	1A / 1B	1A / 1B	N	N	N	N	Not listed	#N/A	2
Copper Sulfate	Inorganic - copper	Fungicide, Oomycide, Bactericide	2	1A / 1B	N	N	N	N	N	N	Approved	C	4
Daminozide	Growth retardant	plant growth regulator	U	1B	N	N	N	N	N	Y	Approved	B	2
Ddt	Organochlorine	Insecticide, Acaricide	2	2	N	N	Y	Y	N	Y	Not Approved	A	2
Diazinon	Organophosphorus	Insecticide	2	1B	N	1B	N	N	N	Y	Not Approved	B	13
Dichlorvos (Ddvp)	Organophosphorus	Insecticide, Acaricide	1B	2	N	N	N	N	N	Y	Not Approved	A	24
Diclofop-Methyl	Phenoxy	Herbicide	2	1B	N	1A / 1B	N	N	N	Y	Approved	B	2
Diuron	Urea	Herbicide	3	1B	N	N	N	N	N	Y	Approved	B	33
Epoxiconazole	Triazole	Fungicide	N	1B	N	1A / 1B	N	N	N	Y	Approved	A	17
Ethoprop	Organophosphorus	Insecticide, Nematicide	1A	1B	N	N	N	N	N	Y	Approved	A	12
Fenamiphos	Organophosphorus	Insecticide, Nematicide	1B	N	N	N	N	N	N	Y	Not listed	A	8
Fenchlorazole-Ethyl	Safener	Herbicide	N	1B	N	N	N	N	N	Y	Not PPP	A	1

Highly Hazardous Pesticide Active Ingredients	Chemical class	Use Type	HHP1 Acute toxicity	HHP2 Carcinogenicity	HHP3 Mutagenicity	HHP4 Reproductive toxin	HHP 5 POP	HHP 6 PIC	HHP 7 ODS	PAN HHP	EU Approved	GIZ Classification	Number of products registered
Flusilazole	Triazole	fungicide	2	2	N	1A / 1B	N	N	N	Y	Not Approved	A	8
Fosthiazate	Organophosphorus	Nematicide	N	N	N	1A / 1B	N	N	N	Y	Approved	B	3
Furfural	Unclassified	Fungicide, Nematicide	N	1B	N	N	N	N	N	N	Not Approved	B	4
Glufosinate Ammonium	Organophosphorus	Herbicide	N	N	N	1A / 1B	N	N	N	Y	Not listed	A	2
Haloxyfop-P-Methyl	Phenoxy	Herbicide	2	1B	N	N	N	N	N	Y	Approved	B	1
Hexythiazox	Thiazolidine	Acaricide	U	1B	N	N	N	N	N	Y	Approved	B	8
Hydramethylnon	Unclassified	Insecticide	2	N	N	1B	N	N	N	N	Not Approved	B	3
Imazalil	Conazole	Fungicide	2	1B	N	N	N	N	N	Y	Approved	B	2
Iprodione	Dicarboximide	Fungicide	3	1B	N	N	N	N	N	Y	Approved	B	14
Iprovalicarb	Carbamate	Fungicide	U	1B	-	N	N	N	N	Y	Approved	B	4
Isoprene	Trap	Rodenticide	N	1B	2	N	N	N	N	N	Not listed	#N/A	1
Isoxaflutole	Oxazole	Herbicide	N	1B	N	2	N	N	N	Y	Approved	B	12
Kresoxim-Methyl	Strobilurin	Fungicide	N	1B	N	N	N	N	N	Y	Approved	B	6
Linuron	Urea	Herbicide	3	2	N	1A / 1B	N	N	N	Y	Not Approved	A	3
Magnesium Phosphide	Fumigant	Insecticide	1	N	N	N	N	N	N	Y	Approved	B	6
Mancozeb	Dithiocarbamate	Fungicide, Oomycide	U	1B		2	N	N	N	Y	Approved	B	157
Metam-Sodium	Dithiocarbamate	Fungicide, herbicide, nematicide	2	1B	N	N	N	N	N	Y	Approved	B	9
Methiocarb	Carbamate	Insecticide, Molluscicide	1B	N	N	N	N	N	N	Y	Approved	A	5
Methomyl	Carbamate	Insecticide	1B	N	N	N	N	N	N	Y	Approved	A	20
Omethoate	Organophosphorus	Insecticide	1B	N	N	N	N	N	N	Y	Not Approved	A	1
Oxamyl	Carbamate	Insecticide, Nematicide	1B	N	N	N	N	N	N	Y	Approved	A	18
Oxydemeton-Methyl	Organophosphorus	Insecticide	1B	N	2	2	N	N	N	Y	Not Approved	A	2
Oxyfluorfen	Diphenyl ether	Herbicide	U	1B	N	N	N	N	N	Y	Approved	B	12
Permethrin	Pyrethroid	Insecticide	2	1B	N	N	N	N	N	Y	Not Approved	B	62
Pirimicarb	Carbamate	Insecticide	2	1B	N	N	N	N	N	Y	Approved	B	4

Highly Hazardous Pesticide Active Ingredients	Chemical class	Use Type	HHP1 Acute toxicity	HHP2 Carcinogenicity	HHP3 Mutagenicity	HHP4 Reproductive toxin	HHP 5 POP	HHP 6 PIC	HHP 7 ODS	PAN HHP	EU Approved	GIZ Classification	Number of products registered
Procymidone	Dicarboximide	fungicide	U	1B	N	N	N	N	N	Y	Not Approved	B	3
Propargite	Sulfite ester	Acaricide	3	1B	N	N	N	N	N	Y	Not Approved	B	4
Propineb	Dithiocarbamate	Fungicide, Oomycide	U	1B	N	2	N	N	N	N	Approved	D	15
Pymetrozine	Organophosphorus - pyridine	Insecticide	N	2	N	N	N	N	N	Y	Approved	B	3
Quizalofop-P-Tefuryl	Phenoxy	Herbicide	2	N	2	1A / 1B	N	N	N	Y	Approved	A	3
Thiabendazole	Benzimidazole	Fungicide	3	1B	N	1A / 1B	N	N	N	N	Approved	B	6
Thiacloprid	Neonicotinoid	Insecticide	2	1B	N	2	N	N	N	Y	Approved	B	6
Thiophanate-Methyl	Benzamidazole	Fungicide	U	1B	2	2	N	N	N	Y	Approved	B	8
Thiodicarb	Carbamate	Insecticide, Molluscicide	N	1B	N	2	N	N	N	Y	Not Approved	B	1
Topramezone	Pyrazole	Herbicide	-	N	N	1A / 1B	N	N	N	N	Pending	NA	1
Triadimefon	Triazole	Fungicide	N	2	N	1B	N	N	N	N	Not Approved	B	4
Trichlorfon	Organophosphorus	Insecticide	2	1B	N	N	N	N	N	Y	Not Approved	B	1
Triforine	Amide	fungicide	U	N	N	1B	N	N	N	N	Not Approved	B	1
Zeta-Cypermethrin	Pyrethroid	Insecticide	1B	2	-	-	N	N	N	Y	Approved	A	3

Annex III. List of AIs registered in Kenya which require exceptional authorisation for recommendation or procurement

Pesticide Active Ingredients	Chemical class	Use Type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU	Number of products registered
1,3-Dichloropropene	Fumigant	Nematicide	Danger	N	Y	Y	Not Approved	5
Abamectin	Macrocyclic Lactone - avermectin	Insecticide	HHP	N	N	Y	Approved	81
Acephate	Organophosphorus	Insecticide	Danger	N	Y	Y	Not Approved	25
Acetochlor	Chloroacetamide	Herbicide	Warning	N	Y	Y	Not Approved	38
Acrinathrin	Pyrethroid	Insecticide, Acaricide	Warning	N	N	Y	Approved	1
Aluminum Phosphide	Fumigant	Insecticide, Rodenticides	HHP	N	N	Y	Approved	36
Ametryn	Triazine	Herbicide	Danger	N	N	N	Not Approved	20
Aminopyralid	Aromatic acid	Herbicide	Danger	N	Y	N	Approved	1
Amitraz	Formamidine	Insecticide	Danger	N	Y	N	Not Approved	27
Atrazine	Triazine	Herbicide	Warning	N	Y	Y	Not Approved	40
Benzalkonium Chloride	Unclassified	Fungicide; Algicide	Missing data	N	N	N	Not Approved	2
Bifenthrin	Pyrethroid	Insecticide	Danger	N	Y	Y	Approved	20
Bitertanol	Triazole	Fungicide	Danger	N	Y	N	Not Approved	2
Bromacil	Uracil	Herbicide	Warning	N	N	N	Not Approved	6
Bromoxynil Octanoate	Nitrile	Herbicide	Danger	N	Y	Y	Approved	10
Bronopol	Unclassified	Bactericide	Danger	N	N	N	Not Approved	1
Captan	Phthalimide	Fungicide	HHP	N	N	N	Approved	8
Carbaryl	Carbamate	Insecticide	HHP	N	Y	Y	Not Approved	12
Carbosulfan	Carbamate	Insecticide	Danger	N	Y	Y	Not Approved	5
Cartap	Nereistoxin analogue	Insecticide	Warning	N	N	N	Not Approved	8
Chlorantraniliprole	Pyrazole / diamide	Insecticide	Warning	N	N	Y	Approved	5
Chloropicrin	Fumigant	Insecticide, Fungicide, Nematicide	Danger	N	N	Y	Not Approved	2
Chlorothalonil	Aromatic fungicide	Fungicide, Oomycide	HHP	N	N	Y	Approved	41
Chlorpyrifos	Organophosphorus	Insecticide, Acaricide	Danger	N	N	Y	Approved	131
Chlorsulfuron	Urea	Herbicide	Warning	N	Y	N	Approved	3
Clothianidin	Neonicotinoid	Insecticide	Warning	N	N	Y	Approved	7
Copper Hydroxide	Inorganic - copper	Fungicide, Oomycide, Bactericide	Danger	N	N	Y	Approved	13
Cyclanilide	Unclassified	plant growth regulator		N	N	N	Not Approved	1
Cyenopyrafen	Pyrazole	Acaricide	Warning	N	N	N	Not Approved	1
Cyflufenamid	Amide	Fungicide	Missing data	N	N	Y	Approved	1
Cypermethrin	Pyrethroid	Insecticide, Acaricide	Danger	N	N	Y	Approved	151
Daminozide	Growth retardant	plant growth regulator	Warning	N	N	Y	Approved	2
Deltamethrin	Pyrethroid	Insecticide	Danger	N	N	Y	Approved	135
Diafenthiuron	Thiourea	Insecticide, Acaricide	Danger	N	N	Y	Not listed	5

Pesticide Active Ingredients	Chemical class	Use Type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU	Number of products registered
Diazinon	Organophosphorus	Insecticide	HHP	N	Y	Y	Not Approved	13
Diclofop-Methyl	Phenoxy	Herbicide	HHP	N	N	Y	Approved	2
Dicofol	Bridged diphenyl	Acaricide	Danger	N	Y	N	Not Approved	4
Didecyl Dimethyl Ammonium Chloride	Disinfectant	Fungicide, Virucide	Danger	N	N	N	Not Approved	5
Dimethenamid-P	Amide	Herbicide	Warning	N	N	N	Approved	2
Dimethoate	Organophosphorus	Insecticide	Danger	N	N	Y	Approved	48
Dinotefuran	Neonicotinoid	Insecticide	Warning	N	N	Y	Not Approved	1
Diuron	Urea	Herbicide	HHP	N	N	Y	Approved	33
Ethaboxam	Amide	Fungicide	Missing data	N	N	N	Not Approved	1
Etofenprox	Pyrethroid	Insecticide	Danger	N	N	Y	Approved	4
Fenazaquin	Unclassified	Acaricide	Danger	N	N	Y	Approved	4
Fenitrothion	Organophosphorus	Insecticide	Danger	N	Y	Y	Not Approved	26
Fenpropathrin	Pyrethroid	Insecticide	Danger	N	N	Y	Not Approved	2
Fenvalerate	Pyrethroid	Insecticide	Danger	N	N	Y	Not Approved	13
Fipronil	Pyrazole	Insecticide	Danger	N	Y	Y	Not Approved	25
Fluazifop-P-Butyl	Phenoxy	Herbicide	Warning	N	Y	N	Not listed	17
Flufenoxuron	Insect growth regulator	Insecticide, Acaricide	Warning	N	Y	Y	Not Approved	2
Folpet	Phthalimide	Fungicide	Warning	N	Y	Y	Approved	4
Fosthiazate	Organophosphorus	Nematicide	HHP	N	N	Y	Approved	3
Furfural	Unclassified	Fungicide, Nematicide	HHP	N	Y	N	Not Approved	4
Gamma-Cyhalothrin	Pyrethroid	Insecticide	Danger	N	N	Y	Approved	1
Glyphosate	Organophosphorus	Herbicide	HHP	N	N	Y	Approved	243
Haloxyfop-P-Methyl	Phenoxy	Herbicide	Warning	N	N	Y	Approved	35
Hexaconazole	Triazole	Fungicide	Warning	N	N	N	Not Approved	11
Hexazinone	Triazinone	Herbicide	Warning	N	N	N	Not Approved	14
Hexythiazox	Thiazolidine	Acaricide	HHP	N	N	Y	Approved	8
Hydramethylnon	Unclassified	Insecticide	HHP	N	N	N	Not Approved	3
Imazalil	Conazole	Fungicide	HHP	N	Y	Y	Approved	2
Imazapic	Imidazolinone	Herbicide	Warning	N	N	N	Not Approved	3
Imazapyr	Imidazolinone	Herbicide	Warning	N	Y	N	Not Approved	6
Imazethapyr	Imidazolinone	Herbicide	Warning	N	N	N	Not Approved	1
Imidacloprid	Neonicotinoid	Insecticide	Warning	N	N	Y	Approved	162
Indoxacarb	Oxadiazine	Insecticide	Danger	N	N	Y	Approved	37
Ioxynil	Nitrile	Herbicide	Danger	N	N	Y	Not Approved	1
Iprodione	Dicarboximide	Fungicide	HHP	N	N	Y	Approved	14
Iprovalicarb	Carbamate	Fungicide	HHP	N	N	Y	Approved	4
Isoxaflutole	Oxazole	Herbicide	HHP	N	N	Y	Approved	12
Kresoxim-Methyl	Strobilurin	Fungicide	HHP	N	N	Y	Approved	6
Lambda-Cyhalothrin	Pyrethroid	Insecticide	Danger	N	N	Y	Approved	175

Pesticide Active Ingredients	Chemical class	Use Type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU	Number of products registered
Lufenuron	Biochemical biopesticides - Insect Growth Regulators	Insecticide	Warning	N	N	Y	Approved	16
Magnesium Phosphide	Fumigant	Insecticide	HHP	N	N	Y	Approved	6
Malathion	Organophosphorus	Acaricide, Insecticide	HHP	N	Y	Y	Approved	38
Mancozeb	Dithiocarbamate	Fungicide, Oomycide	HHP	N	N	Y	Approved	157
Mandipropamid	Amide	Fungicide	Warning	N	N	N	Approved	1
Metam-Sodium	Dithiocarbamate	Fungicide, herbicide, nematicide	HHP	N	N	Y	Approved	9
Metolachlor	Amide	Herbicide	Danger	N	N	N	Not Approved	31
Metominostrobin	Amide	Fungicide	Warning	N	N	N	Not Approved	1
Metribuzin	Triazinone	Herbicide	Danger	N	N	Y	Approved	34
Milbemectin	Milbemycin	Insecticide, Acaricide	Warning	N	N	Y	Approved	1
Novaluron	Insect growth regulator	Insecticide	Warning	N	N	N	Not Approved	6
Oxyfluorfen	Diphenyl ether	Herbicide	HHP	N	N	Y	Approved	12
Paraquat	Quaternary ammonium	Herbicide	Danger	N	Y	N	Not Approved	15
Paraquat Dichloride	Quaternary ammonium	Herbicide	Danger	N	Y	Y	Not listed	8
Quintozene	Aromatic	Fungicide	Danger	N	Y	N	Not Approved	1
Permethrin	Pyrethroid	Insecticide	HHP	N	Y	Y	Not Approved	62
Picloram	Pyridine	Herbicide	Warning	N	N	Y	Approved	3
Pirimicarb	Carbamate	Insecticide	HHP	N	N	Y	Approved	4
Pirimiphos-Methyl	Fumigant, organophosphorous	Fumigant, Insecticide, Acaricide	Warning	N	N	Y	Approved	54
Polyoxin	Biopesticide - microbial	Fungicide	Missing data	N	N	N	Not Approved	3
Procymidone	Dicarboximide	fungicide	HHP	N	Y	Y	Not Approved	3
Profenofos	Organophosphorus	Insecticide	Danger	N	Y	Y	Not Approved	92
Propanil	Amide	Herbicide	Warning	N	Y	N	Pending	28
Propargite	Sulfite ester	Acaricide	HHP	N	Y	Y	Not Approved	4
Pymetrozine	Organophosphorus - pyridine	Insecticide	HHP	N	Y	Y	Approved	3
Pyrasulfotole	Pyroxasulfone	Herbicide	Warning	N	N	N	Not Approved	1
Pyridaben	Unclassified	Insecticide, Acaricide	Danger	N	N	Y	Approved	4
Pyrimidifen	Pyrimidinamine	Insecticide, Acaricide	Danger	N	N	N	Not Approved	1
Saflufenacil	Amide	Herbicide	Warning	N	N	N	Not Approved	4

Pesticide Active Ingredients	Chemical class	Use Type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU	Number of products registered
Spinetoram	Biochemical biopesticides - Microbial extracts / fermentation products / enzymes	Insecticide	Warning	N	N	Y	Approved	19
Spinosad	Biochemical biopesticides - Microbial extracts / fermentation products / enzymes	Insecticide	Warning	N	N	Y	Approved	26
Spirodiclofen	Tetronic acid	Acaricide	Warning	N	N	Y	Approved	2
Sulfosulfuron	Urea	Herbicide	Low hazard	N	N	N	Approved	1
Sulfoxaflor	Sulfoximine	Insecticide	Missing data	N	N	Y	Approved	3
Tetraconazole	Triazole	Fungicide	Warning	N	N	Y	Approved	2
Tetradifon	Bridged diphenyl acaricide	Insecticide	Warning	N	N	N	Not Approved	10
Thiabendazole	Benzimidazole	Fungicide	HHP	N	Y	N	Approved	6
Thiacloprid	Neonicotinoid	Insecticide	HHP	N	N	Y	Approved	6
Thiamethoxam	Neonicotinoid	Insecticide	Warning	N	N	Y	Approved	52
Thiobencarb	Thiocarbamate	herbicide	Danger	N	N	N	Not Approved	1
Thiodicarb	Carbamate	Insecticide, Molluscicide	Danger	N	Y	Y	Not Approved	2
Thiophanate-Methyl	Benzamidazole	Fungicide	HHP	N	N	Y	Approved	8
Triadimefon	Triazole	Fungicide	HHP	N	N	N	Not Approved	4
Trichlorfon	Organophosphorus	Insecticide	HHP	N	N	Y	Not Approved	1
Triforine	Amide	fungicide	HHP	N	N	N	Not Approved	1

Annex IV. List of the key pests of sweet potato with the HHP and non-HHP active ingredients which are registered for their management

Target pest name	Active ingredients effective against target pest which are registered for a wide range of food crops[1] and are not HHP	HHPs which are used to manage the target pest[2]
Aphids	*Aphidius transcaspinus* (GIZ Class: not listed) Pyrethrins (GIZ Class: C) Thiocyclam hydrogen oxalate (GIZ Class: not listed) Bifenthrin (GIZ Class: B) Cypermethrin (GIZ Class: B) Deltamethrin (GIZ Class: B) Diafenthiuron (GIZ Class: B) Dimethoate (GIZ Class: B) Lambda-cyhalothrin (GIZ Class: B) Malathion (GIZ Class: B) Pirimiphos-methyl (GIZ Class: B) Thiamethoxam (GIZ Class: B)	Carbaryl Diazinon Oxydemeton-methyl Pirimicarb Propineb Trichlorfon Ethoprop
Cutworms	Diflubenzuron (GIZ Class: D) Bifenthrin (GIZ Class: B) Cypermethrin (GIZ Class: B) Deltamethrin (GIZ Class: B) Diafenthiuron (GIZ Class: B) Dimethoate (GIZ Class: B) Lambda-cyhalothrin (GIZ Class: B) Malathion (GIZ Class: B) Pirimiphos-methyl (GIZ Class: B) Spinosad (GIZ Class: B) Thiamethoxam (GIZ Class: B)	Carbaryl Diazinon Pirimicarb Propineb Trichlorfon Ethoprop
Fusarium root rot	*No effective AI registered*	Mancozeb Triforine (These AI are registered for all fungal diseases; however, their efficacy against the target pest is not proven)
Fusarium surface rot	*No effective AI registered*	Mancozeb Triforine (These AI are registered for all fungal diseases; however, their efficacy against the target pest is not proven)

[1] E.g. vegetable crops, horticultural crops, field crops. No active substance is specifically registered for use on sweet potato.

[2] The list of HHPs includes those that are registered for use against the pest and those for which farmers report use, even if they are not registered. Farmers indicate that the HHP AI in bold are specifically used to manage the pest.

Target pest name	Active ingredients effective against target pest which are registered for a wide range of food crops[1] and are not HHP	HHPs which are used to manage the target pest[2]
Leaf rust	*No effective AI registered*	Mancozeb Triforine (These AI are registered for all fungal diseases; however, their efficacy against the target pest is not proven)
Mole rat	*No non-HHP AI registered*	Aluminium phosphide Bromadiolone
Nematodes	*No non-HHP AI registered for use on Sweet potato*	Ethoprop Fenamiphos
Sweet potato black rot	*No effective AI registered*	Mancozeb Triforine (These AI are registered for all fungal diseases; however, their efficacy against the target pest is not proven)
Sweet potato scurf	*No effective AI registered*	Mancozeb Triforine (These AI are registered for all fungal diseases; however, their efficacy against the target pest is not proven)
Sweet potato weevil	Bifenthrin (GIZ Class: B) Cypermethrin (GIZ Class: B) Deltamethrin (GIZ Class: B) Diafenthiuron (GIZ Class: B) Dimethoate (GIZ Class: B) Lambda-cyhalothrin (GIZ Class: B) Malathion (GIZ Class: B) Pirimiphos-methyl (GIZ Class: B) Thiamethoxam (GIZ Class: B)	Carbaryl Diazinon Pirimicarb Propineb Trichlorfon Ethoprop

Target pest name	Active ingredients effective against target pest which are registered for a wide range of food crops[1] and are not HHP	HHPs which are used to manage the target pest[2]
Sweet potato whitefly	*Encarsia formosa* (GIZ Class: not listed) Pyrethrins (GIZ Class: C) Amitraz (GIZ Class: B) Bifenthrin (GIZ Class: B) Cypermethrin (GIZ Class: B) Deltamethrin (GIZ Class: B) Diafenthiuron (GIZ Class: B) Dimethoate (GIZ Class: B) Lambda-cyhalothrin (GIZ Class: B) Malathion (GIZ Class: B) Pirimiphos-methyl (GIZ Class: B) Thiamethoxam (GIZ Class: B)	Carbaryl Diazinon Oxydemeton-methyl Pirimicarb Propineb Trichlorfon Ethoprop

Annex V. Focus group discussions and individual interviews conducted in the GIAE Kenya study, 9 – 21 October 2017

County	Kakamega	Siaya	Bungoma
Individual farmer interviews	18	1	1
Individual extension agents interviews	17 (MOALF)	2 (1 MOALF & 1 REFSO)	1 (CREADIS)
Focus group discussion – Farmers	2 Emeb Kappap farmer group – 13 participants; Khonyeko farmer group – 23 participants)	-	-
Focus group discussions – Extension agents	1 (MOALF – 10 participants)	-	-
Key informant interviews	2 (KALRO, KEPHIS)	4 (NEMA, MOH, processor, transporter)	4 (MOALF, MOH, MENR, CREADIS)
Total number of participants	83	7	6

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