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

Ghana

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KNOWLEDGE FOR LIFE

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Executive summary

Losses due to pests, diseases and weeds are estimated to be about 35% in major crops, and may exceed 50% in developing regions where pest management strategies are limited. Sustainable pest management methods include non-chemical control methods (biological, cultural, mechanical and physical) although presently, many farmers still rely on chemical pesticides to control pest outbreaks. The Green Innovation Centres initiative for the Agriculture and Food Sector initiative (GIAE), led by Gesellschaft für Internationale Zusammenarbeit (GIZ), aims to boost smallholder farmer productivity and improve the whole value chain to maximize farmers' benefits. In order to align its Green Innovation Centres to the best practices in pest and pesticide management, GIZ has mandated CABI to lead this study.

The aim of the study was to analyze the legal framework for pesticide management in Ghana and review pest management practices for the major pests of the focal crops of the Green Innovation Centre. A desk study was carried out to analyse legislation and policy relating to pest and pesticide management and a review of scientific literature relating to the integrated pest management methods for the focal crops, maize and rice. To compliment the gaps in the publically available information in-country data collection was carried out. This consisted of one on one questionnaires and focal group discussions with farmers and extension agents and interviews with key stakeholders in the focal crop supply chains. The results and recommendations from the study were validated during an in-country stakeholder workshop and their implementation discussed.

The analysis of the legal framework for pest and pesticide management highlighted several important gaps. Areas not covered by the legislation that need to be addressed include the transportation of pesticides, requirements for sale, procedures and facilities for the disposal of empty containers and out-of-date products and protection of vulnerable groups such as children and pregnant women. Harmonization of the legislation relating to pesticide management needs to be prioritised especially where there is overlap in responsibilities between agencies and building capacity for inspection and enforcement of the laws relating to pesticide management. The stakeholders recognized there are gaps and a lack of legislative instruments to support the current legislation and steps are being taken to address these.

Many farmers still rely on chemical pesticides to control pests and diseases and have a lack of knowledge of alternative non-chemical management options. They have a reasonable knowledge of pesticide management but this is rarely put into practice. Many farmers expressed concerns about the use of highly hazardous pesticides and availability of counterfeit and low quality products and showed interest in using lower hazard alternative if they could be made available. It was reported that there is also low adoption of new technologies amongst farmers and this may be related to provision of conflicting information as a result of multiple organisations and programmes operating in the same areas.

Extension agents seem to have a reasonable knowledge of the pests and diseases affecting the focal crops but their knowledge of non-chemical management methods is limited and they rely on chemical pesticides for many of the recommendations they give farmers. Extension agents also demonstrated a reasonable level of knowledge on pesticide use and safety and many were aware of the current legislation in place. They did not however differentiate between highly hazardous pesticides and lower hazard alternatives.

Several recommendations have been made in the report to improve management of pest and pesticide management. The following recommendations are highlighted as those most actionable for the GAIEs in the short to medium term:

- Stocktaking of highly hazardous pesticides registered for use in Ghana and low hazard alternatives identified and publicised for use
- Development of local training programmes for agro-input shop assistants to improve basic information on pests and diseases, their management and alternative control strategies

- Development and provision of quality pest management extension materials for extension agent and linking extension to existing Apps through ICT
- Improve extension agents and farmers awareness of the registered pesticide list and the products and their uses contained within it
- Development of recommendations for the sustainable management of fall armyworm on maize with national partners

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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

AEA	Agricultural Extension Agent
AI	Active ingredient
Bt	*Bacillus thuringiensis*
CABI	Centre for Agriculture and Bioscience International
CCMC	Chemicals Control Management Centre
COCOBOD	Ghana Cocoa Board
EPA	Environmental Protection Agency
FAW	Fall armyworm
FGD	Focus Group Discussion
GAP	Good Agricultural Practices
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")
GSA	Ghana Standards Agency
HHP	Highly hazardous pesticide
ILO	International Labour Organization
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
ISO	International Organization for Standardization
ITC	International Trade Centre
MESTI	Ministry of Environment, Science, Technology and Innovation
MOFA	Ministry of Food and Agriculture
MRLs	Maximum residue levels
OEC	Observatory of Economic Complexity
PAN	Pesticide Action Network
PIC	Prior informed consent
POP	Persistent organic pollutant
PPE	Personal Protective Equipment
PPRSD	Plant Protection and Regulatory Services Directorate
SPS	Sanitary and Phytosanitary
SRP	Sustainable Rice Platform

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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 initiative for the Agriculture and Food Sector initiative (GIAE), led by Gesellschaft für Internationale Zusammenarbeit (GIZ) under the special initiative One World – No Hunger, aims to boost smallholder farmer productivity and improve the whole value chain to maximize farmers' 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 has mandated 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 FAO and WHO, details the best pesticide management practices. These best practices are designed to minimize the 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 major stakeholders in each value chain, 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 (IPM).

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 GIAE initiative is active.

Methodology

The methodology for the study was devised in such a way that it could be implemented in all 14 countries without any major changes in the approach. Approaches and tools for the desk study and in-country data collection were developed by CABI Switzerland, based on experience from previous studies. Based on the findings from the desk study, adaptations were made to the in-country data collection tools to ensure information gaps were filled.

Desk study

A review of literature in the public domain and to which CABI has access was conducted to provide an overview of the agriculture sector within Ghana, to map the value chains for each focal crop 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 the focal crops maize and rice.

Utilizing 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 which are registered for use in Ghana. 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 profiles also included information on the crops and pests for which the pesticide was registered. 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. HHPs which are registered for use in Ghana were identified using these criteria, and 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 national Environmental Protection Agency Act, subsidiary legislation and other policies relating to pest and pesticide management were identified, and an analysis of the existing legal framework for pest and pesticide management was carried out. A cross-comparison was made with international guidelines (e.g. from FAO and the ILO) and other regulatory best practices (e.g. OEC).

The desk study information was used to compile a preliminary description of the policy-setting process in Ghana. 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.

Limitations of the methodology and data

An overview of the national legal and policy framework, with links to many of the legal documents relating to agriculture, food and the environment, was accessed through the Ghana country profile in the FAOLEX database (http://www.fao.org/faolex/en/). Other policy and legal documents were available to download from ministry websites. Remaining gaps were filled by the participants of the in-country workshop. The fieldwork was conducted only in a limited number of regions where the GAIE initiative was operating and the interviews were only conducted with selected farmers and extension staff who were involved in the initiative. The sample size of farmers, extension staff and key informants interviewed was very small and from a narrow geographic range and cannot be used to draw conclusions on a wider scale.

Results/findings

Agriculture sector characteristics and key stakeholders

Overview of agriculture sector performance and contribution to the economy

Agriculture is a key sector of Ghana's economy and as at 2016 accounted for approximately 20% of the nation's GDP (Table 1). Although its contribution to the country's GDP has decreased from 31% in 2010 the agricultural sector has shown steady growth since 2007. Ghana has a large rural population (45% of the total population), with half of the nation labour force being employed by the agricultural sector. Despite the growth of the sector in recent years, agriculture remains predominantly rain-fed subsistence farming, with 80% of total agricultural output relying on basic technology (FAO 2015).

Table 1. General characteristics of the agricultural sector in Ghana

Selected indicators – agriculture sector generally	2007	2010	2013	2016
Total area of land under agriculture (1000 ha)	15,400*	15,620*	15,700*	No data available
Arable land per person (ha)	0.2	0.2	0.2	No data available
GDP per capita (current US$)	1,091	1,313	1,815	1,514
Agricultural value added (% of GDP)	29.7	30.8	23.2	19.6
Agricultural value added (annual % growth)	-1.7	5.3	5.7	3.6
Agricultural labour force (% of total labour force)	55.2*	No data available	53.6*	No data available
Rural population (% of total)	51.3	49.3	47.3	45.3
Value of total agriculture production (constant gross value 2004–2006, billion US$)	7,760*	9,331* (2009)	1,0717* (2012)	No data available

Source of data: The World Bank (2018) and *FAOSTAT (2018)

Key crops, both domestic and for export

Fresh food contributed to 25% of total exports from Ghana between 2009 and 2013 (ITC, 2014). Cocoa beans, cashew nuts and palm oil are the main agricultural exports of Ghana (Table 2). Cocoa alone accounted for 17.9% of total exports from Ghana in 2016 (OED, 2018). Cassava, yam and plantain are the three most important staple crops for domestic consumption and have the highest production rates, with very little being exported. Maize is Ghana's most important domestic cereal crop, followed by rice – although Ghana remains a net importer of rice as domestic production cannot keep pace with demand.

Table 2. Production and export data for key crops during 2013

Key commodities	Year	Production (tonnes)	Area harvested (Ha)	Yield Kg/Ha	Export (1000 US$)
Cassava	2013	15,989,940	875,185	18,270	6
Yam	2013	7,074,574	421,558	16,782	0
Plantain	2013	3,675,295	339,060	10,840	147
Palm oil	2013	2,326,920 (fruits)	318,760 (fruits)	7,299 (fruits)	117,233 (kernel) 47,722 (oil)
Maize*	2013	1,764,477	1,023,459	1,724	399
Taro (cocoyam)	2013	1,261,473	193,998	6,503	0
Cocoa (beans)	2013	835,466	1,600,300	522	1,380,613
Rice (paddy)*	2013	569,524	421,558	2,638	0
Cashew nuts (with shell)	2013	42,000	79,000	532	232,600

Source of data: FAOSTAT (2018) * Focal crops of the study

General information about the focal crop value chain in the country

Maize is produced in all of Ghana's regions but 70% of the production comes from only five regions (Brong Ahafo, Eastern, Ashanti, Central and Northern). It is grown predominantly by smallholder farmers for consumption and any excess can be sold. Maize is marketed through a network of traders in local and regional markets. Larger wholesalers also operate at a regional and national level. Rice is a relatively new crop in Ghana and the largest rice growing region is Volta, followed by the Northern Region then Upper East, Ashanti and Eastern. Rice is predominantly grown as a cash crop by smallholder farmers. The marketing of rice is similar to that of maize: local traders buy from farmers and sell to regional and national wholesalers.

Major markets

Maize is the most widely consumed staple cereal crop consumed in Ghana and domestic production is for both human consumption (white maize) and animal feed (yellow maize). The poultry and fish farming industries are expanding and demand for maize as feedstuff for these industries is increasing. Currently, the poultry industry utilizes 40% of the domestic maize available on the market, in addition to imports from other countries. Demand for rice in Ghana is growing but Ghana currently only produces just under half of the rice it requires for domestic consumption and relies on imports to satisfy the additional demand.

Sources of synthetic pesticides other inputs

In 2013 Ghana imported US$241 million of pesticides and exported US$2.4 million; hazardous pesticide imports accounted for only US$0.5 million of the total imports. Excluding hazardous pesticides, insecticides and herbicides accounted for approximately 80% of all imports, in equal proportions, whereas fungicides only accounted for 20%. Ghana does not manufacture pesticides but imports them, and private companies formulate and distribute or import and distribute directly. Ghana does export small quantities of insecticides, fungicides and herbicides within the West Africa region. Table 3 provides some examples of the private enterprises operating in Ghana and the inputs they provide.

Table 3 Sources of inputs such as pesticides, seeds, personal protection equipment (PPE) and pesticide application equipment

Activity type	Company and address	Inputs
Private importer and distributer	Agrimat Limited Legon-Madina High Road, Accra	Synthetic pesticides (herbicides, insecticides, fungicides, seed treatments), fertilizers, public health, fruit fly control, pesticide application equipment, PPE
Private importer and distributer	Callighana No. 3 Adomi Road Airport, Accra	Synthetic pesticides (herbicides, insecticides, fungicides), fertilizers, pesticide application equipment, bio-stimulants, seeds
Private importer and distributer	Chemico Limited Community No.1 Ind. Area Obedeka Road P.O. Box CO 950, Tema	Synthetic pesticides (herbicides, insecticides, fungicides), fertilizers, pesticide application equipment
Private importer and distributer	Dizengoff Ghana Limited No. 2 Fe No. 2 Feo Eyeo Street North Industrial Area P. O. Box 3403, Accra	Synthetic pesticides (herbicides, insecticides, fungicides), fertilizers, pesticide application equipment, PPE, irrigation and mechanized farming equipment
Private importer, distributer and retailer	K. Badu Agrochemicals Company Limited Box KJ 193 Kajetia	Synthetic pesticides (herbicides, insecticides, fungicides), fertilizers, pesticide application equipment, PPE, farming equipment
Private importer and distributer	RMG Ghana Ltd No. 14 Narku Ipan Rd., near Nyaho Clinic, Airport Residential Area, Accra-North, Accra	Synthetic pesticides (herbicides, insecticides, fungicides, seed treatments), fertilizers, foliar supplements, pesticide application equipment, growth regulators, PPE
Private importer and distributer	WIENCO Ghana Limited P.O. BOX AN 7593, Accra-North Accra	Synthetic pesticides (herbicides, insecticides, fungicides), seeds
Private importer and distributer	Yara Gh. Ltd. No. 2, Roman Ridge, Accra, Ghana	Fertilizers

Table 4. Private sector and other stakeholders

Farmer associations	Trade sector actors	Others
Peasant Farmers Association of Ghana	Ghana Grains Council	University of Ghana
Apex Farmers Organization of Ghana	Ghana Rice Inter-Professional Body	Alliance for a Green Revolution in Africa
Farmers Organization Network in Ghana	Association of Ghana Industries	Savanna Agricultural Research Institute
	Ghana Agricultural Associations Business & Information Centre	Crop Research Institute

Organizational arrangements within the national government for pest and pesticide management

Table 5. Organization of national government and roles and functions in pest and pesticide management

Role	Ministry name	Department/agency responsible	Specific functions (relating to pest and pesticide management)
Registration of pesticides	Ministry of Environment, Science, Technology and Innovation (MESTI)	Chemicals Control Management Centre (CCMC), a division under the Environmental Protection Agency (EPA)	- The CCMC is responsible for implementing parts of Part I and all of Part II of the Environmental Protection Act 1994, (Act 490) and the Pesticides Control and Management. Act 528 1996 - The Director of the CCMC acts as the Pesticide Registrar - Pesticides registration and licensing - Permitting chemical imports and exports - Management of hazardous waste and obsolete chemicals - Regulating the use of pesticides for agriculture, horticulture, forestry etc. - Inspection and monitoring of agrochemicals - Meeting Ghana's international obligations - Projects and research
Enforcement of pesticide regulations	MESTI	CCMC, a division under the EPA	- Monitoring the use of pesticides and taking enforcement action against illegal use
National plant protection organization	Ministry of Food and Agriculture (MOFA)	Plant Protection and Regulatory Services Directorate (PPRSD)	Established in 1965 by an Act of Parliament: Prevention and Control of Pests and Diseases, Act 307, now replaced by Plants and Fertilizer Act, 2010 (Act 803). The national plant protection policy from 1992 is currently still in place promotes the use of Integrated Pest Management (IPM) PPRSD comprises four divisions: Crop Pests and Disease Management - Develops GAP and IPM guidelines for food crop production - Training and backstopping for stakeholders - Diagnostic support for plant pests and diseases - Leads biological control programmes Pesticide and Fertilizer Division - Registration, inspection and training of pesticide and fertilizer dealers and applicators - Facilitation of removal of obsolete and unwanted chemicals - Record-keeping and compiling statistics on pesticides and fertilizers in-country - Management of pesticide and fertilizer stocks in-country - Supervision of bio-efficacy trials - Training in chemical management for extension and exporters

Role	Ministry name	Department/agency responsible	Specific functions (relating to pest and pesticide management)
			Ghana Seed Inspection and Certification Division - Supports production of quality seeds and planting materials - Registration of seed growers and dealers (including import and export) - Certification of seed and planting material - Monitoring of growers and dealers - Education and training of inspectors, dealers, growers, extension services and farmers Plant Quarantine Division - Issue of phytosanitary certificates and import permits - Operation of the Sanitary and Phytosanitary (SPS) System Enquiry Point - Inspection on quality standards for export fruit and vegetables - Record-keeping of pests and diseases of quarantine importance - Training on import and export requirements
Food safety	MESTI	Food and Drugs Authority	Mandated by the Public Health Act, 2012 (Act 851) to ensure adequate and effective standards for food, drugs, cosmetics, household chemicals and medical devices
Public health issues related to pesticides	Ministry of Health	Ghana Health Service	Mandated by Act 525 of 1996 to perform any functions relevant to the promotion, protection and restoration of health - Develop appropriate strategies and set technical guidelines to achieve Ghana's national policy goals/objectives - Undertake management and administration of Ghana's overall health resources within the service
Plant variety registration	MOFA	National Varietal Release and Registration Committee	Mandated by the Plant and Fertilizer Act (Act 803), 2010, to approve the release of new crop varieties
Environment	Ministry of Lands and Natural Resources	The Forestry Commission of Ghana	Mandated by the Forestry Commission Act, 1999 (Act 571), to manage the nation's forest reserves and protected areas
Agricultural research Sources	MESTI	Council for Scientific and Industrial Research	Mandated by CSIR Act 521 of 1996 to, among others, pursue the implementation of government policies on scientific research and development
Extension	MOFA	Directorate of Extension Services	Mandated by guidelines and policy documents that make it responsible for providing leadership in extension advisory delivery. Not a regulatory body but a civil service organization
Farmer training	MOFA	Directorate of Extension Services	Mandated by guidelines and policy documents that make it responsible for providing leadership in extension advisory delivery. Not a regulatory body
Commodity boards	Ministry of Finance	Ghana Cocoa Board (COCOBOD)	- Production, research, extension, internal and external marketing and quality control of cocoa, sheanut and coffee - Pre-harvest functions performed by the Cocoa Research Institute of Ghana, the Seed Production Unit and the Cocoa Swollen Shoot Virus Disease Control Unit

Role	Ministry name	Department/agency responsible	Specific functions (relating to pest and pesticide management)
			- Post-harvest functions undertaken by the Quality Control Division and the Cocoa Marketing Company Limited, including quality control measures
Setting and overseeing policies relating to IPM, good agricultural practices (GAP), organic agriculture and/or sustainable agriculture	MOFA	PPRSD Directorate of Crops Services	PPRSD is mandated to deal with all plant protection issues, while Crop Services focuses on all production issues
Setting and overseeing financial instruments	MOFA	Directorate of Crop Services	The main policy in this area has been the fertilizer subsidy programme
Official contact points / designated national authorities for multi-lateral environmental agreements	MESTI	EPA CCMC	Executive Director: Mr. Daniel S. Amlalo Director: Mr. Sam Adu-Kumi

Analysis of existing legal framework for pest and pesticide management

Description of policy-setting process and transparency

Adherence to and implementation of international agreements relating to pesticides

- Ghana became a party to the Montreal Protocol in 1987, which came into force in 1989, and has banned the sale and use of Methyl Bromide.
- Ghana signed the Rotterdam Convention in 1998. This was ratified in 2003 and the Convention entered into force in 2004. Article 10 of the Convention sets out the obligations of Parties with respect to the future import of chemicals listed in Annex III of the Convention and subject to the prior informed consent (PIC) procedure. Parties have an ongoing obligation to submit to the Secretariat, as soon as possible and in any event no later than nine months after the date of dispatch of a decision guidance document, their import decision (whether a final or interim response) concerning the future import of the chemical (Secretariat of the Rotterdam Convention 2017). Ghana has submitted 35 import responses for the importation of chemicals, the majority in 2003/2004 but the most recent being 2010, but it has failed to provide responses for 12 requests. No notifications of final regulatory actions have been received to date.
- Ghana signed the Stockholm Convention 2001, with ratification in 2003 and entry into force in 2004 (Secretariat of the Stockholm Convention 2017). In 2007 the EPA released Ghana's 'National Implementation Plan of the Stockholm Convention on Persistent Organic Pollutants' (EPA 2007). The plan includes methodologies for raising awareness on persistent organic pollutants (POPs), improving policy and legal frameworks for their management, institutional strengthening and capacity building, developing best environmental practices and developing analytical capacity. To date, a chemicals management unit has been set up in the EPA to regulate pesticide manufacture, importation, distribution, sale and disposal. Stockpiles of POPs have also been identified and collaboration has taken place between Ghana and Nigeria to review the issue at a sub-regional level.
- Ghana became a party to the Basel Convention in 2003 (Secretariat of the Basel Convention 2017). Ghana's Parliament has passed the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917). The act is in two parts: the first refers to hazardous waste and the second to electrical and electronic waste. Regulations related to the adherence to and implementation of the Basel Convention includes: restrictions on the importation and exportation of hazardous wastes; transboundary movement of hazardous waste; and selling, purchasing or dealing in hazardous waste.
- Ghana is a party to the ILO's Safety and Health in Agriculture Convention (C184), which was ratified in 2011 (ILO 2017). Agricultural workers are also included under Ghana's Labour Act, 2003 (Act 651), which addresses occupational health and safety. There is a draft policy on Occupational Safety and Health, 2000, which aims to attain optimal health for Ghana's entire workforce, and covers pesticide application (FAO 2006). This policy is not yet law. Regulations on hazardous chemicals, including pesticides, are covered in the Environmental Protection Agency Act, 1994, Section 9.2.1 Handling, storage, labelling and use; and Section 9.2.2 Duty of manufacturers, suppliers and importers of chemicals in relation to the safety and health of users.

Overview of national regulation related to pest and pesticide management

- Customs, Excise and Preventive Service (Management) Law, 1993 (PNDCL 330) – Regulates all imports and exports in Ghana, including chemicals.
- Environmental Protection Agency Act, 1994 (Act 490) – This act establishes the EPA, whose main function is to protect the environment. Part 2 of the act focuses on pesticide registration but has since been replaced by the Pesticides Control and Management Act, 1996 (Act 528).
- Export and Import Act, 1995 (Act 503) – Facilitates all imports and exports in Ghana, including chemicals.

- Public Health Act, 2012 (Act 851) – Regulates the manufacture, preparation, supply, import and export of food, drugs, cosmetics and chemical substances to protect the health of customers.
- Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917).
- Labour Act, 2003 (Act 651) – Occupational health and safety.
- Pesticides Control and Management Act, 1996 (Act 528) – Addresses the importation, export, manufacture, distribution and advertisement of pesticides.
- Plants and Fertilizer Act, 2010 (No. 803) – Addresses plant protection, seeds and fertilizer, including the use of pesticides in plant protection.
- Standards Authority Act, 1973.
- Management of Ozone Depleting Substances and Products Regulations, 2005 (L.I. 1812).
- Plant Protection Regulations, 2012 (L.I. 2193).
- The Standards Decree, 1973 (NRCD 173).
- The Safety and Health in Agriculture Convention, 2001 (No. 184).

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

MOFA's National Plant Protection Policy (2004) framework states that crop losses can be minimized and risks reduced by improved and sustainable plant protection strategies, which include application of IPM, increased use of biological control and sensible use of synthetic chemical pesticides. The policy also highlights the importance of research and the need for PPRSD to liaise with international research centres to provide technical knowledge that will support the development and application of crop and pest management strategies in the context of GAP. Section 1 Crop Pests and Disease Management, under the implementation strategy of the policy, aims to support IPM development and research on the use of biocontrol agents, botanicals and resistant varieties. The policy also aims to promote awareness creation and adoption of IPM and the development of complementary GAP standards. Food safety issues are also addressed by the establishment of linkages with other stakeholders to jointly develop a commodity-specific Hazard Analysis and Critical Control Point (HACCP) protocols on the basis of GAP. Section 3 focuses on pesticide management and the gradual elimination of 1a and 1b pesticides from the registered pesticide list. It outlines the need for the development of protocols for the effective disposal of obsolete pesticides according to international standards, as well as establishing a National Pesticides Data Bank through the collection of data on markets, consumption, use and impact on the environment and human health. The policy also refers to the need to develop standards for proper pesticide management as part of GAP, including minimal use of pesticides, proper handling procedures in storage, transportation, application equipment and PPE.

Research

There is currently no policy in place that specifically promotes research on alternatives to existing pesticides and non-chemical control measures. The need to strengthen linkages with research institutes in Ghana to develop sustainable IPM strategies is highlighted in MOFA's National Plant Protection Policy (2004) framework, discussed above.

Regulations related to the manufacture of pesticides

Ghana does not manufacturer pesticides but there is an industry for the reformulation, distribution and resale of pesticides. No specific legislation could be found for the manufacture of pesticides but the Pesticides Control and Management Act, 1996 (Act 528) requires the manufacture of pesticides to be registered.

Legal framework for non-chemical preventive and direct control measures

There is currently no legislation in place in Ghana which covers registration for non-chemical preventive and direct control measures.

Price and trade policy, including subsidies

Distribution and trade of chemical pesticides is a market-driven supply process in Ghana and no subsidy scheme for pesticides is in place. However, COCOBOD provides cocoa farmers with cocoa-approved and recommended pesticides free of charge under the "cocoa mass spraying programme". MOFA also supplies farmers with pesticides in times of emergencies to bring pests under control and reduce extensive losses, such as during the recent incursion by FAW into Ghana.

Registration (synthetic pesticides and biopesticides)

The registration of pesticides is covered by the Pesticide Control and Management Act (Act, 1996), which replaced Part Two of Act 490 Environmental Protection Agency Act, 1994 – Pesticides Control and Management) and accompanying registration guidelines. The regulation details the mandatory registration system for pesticides in Ghana. Registration is based on a 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. Part 1.1 states that "No person shall import, export, manufacture, distribute, advertised, sell or use pesticides in Ghana unless the pesticide has been registered by the EPA in accordance with this Act". The definition of a pesticide used in the regulations is as follows:

> "(a) A substance or mixture of substances intended for preventing, destroying, repelling or reducing the destructive effects of any pest; or
> (b) A substance or mixture of substances intended for use as a plant regulator, defoliant, desiccant or wood preservative."

An assumption might be made that "pesticide" therefore includes: herbicides, insecticides, plant growth regulators, rodenticides, fungicides, biopesticides, and other substances used to control a wide variety of pests and diseases. The word "substances" probably indicates that macrobials are not included under the definition of pesticides in the broader sense.

The CCMC of the EPA is responsible for ensuring the proper labelling, distribution, storage, transportation, use, application, and disposal of chemicals and associated hazardous waste within Ghana through the implementation and enforcement of the EPA Act 490, although the Act predates the formation of the CCMC. The Director of the CCMC also acts as the Pesticide Registrar. The main functions of the CCMC are:

- regulation of the use of pesticides for agriculture, horticulture, forestry, gardening and public health and other pesticide-related uses
- monitoring the use of pesticides and enforcement action against illegal use
- providing policy advice to government and taking the lead on pesticide issues
- monitoring and providing controls on industrial/consumer chemicals and ozone-depleting substances in Ghana
- providing information on chemicals to the entire populace of Ghana
- research and development in issues relating to pesticides and industrial/consumer chemicals
- meeting Ghana's international obligations on the control and management of chemicals (international conventions)
- management and disposal of hazardous chemicals and waste

Ghana signed the regulation c/reg.3/05/2008 on the Harmonization of the Rules Governing Pesticides Registration in the Economic Community of West African States (ECOWAS) region in 2008 but to date this has not been incorporated into national pesticide legislation.

As stated in the guidelines for registration of pesticides, the information and data required to be included in an application includes: mammalian toxicity, ecotoxicity, environmental fate, physical and chemical properties, analysis of pesticides residue if the pesticide is to be used on a food or

feed crops, toxicity to fish and wildlife, phytotoxicity and bio-efficacy, chronic toxicology data, and crop residue data.

The registration body makes its final registration decision based on: characteristics of the formulation; persistence and mobility; likelihood of misuse; relative hazard of its application method and formulation; extent of intended use; and review of the technical data submitted (acute and chronic toxicology, human toxicology, WHO Hazard Class, ocular and dermal irritability, obligations to international conventions).

The types of final decisions which can be made are: a) for general use; b) for restricted use; c) suspended; and d) banned. Pesticides classified as suspended, restricted or banned will be subject to PIC procedures. The Pesticide Control and Management Act defines pesticides for general use as those that, when applied for the use they are registered for, do not have an unreasonable adverse effect on the environment. The timeframe for making a final decision on registration is no longer than 90 days. If the application is incomplete, the written notification must identify the deficiencies in the application. When an application is refused the applicant will be informed in writing of the refusal and the grounds for the refusal within 14 days of the decision.

All pesticides for use in Ghana require registration (see definition of “pesticide” in the text above); however, the legislation states in Part 1, Section 2, that there are exceptions and the EPA may authorize importation of unregistered pesticides if:

- they are for experimental or research purposes
- there is a national emergency
- they are in direct transit through Ghana and the agency is satisfied they are permitted to enter the country of destination

No definition of low-toxicity / low-risk pesticides is included in the legislation.

The act does not provide a definition for what biopesticides/biocontrol agents are but definitions are included in the registration guidelines for biochemical pesticides:

- Biopesticides – pesticides derived from natural material, primarily microbes, but can originate from animals, plant and certain minerals. Biopesticides can be divided into four major groups:
    - microbial pesticides – microorganisms (bacteria, fungi, viruses, protozoar) as AI (e.g. *Bacillus thuringiensis* (Bt))
    - biochemical pesticides – naturally occurring substances that control pests by non-toxic mechanisms (e.g. insect sex pheromones)
    - plant-incorporated protectants – pesticidal substances produced by genetically modified plants
    - plant extracts – unprocessed or highly refined (e.g. neem-based products)
- Biochemicals include semiochemicals and botanical extracts. The guidelines stipulate that the following information and data must be supplied in a registration application:
    - identity, biology and ecology of the agent
    - safety data and effects on human health
    - assessment of environmental risks
    - information for assessment of efficacy and quality control

Additional supporting guidelines exist from the EPA for the registration of pheromones and other semiochemicals for arthropod control. It is not clear at this time whether separate guidelines exist for registering microbial pesticides as the guidelines are only available for purchase at the EPA’s office in Accra and no listing is present on the website.

There is no system in place under Ghana’s legislation to encourage the use of fewer or less toxic pesticides through an accelerated process or lower fees for registration of less toxic products. The

validity period for registrations is not more than three years. After this period re-registration is mandatory. If the agency is satisfied that the pesticide remains safe and effective its registration can be renewed for three years at a time. Procedures for appeal or label extension are outlined in the guidelines for registration, not in the act itself. Section 14 of the Pesticide Control and Management Act states that if the agency is satisfied that a registered or provisionally registered pesticide could be ineffective or a hazard to people, animals, crops or the environment it has the authority to reclassify, suspend or ban the pesticide. A list of all registered products is compiled by the agency and updated on an annual basis. The list is published in the Gazette and available there to the public. The information in the list of registered pesticides includes trade names of products, their registration numbers, the name(s) of AI and their concentrations, formulation type, authorized uses (including crops and target pests), the name of the registrant and the period of registration. The currently available list was last revised in February 2017. A separate listing within the main list denotes products that are banned or severely restricted. A separate list of biopesticides is not available. Any biopesticides that are registered appear in the main list.

Analysis of registered pesticide list

The Register of Pesticides for Ghana is updated and published annually. The most recent update was released in February 2017. The list contains 569 registered products, which correspond to 159 different AI. 414 registered products have full registration, and 123 have provisional registration. The list of banned pesticides is included within the pesticide register and there are currently 32 AI listed in it (Annex II). The banned list is also updated annually, along with the pesticide register. There are 72 different registrants listed as local suppliers in the current registered pesticide list.

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

The current legislation does not contain any provision regarding export, shipment, import and release of biological control agents and other beneficial organisms.

Packaging and labelling

The EPA reserves the right to recommend the packaging and labelling of registered pesticides at wholesale and retail levels under Section 27.1. of the Pesticide Control and Management Act. Where packaging or a label is prescribed by the agency it is not permissible to manufacture, import, export distribute, advertise or sell that pesticide other than in the prescribed packaging or container. In addition, the label of the pesticide must not be altered to misrepresent its nature. The registration guidelines outline much more specific information about labelling and packaging:

- they require that packaging does not resemble food packaging
- they prohibit reuse of containers
- they require that an officially approved label is a mandatory part of the product package
- they indicate the information which is required on the label, e.g.
    - *product content:* product name, use type (e.g. herbicide, fungicide), type of formulation AI name, concentration of the AI, co-formulants, net contents, name of manufacturer, registration number
    - *for hazard and safety information:* label information is communicated using the Globally Harmonized System of Classification and Labelling of Chemicals (GHS), including: hazard symbols and pictograms, hazard statements, precautionary statements, hazard colour bands (in line with WHO recommendations), first aid, medical advice, PPE
    - *directions for use:* crops and target pests, dose rates, mixing instructions, application methods, equipment, timing and frequency of applications
    - *instructions for storage and disposal*
- under the guidelines, information is not required on the maximum number of applications, the interval between applications, incompatibility issues, and information related to resistance management

Marketing

Advertising is included under Section 26 of the Pesticide Control and Management Act, which states that registered or provisionally cleared pesticides should not be advertised in a manner which is false, misleading or inconsistent with information supplied to the agency, and which omits warnings prescribed by the agency.

Transport

No specific regulations currently exist for transporting pesticides in Ghana, although the guidelines state that information on safe transport has to be included on the label.

Import and export

The Pesticide Control and Management Act (Act, 1996) contains legislation relating to the import and export of pesticides, in Part 1.1: “No person shall import or export a pesticide into Ghana unless it has been registered with the EPA”. The Act prohibits the import / export of pesticides that have not been registered. Exceptions include the fact that unregistered pesticides may be imported, with the permission of the agency, for experimental or research purposes, but not for distribution, and in the event of national emergency or in direct transit through Ghana, where the agency is satisfied that the pesticide is permitted to enter the country of destination. The Act also stipulates, in Part IV 38 (1) that customs officers shall assist in the enforcement of the Act and prevent the importation into Ghana of any pesticide that is contrary to the Act. The agency supplies the Commissioner of Customs with a list of registered and banned products and the commissioner must record all pesticides imported into Ghana. The Customs, Excise and Preventive Service (Management) Law, 1993 (PNDCL 330) regulates all imports and exports from Ghana, including chemicals, but pesticides are not specifically mentioned.

Requirements for sale

The only reference to the sale of pesticides in the Pesticide Control and Management Act is in Part III Section 35, which states that it shall not be a defence for any person charged with the sale of an unregistered pesticide to plead that at the time of the sale they had no reason to believe the product was unregister or did not meet the requirements of the Act.

Licensing

Section II of the Act outlines legislation on the licensing of pesticide dealers. A valid licence is required for the import, export, manufacture, distribution, advertisement or sale of pesticides. No specific mention is made of transportation. Part III outlines provisions for inspection and enforcement by the EPA and penalties issued. A system to receive and evaluate applications is outlined which sets out clear criteria for the grant or denial of a licence, as well as provisions for the imposition of conditions, suspension and revocation. The system allows the agency to impose fees for services associated with licensing and sets out an appeal process in the case of suspension or cancellation of a licence.

Availability

The legislation does not contain any provision to regulate the availability and use of pesticides in accordance with the hazards involved and the existing levels of user training.

Handling and use, including regulations on application equipment

The Labour Act, 2003 (Act No. 651) addresses health and safety in the workplace in Part XV and outlines the employer’s responsibilities to protect the health of workers. The section includes a provision on training and protective equipment. The act applies to all workers and to all employers except the armed forces, police and prison guards. Pesticides are not specifically mentioned in the act. The Poison Control Centre in Accra has its own database and Mr Nyadedzor (personal communication 2017) informed the authors that other institutes keep records on pesticide and health-related issues but there is no centralized organisation that is responsible for collecting and storing data.

Requirements for training

There is no clear policy that addresses the production and dissemination of relevant and clear educational materials on pesticide use and management. MOFA's Guidelines for the National Plant Protection Policy touch on this as their function of promoting IPM.

Restrictions related to vulnerable groups

There is currently no legislation containing any provision to prevent the use of pesticides or the sale of pesticides to children or pregnant and nursing women, and other vulnerable groups.

Requirements for PPE

There is currently no policy in place to promote the use of PPE. However, under Act 528 pesticide labels are required to list the type of PPE that should be worn whilst applying the pesticide.

Storage

Act 528 makes provision for the power of inspectors to inspect any storage or disposal facility but does not outline any measures for the safe storage of pesticides. The act does state in Part II, Section 28, that every person who imports, exports, manufactures, distributes or sells a pesticide must make a record of the quantities of pesticides imported, exported, manufactured, distributed or sold by him, and the record must be maintained for 10 years from the time it is made, and be made available to the EPA at its request at such time and in such manner as the agency may require.

Disposal of unused pesticides and empty containers

No policy is in place to prevent the accumulation of obsolete pesticides and used containers but the CCMC does supervise the disposal of obsolete chemicals. The EPA does not have its own disposal facility and has to rely on other organizations for this service (FAO 2006).

Post-registration monitoring

No centralized database exists were reliable data is maintained on the health effects of pesticides and pesticide poisoning incidents. Several different organizations collect data independently, such as the EPA, the Ghana Standard Authority, the Poison Centre, PPRSD and the Food and Drugs Authority (Dr Kumi, personal communication 2017). CCMC, through the EPA and Act 528, has the power of an inspectorate. The responsibilities of the inspectorate are outlined in Part III Section 1 of the Act. PPRSD works in collaboration with CCMC and takes on some of the inspectorate responsibilities; however, where the boundaries lie is not completely transparent. As mentioned above, Act 528 also imposes reporting requirements on manufacturers, importers, distributors and sellers of pesticides.

Residue monitoring in food and Maximum Residue Levels (MRLs)

The Standards Authority Act, 1973 gives the responsibility to the Ghana Standards Agency (GSA) for the promulgation of standard specifications in industry, including food. The GSA is responsible for setting and monitoring MRLs in food although this is not specified in the legislation. The GSA prescribes the following of the MRLs set by the Codex Alimentarius as a minimum standard. If there are other standards which are more relevant these are applied: e.g. for cocoa being exported to the EU, the EU standards for pesticide residues are applied. The GSA has the only accredited laboratory in Ghana for testing residues. GSA does not routinely test agricultural produce in Ghana. Most analysis carried out by the GSA is done on request for private companies exporting produce.

Compliance and enforcement

Act 528 gives responsibility to CCMC to enforce the law and issue penalties, under Part III – Enforcement and Penalties. It defines the powers given to the inspectors appointed under Section 15 of the EPA Act. 1994 (Act 490). There is no formal provision to facilitate information exchange; however, the Pesticide Technical Committee outlined in the Act is made up of representatives from other ministries and departments with a vested interest in pesticide management and information is shared through this mechanism. The legislation designates the agency (CCMC, through the EPA) as the responsible authority for inspection. PPRSD and Customs and Excise also support the EPA

with inspection. The legislation does not define whether or not the inspector appointed needs to be qualified. No procedures are defined for taking samples or designating an official laboratory.

Actions considered offences under the Act include wilful obstruction of inspectors and failure to comply – both attract a fine or imprisonment. Other offences include importing, exporting, manufacturing, distributing, advertising, selling, or using any pesticide which has not been registered, or doing so without a licence. Changing the formulation of a pesticide and selling a faulty or deteriorated pesticide is also grounds for conviction. The published fines in the Act have no units attached so it is difficult to know if they are in currency or an arbitrary unit. Additional consequences of a conviction are the revocation of a licence.

Farm characteristics and production practices in focal crops

Overview of farmers in the study area

Questionnaires were conducted with 30 farmers. Fifteen rice farmers were interviewed in the Ho and Ho West districts of the Volta Region and 15 maize farmers were interviewed in the Techiman district of the Brong Ahafo Region. Questionnaires were also conducted with extension agents: five extension agents in the Volta and eight in Brong Ahafo. The data from the questionnaires was analysed and the findings are presented below. All accompanying tables and charts are presented in Annexes III and IV. Focus group discussions (FGD) were also held with rice and maize farmers in Ho Municipality in Volta and Techiman Municipality, Brong Ahafo, respectively. A single FGD was held with Agricultural Extension Agents (AEAs) in Techiman. The numbers of AEAs in Ho and Ho West districts were very low and insufficient numbers were available during the visit to hold a FGD. The AEAs present were interviewed using the questionnaire. Findings from the FGDs with farmers and AEAs have been incorporated into the discussion presented below.

The majority of the farmers interviewed for both focal crops were male (Annex III – Figure 4). Rice farmers had a higher level of education, in comparison to the maize farmers, with a third of maize farmers having no formal education, compared to the majority of rice farmers who were educated to secondary school level and above (Annex III – Figure 5).

Pest problems in the focal crops

The pests in the field most commonly reported by maize farmers (Annex III – Figure 6) were FAW (100%), closely followed by various weed species (93%). Whilst many farmers referred to weeds in general terms *Euphobia hirta*, elephant grass, spear grass and striga were mentioned specifically. A weed referred to as ‘Akuffo addo’ was reported by 20% of farmers, and was reported as a new problem in maize-producing areas in Brong Ahafo. The farmers were unable to give the common name for this weed and even with a description the interviewing team was unable to identify it. Other common pests reported were ants (60%), birds (53%) and various other insect pests and mammals, at a lower rate. The most common post-harvest pests of maize for all farmers were weevils (Annex III – Figure 7) followed by rodents (40%) and mould caused by fungi producing aflatoxins in stored maize (20%).

The main field pests of rice (Annex III – Figure 8) were birds, which were reported by all farmers, 80% reported grasscutter, 73% termites, 46% rodents and 33% rice blast disease. Other pests reported by farmers in the field included various types of weeds. The main post-harvest pests reported by 60% of farmers was rodents (Annex III – Figure 9), followed by weevils (20%) and lizards and ants (10%). According to Dr Joseph Ofori (personal communication 2017) the main pest and disease problems in rice are insects. Fungal diseases should not be an issue in the field if they can be prevented at the nursery stage. Chemical seed treatments can be applied as a seed treatment before sowing in the nursery and healthy seedlings transplanted into the field. Many farmers sow seeds directly into the field by broadcast sowing as setting up a nursery and transplanting is perceived to be too labour-intensive.

Description of the current crop protection methods

Both maize and rice farmers generally used a variety of control measures to manage pests (Annex III – Figure 10). However, over 90% of maize farmers interviewed reported that at some time they had used synthetic pesticides in addition to other methods. During the FGD in Brong Ahafo maize farmers reported that until the arrival of FAW in Ghana they had not used many synthetic pesticides as pest problems were at very low levels. FAW is now the biggest constraint faced in maize production and so far they have had to rely on synthetic pesticides for its management. Some maize farmers (40%) reported using biopesticides or lower-risk pesticides to control FAW. Physical control methods were the largest category of management method used, by 72% of rice farmers, closely followed by 67% using synthetic pesticides. Only 2% of both maize and rice farmers were found to have used an HHP (aluminium phosphide, beta cyfluthrinviphos, carbofuran, chlorfenvin, mancozeb). More than twice as many rice farmers (32%) than maize farmers (12%) used preventive strategies to control pests. Full details of control measure used by farmers can be found in Annex III – Tables 6–13.

Bottlenecks and challenges in plant protection and other constraints on production

Access to affordable inputs seems to be a major challenge for both groups of farmers (Annex III – Figure 11). The majority of farmers said that chemical pesticides, PPE and disease-free seeds were available but not affordable. Only 16% of farmers said that biological control options for management were available on the open market.

Several constraints were highlighted by maize farmers during the FGD. The increasing cost of inputs is making maize production more difficult as the selling price has not increased in line with the cost of inputs. The emergence of new pests (specifically FAW) and weeds is making management more difficult and more expensive. The farmers also reported that some weeds and pests have become resistant to the chemical pesticides they are using. The maize farmers requested more information on the use of pesticides, such as which products to select and when and how to use them. They were also concerned that some agro-input suppliers do not have enough knowledge about the products they are selling and that there are too many low-quality and counterfeit products on the market. Lack of adoption of GAP is a challenge as farmers complained that the guidelines are too labour-intensive and time-consuming. Constraints to adopting GAP include resistance to change, lack of funds at the right time and a reluctance to pool resources to make access to inputs easier.

During the FGD rice farmers reported their main challenges as being a lack of availability of good-quality, certified rice seed. Some stated that when certified seed had been purchased in the past it either contained mixed varieties of rice or was contaminated with weed seeds. Weeds are becoming a major issue for production as manual weeding is too labour-intensive and expensive but overreliance on chemical herbicides has been reported by farmers to have caused resistance in some weeds. Transplanting is recommended for cultivating rice but many farmers still broadcast seed directly into the field when sowing, as transplanting is too labour-intensive. Many farmers expressed a need for mechanization to make rice farming more efficient and profitable.

Birds were highlighted as a major problem at rice maturity stage and current control methods, which involve manual scaring and poisoning, are not effective or sustainable. The farmer group present at the FGD is involved in a GIZ trial exploring novel alternative methods for bird control using birds of prey. Mr Ahmad Hashemi from Dizengorff (personal communication 2017) mentioned that they were exploring new options for bird management for rice farmers in the form of a low-hazard chemical application bird repellent which prevents birds landing on the crop but this is unlikely to be economic for smallholder farmers in the near future.

Plant protection practices applied in organic agriculture

None of the farmers interviewed reported growing maize or rice in organic systems.

Pesticide sources and availability of pesticides

Nearly all farmers reported that their main source of pesticides was from private agro-input dealers, with a small number reporting they receive pesticides from AEAs and government agencies (Annex III – Figure 12). Since the recent arrival of FAW MOFA has bulk-purchased emergency supplies of chemical insecticide and distributed these to farmers to get the outbreak under control. Farmers reported using a variety of sources of information to find out which pesticides are available and which to use, with the majority (90%) seeking advice from AEAs. Other major sources included agro-input retailers (60%) and other farmers (66%), and to a lesser extent friends and family members (Annex III – Figure 13). The main reasons given by farmers for choosing a specific pesticide were that it had been recommended by someone else (75%) and that they believed it was effective (65%). Other reasons for choosing a pesticide were that it had been previously used (35%) and that it was available to purchase (25%); only 7% of farmers said they chose pesticides based on the price (Annex III – Figure 14).

State of the implementation of international agreements relating to pesticides

Policy is in place in Ghana to promote IPM and GAP through MOFA; however, few of the farmers interviewed had a good understanding of the concept and principles of IPM and few implement IPM or GAP fully. Training does take place on IPM and GAP for the focal crops, provided by various institutes, including MOFA, district extension, development agency programmes, NGOs and private extension providers, but few farmers seem to adopt the practices recommended. It is not clear how far-reaching training on IPM and GAP is for rice and maize farmers currently.

Biopesticide registration is well defined in Ghana's legislation but very few biopesticides are registered and available on the market. During the FGDs farmers expressed an interest in using less hazardous pesticides (i.e. biopesticides) but stated that they are not available to buy. Several of the maize farmers have tried Bt for management of FAW and have been satisfied with the results. Agro-input suppliers interviewed in Ho and Techiman (Mr Hokey and Mrs Dwamena, personal communication) stocked only one biopesticide, which was Bipel (Bt). They reported that farmers who buy it like it but it is more expensive than chemical pesticides and the short shelf life makes it less attractive to stock.

Legislation in Ghana contains provision to detect and control counterfeiting and illegal trade in pesticides. It also designates the national authority responsible for inspection and defines the powers of inspectors. However, availability of counterfeit pesticides appears to be a widespread problem and is not enforced adequately. Many farmers expressed concern about purchasing low-quality and counterfeit pesticides. The sale of counterfeit pesticides in Ghana was confirmed by MOFA (Dr Ansah-Amprofi, personal communication 2017). These unapproved pesticides come into Ghana via unapproved routes, mainly though land borders. Only seven of the farmers interviewed were familiar with the list of registered pesticides published by the EPA, or the fact that the list specifies crop/pest use for each product. None of the farmers knew the list was produced by the EPA but some said they thought it might have been produced by the Food and Drug Authority, AEAs or GIZ.

Pesticide handling and use

Of the total number of farmers interviewed 85% of them said they used chemical pesticides. Nearly all farmers had received some sort of training on the safe use of pesticides and as a result 60% of farmers reported using PPE. Just over half read the label on the packaging before mixing and applying. Worryingly, 80% of farmers reported feeling negative health effects after using pesticides (Annex III – Figure 15). Approximately 80% of farmers relied on AEAs to give them information on the correct dosage of pesticide to use. Other sources included neighbours, friends and agro-input suppliers. Only 20% of farmers said they were confident enough to calculate the dosage themselves (Annex III – Figure 16). When it comes to storage all farmers reported keeping pesticides in their original containers. Most were stored on the farm or in a shed, although 20% said they kept pesticides in the house so that they were not stolen. Around half of farmers specified that the pesticides were kept out of reach of children, but only 30% kept pesticides in a locked location (Annex III – Figure 17). The most common method for empty container disposal was

burning in the field, which was carried out by all but seven farmers. Only small numbers of farmers buried the containers or found other means of disposal. Only nine farmers rinsed the containers before disposal (Annex III – Figure 18). MOFA and CropLife run schemes to collect empty containers and expired products in Ghana (Mr Ahmad Hashemi, personal communication 2017), although some farmers mentioned that they collected and saved empty pesticide containers but they were never collected.

Health and safety

Not all farmers used appropriate PPE when mixing and applying chemical pesticides. Approximately half of the farmers wore basic items of each specified PPE (rubber boots, long-sleeved shirts and trousers, coveralls, mask, goggles and rubber gloves). All of the farmers reported wearing some type of PPE (Annex III – Figure 19). The main source of acquiring PPE was from agro-input dealers, with a few farmers receiving PPE from NGOs or AEAs or purchasing at the market (Annex III – Figure 20). The most common reason given for not wearing PPE (13 out of 30 farmers) was that it was too expensive (Annex III – Figure 11 and 21).

Knowledge of pests, IPM and rational pesticide use

Both maize and rice farmers expressed a reasonable knowledge of IPM. Only a third of farmers had received training on IPM and of those all said they applied what they had learned (Annex III – Figure 22). Farmers expressed an interest in receiving training and learning more about the use of less hazardous pesticides and biological control.
Very few farmers prepared and used homemade pesticides. Only four farmers used plant-based pesticides in the field. Post-harvest use was a little higher, with three farmers using neem extract and three using ash to control weevils in stored maize (Annex III – Figure 23).

Training and sources of information

Many of the farmers receiving training associated the training with local government and the AEAs, who often lead the training, and not with the programme or the organization providing the training. Half of the farmers interviewed stated that constraints to implementing IPM on their farms were that they considered it too expensive and the techniques were too time-consuming. A third also said they did not feel confident to implement IPM as they did not have a good understanding of the concept. Farmers also expressed concerns that many different organizations offer training on rice and maize production, recommending different techniques and technologies: the lack of continuity is a source of confusion for the farmers and as a result they are less likely to carry out any of the recommended management strategies.

All farmers said their preferred source of information was AEAs, closely followed by radio broadcasts. To a lesser extent, farmers preferred to receive information through mobile phones and printed materials (Annex III – Figure 24). Very little information is provided by AEAs through radio broadcasts as it is considered too expensive as air time has to be paid for but as this is a preferred method for farmers to receive information this medium of dissemination should be explored further.

The intervals at which farmers met with AEAs were very variable. Remarkably, nearly half of the farmers interviewed met with AEAs daily and a third on a weekly basis. The majority of the remainder saw an AEA at least once every two weeks (Annex III – Figure 25). The intervals at which farmers met with AEAs seem to depend on the district in which they live and the programmes/projects that are running in that district.

Analysis of GAP/good crop management and other voluntary standards

Overview of voluntary standards / certifications schemes applied in the focal crops

After consultation with farmers, extension services and key stakeholders it became evident that farmers do not apply voluntary standards in relation to maize and rice crops in Ghana. This may be

because maize and rice are only produced and traded on local markets. Any maize and rice that is exported is done so to neighbouring countries within the region.

Maize and rice traders/middlemen who were interviewed said that they do not take certification into consideration when they buy produce from smallholder farmers (Mr Yeboah, Mr Manu and Mrs Adzakpa, personal communication 2017). Their main concerns when buying are the quality of the product, which is primarily done assessed inspecting them. The criteria they use for grading is the proportion of broken grains, insect/fungal damage, any mould present/colour change of the grain, and whether they can detect any pesticide residue by smell or taste. Due to the fact there is no market for certified maize and rice in Ghana there is little incentive for farmers to apply voluntary standards or certification to their maize and rice crops. However, Mr Yeboah (personal communication, 2017) stated that he was interested in buying maize at a higher price that had been certified and could guarantee low MRLs for pesticides as he has had consignments of maize destined for a school and a poultry farm that were rejected due to high levels of pesticide.

Voluntary standards which are applied in Ghana are mainly applied for export commodities. Fairtrade, Rain Forest Alliance, UTZ Certified and Organic are currently all running schemes for certified cocoa production. There is a demand to buy these products – particularly in Europe. Other export markets with certification include fruit and vegetables.

Voluntary standards that could be applied to maize and rice that are applied in other countries include: GlobalGap, Organic and Fair Trade. UTZ Certified in African countries mainly focuses on commodities such as tea, coffee, shea, cocoa, sugar, flowers and fruit. Voluntary standards which have recently been launched which are relevant to Ghana are Ghana Green Label and the Sustainable Rice Platform (SRP). Ghana Green Label provides a certificate and logo for produce and was initiated by stakeholders in the fruit and vegetable sector in conjunction with MOFA and supported by GIZ's Market-Orientated Agriculature Programme (MOAP). The standard is orientated towards food safety and reducing the use of pesticides and can be used as a stepping stone to achieving organic certification and GlobalGap. SRP is a multi-stakeholder platform which was established in 2011 by UN Environment and the International Rice Research Institute (IRRI) to promote resource efficiency and sustainability in supply chains in the global rice sector. Members include Fair Trade, GlobalGap, Rainforest Alliance, UTZ and GIZ. Details of the performance indicators can be found at http://www.sustainablerice.org.

Analysis of GAP / CGM and other voluntary standards applied to maize and rice

Major voluntary standards criteria relating to pest and pesticide management usually fall into the following categories: IPM, pesticide management, safety and environmental protection. Depending on the voluntary standard these criteria have to be addressed to varying degrees (Annex IX – Figure 46). The following analysis examines how stringent the requirements are.

Fair Trade certification does not address site selection or adequate disposal of spraying mixtures. Only soft detailed requirements are given for adequate storage and disposal of pesticide containers and waste disposal. High-level guidance and strict detailed requirements are given for other criteria relating to IPM, pesticide management, safety and environmental protection.

GlobalGap certification does not address site selection, require the use of HHP to be banned or necessitate the provision of bathing facilities for worker applying pesticides. Most other categories provide high-level guidance or strict detailed requirements.

The only categories Organic certification addresses with high-level guidance and strict detailed requirements are site selection, the fact that preventive measures should be implemented, the fact that pest control should be based on monitoring and the fact that HHPs are banned for use. Organic certification also addresses soil, water and biodiversity conservation.

Farm economic stability and provision of capacity building are only adequately addressed by UTZ, with some requirements included in Fair Trade certification.

State of science on crop protection

Maize – best management practices

FAW (*Spodoptera frugiperda*)

FAW is a Lepidpopteran pest that feeds on the leaves and stems of maize, rice, sorghum, sugarcane and other crops (CABI 2018a). In maize, the larvae can burrow into the cobs and destroy the growing tip, causing the plant to die.

Prevention

- Early planting to avoid high populations of the pest in areas where it has not yet become established.
- Do not plant a new maize crop near an infested field.
- Intercrop with cassava, beans or another legume (Abrahams et al. 2018).

Monitoring

- Scout the field at least once a week as soon as plants emerge.
- Look at 100 plants to assess the damage (Abrahams et al. 2018).
- Look for egg masses on the leaves: they are usually covered with a protective grey-pink protective layer of scales (CABI 2018a).
- Look for the larvae, which are light-green/dark-brown caterpillars with longitudinal stripes down their body, dark heads, with a white/yellow upside-down Y shape.
- Look for ragged leaves on the stem and growing from the whorl.
- Frass can accumulate in the whorl of the maize plant.
- Start treatment if more than 20 whorls have damage and the small larvae are still present (King and Saunders 1984).
- Once the maize is at tassel and silk stage do not spray.

Cultural control

- While scouting for if the infestation is low, hand-pick any eggs masses and larvae found and destroy.

Biopesticide control

- Apply azadirachtin (NeemAzal) [GIZ classification D] or Bt (BiPel) [GIZ classification D].

Chemical control

- As a last resort, apply a lower-risk synthetic insecticide approved by the government but spray early in the morning or afternoon, when the pest is more active.

African maize stalk borer (*Busseola fusca*)

Busseola fusca is a major pest of maize in West Africa. Maize plants are less tolerant to stemborer attack than sorghum and pearl millet plants and the effect on grain yields is therefore greater (CABI 2018b). Stalk borer can be managed adequately using preventive/cultural control. The use of synthetic chemicals on maize is uneconomical.

Prevention

- Early planting to avoid high numbers of the pest at the peak of the season (Addis 2016; Kfir et al. 2002).

- Intercropping maize with cassava or legumes has been found to significantly reduce the rate of infestation of maize by stalk borer (Addis 2016; Kfir et al. 2002).
- Managing crop residue after harvest is important in reducing carry-over of the pest into the next season. Plough in the crop stubble or bury 10–15 cm below the surface (Kfir et al. 2002).

Maize streak Disease (MSD)

Maize streak disease is caused by a virus that is vectored by several species of leaf hoppers (CABI 2018c). It is a major disease in sub-Saharan Africa which can cause significant losses in maize (Karavina 2014).

Prevention

- The most effective method of managing MSD is growing resistant / tolerant cultivars of maize developed and available in Ghana (CABI 2018c; Karavina 2014; Shepherd et al. 2010; Alegbejo et al. 2002)
- Practice early or late planting to avoid the peak of the pathogen and vector. Seedlings infected during the first 8 weeks after emergence show the greatest losses in yield (Karavina 2014; Shepherd et al. 2010; Alegbejo et al. 2002).
- Carry out crop rotation with broad leaf crops or intercropping with broad leaf crops such as legumes and cucurbits (Karavina 2014; Shepherd et al. 2010)
- Remove crop debris from the field before planting and destroy
- Destroy grassy weeds, volunteer and ratoon crops in and around the field (Karavina 2014)

Monitoring

- Inspect the leaves of the plants on a weekly basis as soon as they emerge after planting
- Look for pale yellow circular spots on the leaves. As the disease progresses the spots develop into broken streaks which run parallel to the leaf veins (CABI 2018c; Karavina 2014)

Cultural control

- Rogue out all infected maize plants from the field at the first sign of disease and destroy (Karavina 2014)

Chemical control

- There are no chemicals which can be used to directly manage the virus. Chemical insecticides have been reported to be effective in reducing vector populations but this might not be economically viable for smallholder farmers (CABI 2018c; Karavina 2014; Shepherd et al. 2010; Alegbejo et al. 2002). Systemic insecticidal seed dressings have also been reported to be effective at reducing incidence of MSD (Karavina 2014; Alegbejo et al. 2002)

Rice – best management practices

Rice blast disease (*Magnaporthe oryzae*)

Rice blast is a fungal disease of rice that can cause heavy losses under favourable climatic conditions (CABI 2018d).

Prevention

- Plant varieties which are resistant/tolerant to rice blast (CABI 2018d, IRRI 2017a).
- Plant early, at the beginning of the rainy season (IRRI 2017a).
- Nitrogen must be provided in several applications (two or more). An excess of nitrogen increases the damage caused by the disease (Afolabi and Adigbo 2014; CABI 2017d; IRRI 2017a; Xu et al. 2006).

- Avoid water stress and immerse the fields as often as possible (CABI 2018d, IRRI 2017a).

Monitoring

- Initial symptoms are white to grey-green lesions or spots on the leaves, with dark-green borders. As the disease progresses older lesions become elliptical or spindle-shaped, whitish to grey in the centre, with a brownish-red or necrotic margin. The lesions can widen and join together, eventually killing the entirety of the leaves (IRRI 2017a).

Chemical control

- A systemic fungicide, such as azoxystrobin [GIZ classification D], can be applied at heading (IRRI 2017a).

Rice stemborers (*Maliarpha separatella*, *Scirpophaga* spp., *Chilo* spp., *Sesamia* spp.)

Many different species of stemborers affect rice and feed on rice plants, from the seedling stage until harvest.

Prevention

- Plant resistant varieties. Varieties such as LAC 23, ITA 121, TOS 4153, NERICA 1, NERICA 2, NERICA 4, NERICA 5, NERICA 7 and NERICA 14 have been reported to be tolerant / resistant to rice stemborers (IRRI 2017b, Mück 2015; Nwilene et al 2013).
- Destroy egg masses at the seedling stage and during transplanting. Cut the leaves to shorten them during transplanting to limit the number of eggs transferred on leaves from the seedbed to field (IRRI 2017b).
- Avoid staggering the planting dates, as the pests will move from one crop to another (IRRI 1985; IRRI 2017b).
- Vetiver (Vetiveria zizanioides) or Sudan grass may be used as a trap crop for species of the genus *Chilo* ssp. Plant a strip at the edge of the field: this will attract the stemborers to lay eggs on the trap crop. The eggs will not develop as the trap crops are toxic to borers (Van den Berg 2013, XuSong et al. 2009). Important note: this technique has been effective in Asia against another species of the genus *Chilo*. It has not been tested in West Africa (it has been tested only on maize). There is no scientific study to prove the effectiveness of this measure on rice in Africa.
- In flooded cultivation, periodically raise the water level to submerge the eggs laid at the plant base (IRRI 2017b).
- Avoid excess nitrogen: stagger the application (IRRI 1985, 2017b, Randhawa, Aulakh 2014).
- When harvesting, cut the stems at their base to eliminate the larvae in the straw. Dry the straw in the sun or burn it to kill the larvae (IRRI 2017c, Mück 2015).
- Eliminate crop residues and volunteer regrowth by ploughing and flooding the field (IRRI 2017b, Ramzan et al. 2009, Mück 2015).

Monitoring

- Monitor 20 tufts of rice and consider treatment only if more than two clumped egg masses are seen during the first two months, then more than one egg mass on 20 clumps thereafter (IRRI 2017b).

Chemical control

- Chlorpyrifos (Dursban 4 EC) can be applied to manage stemborers [GIZ classification B].

African rice gall midge (*Orseolia oryzivora*)

Gall midge mainly causes damage to rice grown in lowland areas. Management of gall midge is often limited to only preventative measures but these can adequately limit the damage caused. Most insecticides are ineffective and may affect beneficial insect populations (Nwilene et al. 2006).

Prevention

- Sow resistant varieties if available in Ghana. The following varieties are tolerant to gall midge: NERICA-L 19, NERICA-L 25, NERICA-L 29, NERICA-L 49, Cisadane, BW 348-1, Leizhung, TOS 14519. Many varieties of African rice *O. glaberrima* are resistant to midge, eg TOG varieties 7106, 7206, 7442, 6346, 5681 (Nwilene et al 2017; Mück 2015; Nwilene et al. 2013).
- Plant at the same time as your neighbours to prevent gall midge from moving from one field to another limiting the damage and development of the gall midge population (CABI 2017; Mück 2015; Nwilene et al. 2006)
- Transplanted rice is more frequently attacked than directly sown rice. Rice transplanted late in the season is more likely to be infested (Sama et al. 2016; Mück 2015; Nwilene et al 2006).
- Eliminate volunteer rice plants (Oryzae longistaminata) and regrowth as the midge can survive in these plants (CABI 2017; Mück 2015; Nwilene et al. 2013).
- Apply fertilize in moderation (60kg N / ha). Too much nitrogen will strengthen infestation by the gall midge. Do not use more than 80kg N / ha (Mück 2015; Nwilene et al 2013; Ogah et al. 2005).
- Avoid planting too close together. A planting distance of 30 X 30 cm is appropriate (Mück 2015; Nwilene et al. 2006; Ogah et al. 2005).
- Do not transplant seedlings from an infected nursery (Mück 2015).
- Destroy crop residues. Gall midge can shelter and survive in the residue until the next crop is planted (Nwilene et al. 2013).
- Planting Paspalum (*Paspalum scrobiculatum*; Kodo millet) at the edge of rice paddies attracts another midge (*Orseolia bonzii*) which does not attack rice but will attract parasitoids that will attack gall midge (Nwilene et al. 2017; Ogah et al. 2009).

Monitoring

- The most obvious symptoms caused by African rice gall midge are the long cylindrical galls (3 mm in diameter and from a few cm up to 1-1.5 m) Coiled, silvery leaves similar to onion leaves. There is no intervention threshold for this pest.

Chemical control

- Gall midge damage reduction and increased yield can be achieved with neem products (Ogah and Ogbodo 2012).
- Seed treatments containing neonicotinoids may be used. Thiamethoxam and Metalaxyl-M and Difenoconazole [GIZ classification B, C and C respectively], Thiamethoxam, Fludioxonil and Metalaxyl-M [GIZ classification B, D and C respectively], Imidacloprid and Thiram [GIZ classification B and missing data, respectively).

Review of GIAE advisory material

Module 3.2. Weed and Fertilizer/Nutrient Management Good Handling Practices – Maize

- Recommendations made for herbicides: glyphosate (GIZ category B) paraquat (GIZ category B) pendimethalin (GIZ category C) – look at less hazardous options that are available and that could be recommended.
- The pesticide precautions in this module are lacking. Information on how to calibrate spraying equipment should be given. This section should also mention that only pesticides registered for use with maize should be used. There is no mention of using PPE, pre-harvest interval, re-entry interval, or disposal of empty containers. There is another section specifically on safe use of pesticides, in Module 3.3. If the modules are stand-alone documents this section could be

improved; if they are not, the reader could be referred to the section in Module 3.3 for more information.

- The management section on striga suggests using other cultural practices – these need to be defined and included.

Module 3.3 Pest and Disease Management and Safe Use of Pesticides – Maize

- A description of the damage caused and the lifecycle of FAW and armyworm is given in this section, but the management section is missing. This needs to be added.
- For management of stemborers it is suggested to use neem extract or soap. It would be useful to include instructions on how to prepare these.
- Resistant varieties are suggested for management of maize streak. Examples should be added.
- No additional information is included on the management of other maize diseases. The pest and disease section in the rice module is set out in a tabulated form, with images of the pest or disease symptoms. This could be replicated for the maize material.
- No monitoring advice is given and economic threshold values are not included for maize pests and diseases.
- Pesticides recommended: karate (lambda-cyhalothrin) [GIZ class B], orthene (acephate) [GIZ class B], Rimon (novaluron) [GIZ class B]. Consider replacing or adding lower-hazard biopesticides, such as Bt or azadirachtin.
- Farmers should be aware of the AI in the pesticide product. It would be useful to mention both the AI and examples of trade names – but consistency throughout the material would make it less confusing.
- In cases of pesticide poisoning there is a Poison Control Centre at Ridge Hospital in Accra, which can be contacted for advice 24 hours a day on +233 302 244 733.
- The text for the safe use of pesticides advice could be standardized and used in both maize and rice materials.

Module 3b Nursery Management and Planting

- In the section on seed treatment benlate and mancozeb are recommended. Benlate (benomyl) is an HHP [GIZ Class A] and should not be recommended for use. Mancozeb is also an HHP [GIZ class B].

Module 3d Disease and Pest Management

- Where resistant varieties are mentioned it would be useful to include examples.
- For the fungal diseases, information on when to implement control measures needs to be included.
- Benomyl is mentioned again for management of brown leaf spot. This should be removed.
- IPM is mentioned in several of the modules but no definition is given. It would be useful to include a definition, so both AEAs and farmers have a better understanding of the principles.

Advisory service characteristics and the advice they provide

Overview of extension services

Ghana has a decentralized extension system where AEAs report to each District Assembly. The AEAs are expected to advise farmers on all agronomic aspects of crop production, in addition to pest management in the field and post-harvest. One of the major constraints on the extension system in Ghana is the lack of capacity. Ho West district was reported to have as few as seven AEAs and Techiman reported 12 in their district. With financial constraints for travel, reaching

sufficient farmers is difficult. Two-thirds of AEAs said they rely on group training and demonstration farms to train farmers. Eight AEAs said they have direct individual contact with farmers. Only two AEAs said they used radio as a means of providing information to farmers as it is expensive. However, radio was reported by farmers as one of their preferred methods of receiving information (Annex IV – Figure 33). The majority of AEAs communicate with farmers by telephone and this is a two-way process, with the AEAs following up with the farmer using the same method (Annex IV – Figure 35).

AEAs' perceptions of pest problems in the focal crops

All AEAs reported that FAW was the most common pest on maize in the field, closely followed by stemborers. The most common recommendation for FAW was synthetic pesticide, although two-thirds of AEAs also recommended Bt and three-quarters recommended using neem extracts. AEAs said they mainly recommended synthetic insecticides to control these problems. Very few preventive recommendations were made for FAW or stemborers (Annex IV – Figures 28, 29 and 32; Tables 14–17). The AEAs did not perceive weeds as a problem for maize production in the field but this was reported by 14 out of 15 of the farmers as the second biggest problem in maize, after FAW (Annex III – Figure 6).

Nearly all of the AEAs reported birds as the main problem in rice production, followed by grasshoppers, which is in line with what the farmers reported. AEAs did not recognize rice blast disease as a major issue but this disease was reported by a third of farmers as a problem. The main post-harvest issues for rice that were mentioned by AEAs were rodents and weevils; again, this follows what was reported by the farmers (Annex IV – Figures 30–31). Three AEAs recommended preventive, physical and homemade biopesticides as means of control for rice pests. All AEAs recommended synthetic pesticides for rice pest management, with three HHPs being recommended: e.g. mancozeb for rice blast disease and chlorfenvinphos for leaf hoppers (Annex IV – Figure 32; Tables 18–20).

Other constraints on production and pest management practices

During the FGD, AEAs highlighted the issue of the lack of available thresholds for pest management in maize and stated that farmers are forced to use their own judgement. The AEAs felt that they did not have enough knowledge about managing FAW and that farmers were desperate for information on how to manage the problem and were looking for immediate measures – often relying on synthetic insecticides. The AEAs were concerned that many farmers were unable to read and understand the labels on pesticide containers to calculate the correct dosage for application and use adequate PPE. Marketing was raised by AEAs as an issue as while prices for grain remain relatively stable the cost of inputs is increasing, offering little incentive to farmers to continue production. AEAs reported that farmers were slow to adopt new technologies as several organizations, each with different approaches, were working with the same farmers and AEAs at the same time. This creates a lack of consistency and continuity and ultimately causes confusion amongst the farmers and AEAs.

Knowledge of pests, IPM and rational pesticide use

The questionnaires indicated that although some AEAs had a reasonable understanding of the pests affecting maize and rice and their management, others were unable to name the pests and recommendations for their control. Just under half of the AEAs were able to provide examples of preventive, physical/mechanical and biological control measures for pests affecting their crops (Annex IV – Figure 37). The AEAs reported that there were many different barriers to implementing IPM in maize and rice cropping systems. The barriers most commonly reported by the majority of AEAs were lack of extension materials, lack of knowledge amongst farmers and the fact that IMP takes too much time to implement. Lack of support from government and research were also highlighted as major barriers. Other issues raised by just over half of the AEAs were that IPM is too complicated and expensive to be carried out effectively (Annex IV – Figure 36).

Pesticide handling and use

The AEAs reported numerous issues regarding the application of pesticides. The most commonly reported were that farmers used the wrong dosage, pesticides were applied at the wrong time, too many applications were made, and appropriate PPE was not worn. To a lesser extent they reported that there were issues with spraying equipment not being calibrated correctly, pesticide drift, environmental contamination, counterfeit/low-quality products being used, and at times the wrong product being used (Annex IV – Figure 38). Recommendations for the storage of pesticides were generally good, with 12 AEAs recommending that pesticides should be stored in original containers in a locked location and with 10 recommending that they should be stored in a place that is inaccessible to children and that the location should have a warning sign. Very few of the AEAs, however, recommended that the storage place should be outside the home (Annex IV – Figure 39). Only half of the AEAs recommended rinsing and puncturing the pesticide packaging to prevent reuse. The majority of AEAs recommended burying or burning the empty container, which is acceptable as no reliable collection system is in place (Annex IV – Figure 40). Only two of the AEAs interviewed were very familiar with all of the warning symbols on pesticides. Seven AEAs identified between six and eight symbols correctly. The most commonly symbols answered incorrectly were the symbols for apron, coveralls and corrosive (Annex IV – Figure 41).

Status of the implementation of national laws and regulations

According to the responses to the questionnaires the AEAs seemed to have a reasonable knowledge and understanding of the legislation in place that governs pesticides and pesticide use in Ghana. Approximately two-thirds of the AEAs were aware of legislation in place regarding education, use of PPE, registration, licensing, labelling and re-packaging. Very few of them were aware of legislation relating to collection of data on health effects and environmental poisoning. Although the AEAs were conversant with pesticide legislation, when asked if it was enforced the majority said that all aspects were not enforced.

Training and sources of information

Only two AEAs stated that they had received IPM training in the last five years. This was provided by the Council for Scientific and Industrial Research. Seven of the 23 AEAs surveyed indicated that they completed the FAO course but no further details were given. One AEA had training in cover crops provided by GIZ and another received training on sanitation provided by MOFA. Seven AEAs said they had received no training in the last five years and four failed to respond (Annex IV – Figure 42). Only three AEAs had extension material available and only two of those said they used it and shared it with farmers (Annex IV – Figure 43). During the in-country workshop it was mentioned that at the time of training the AEAs the extension material was not finalized but it is now printed and will be disseminated. The frequency of support received by research organization was variable: six AEAs reported that they received information from research a few times a year; three stated they did so once a year and three stated they did not receive information (Annex IV – Figure 44).

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

Stock-taking of registered HHPs, and their use - *Hazard identification: identification of the HHPs and other hazards associated with pesticides which are registered in Ghana*

The 159 AI registered in Ghana differ in terms of their overall hazard level (Figure 1): 30 of the AI which are allowed for use meet one or more of the HHP criteria; 44 AI are categorized as “danger” (one or more of the associated human health hazard statements indicate that the AI is “toxic” or “fatal if inhaled”); 68 AI are categorized as falling into the “warning” category; nine AI are categorized as falling into the “low-hazard” category (there are no known human health hazard statements associated with the AI); and key human health hazard data is missing for eight AI. The AI which are identified as HHPs are listed in Annex V.

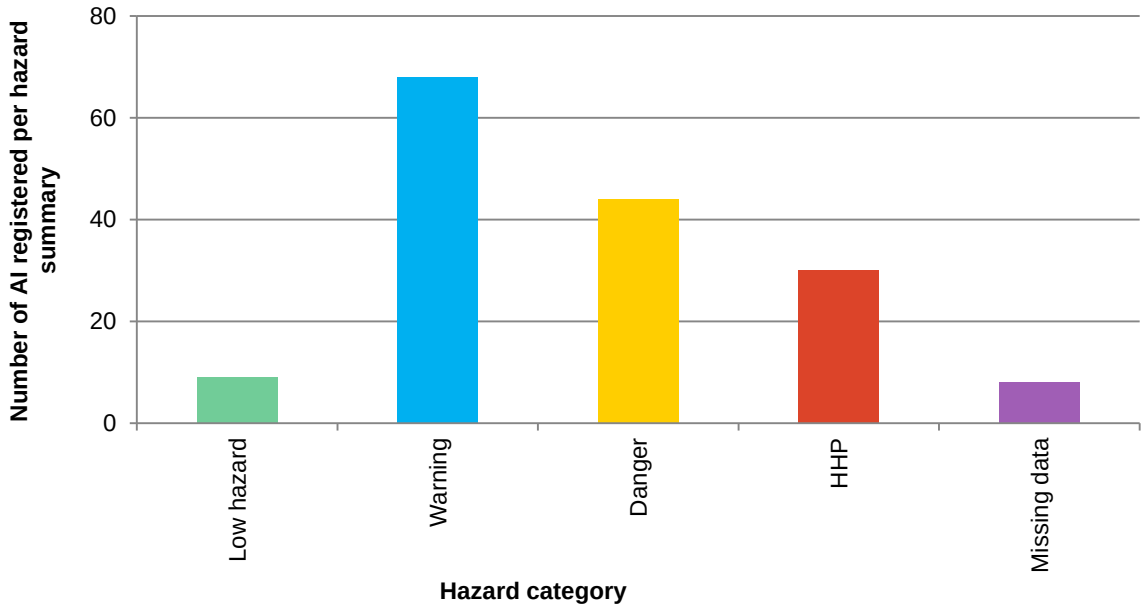

Figure 1. Number of AI in each hazard category

Of the HHPs identified, 47% are carcinogens, 30% are either extremely or highly acutely toxic, 27% are reproductive toxins and 3% are mutagens (Figure 2). Carbofuran requires PIC under the Rotterdam Convention. There are no POPs listed in the Stockholm Convention which are registered for use in Ghana. Carbendazim is the only AI which meets more than one of the HHP criteria.

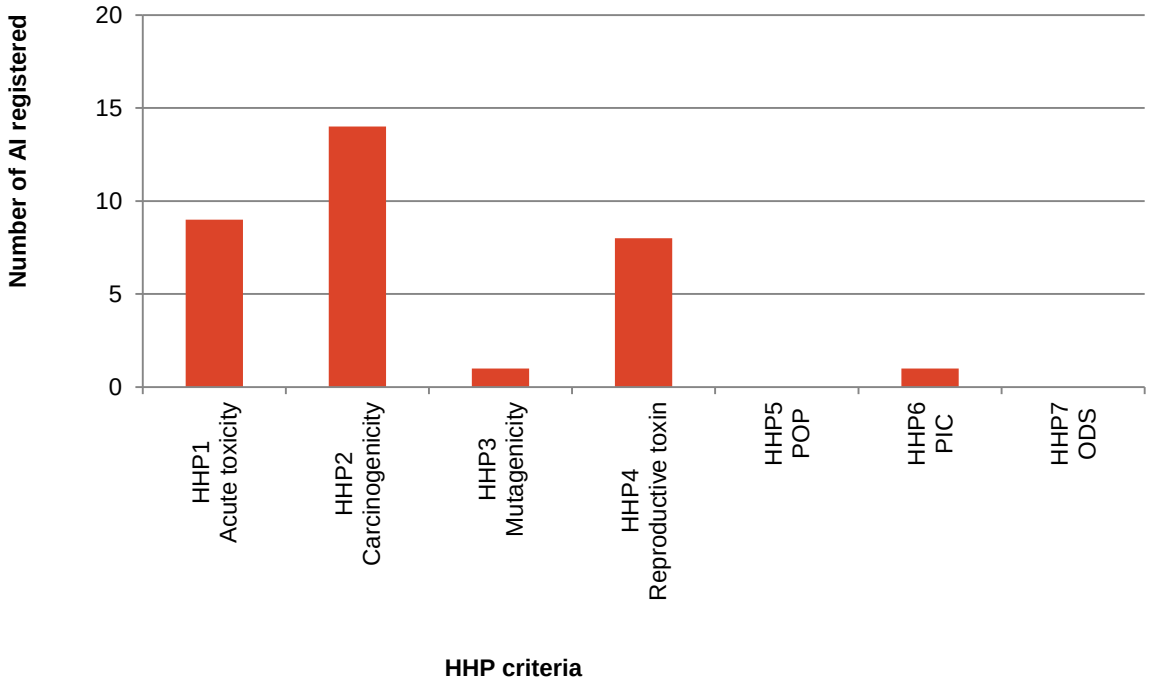

Figure 2. Number of HHP AI allowed for use per HHP criteria

In addition to the information on the HHP criteria, the compiled GHS hazard statements identify other human health and environmental hazards. Irritation to the skin, eyes or respiratory tract are frequently listed as potential health effects (68 AI). Other human health effects which are identified include endocrine disruption (22 AI), allergic reactions (47 AI), the potential for serious eye damage (58 AI) and the potential for organ damage (both specific and general, 56 AI). The human health hazard statements covering health effects are included in the determination of hazard category. With respect to environmental hazards, 109 AI are found to be very toxic to aquatic organisms,

often with the potential for long-lasting effects. Data on pollinator hazards is available for 58 AI, and, of those that were assessed, 13 AI are found to be very toxic or very highly toxic to bees.

None of the AI are listed as candidate POPs. Twenty-two of the identified AI are currently listed in the Rotterdam database of notifications of final regulatory action. Fifty-eight of the AI are included in the PAN HHP list (2016). On an AI basis, 59% of the AI are allowed for use in the EU (approved = 92 AI) or pending approval for use in the EU (pending = two AI), whereas the other 41% are not allowed for use in the EU (not approved = 38 AI) or otherwise not listed (26 AI). Refer to Annex VI for information on the specific AI.

Eleven of the identified AI are allowed for use in organic agriculture in that they are listed in Annex II of Commission Regulation (EC) 889/2008. Thirty-four of the AI are classified as U (unlikely to cause acute hazard under conditions of normal use) in the *WHO Recommended Classification of Pesticides by Hazard* (2009). Many (46 AI) of the AI identified through this study are not listed in the 2009 classification.

Per the GIZ procurement policy, 11 AI fall into procurement category A (not allowed), 64 AI fall into procurement category B (only as exception, elaborate verification needed), 19 AI fall into procurement category C (only by authorized staff with strict protection; not for small farmers) and 39 AI fall into procurement category D (appropriate precaution) (**Error! Reference source not found.**). Twenty-six of the AI have not been classified by GIZ.

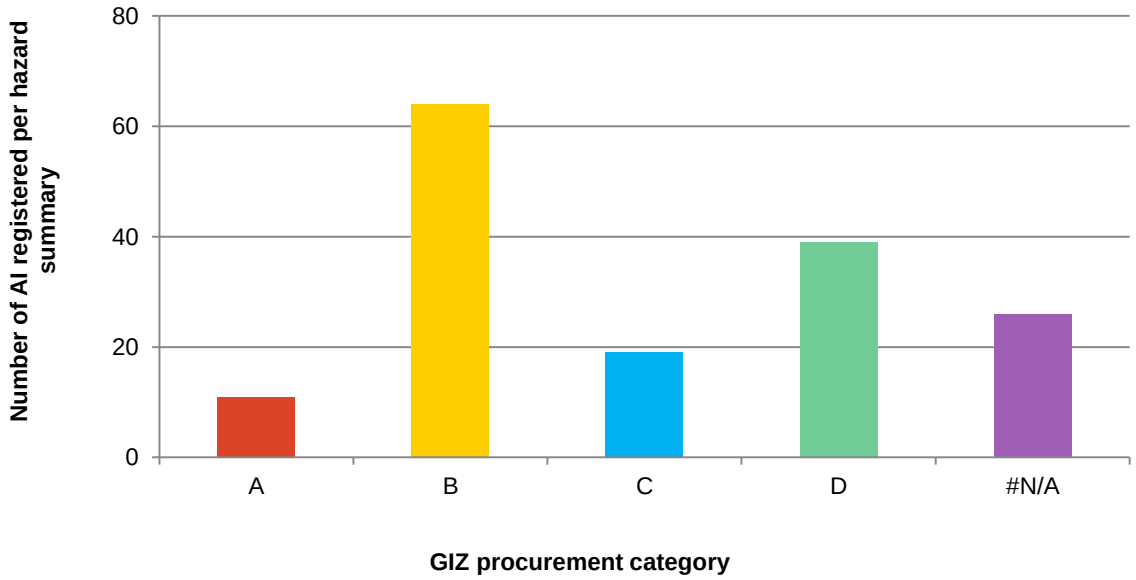

Figure 3. Number of AI per GIZ procurement category

The current study identified 47 non-HHP AI which are also registered to manage the pests for which HHPs are currently registered. For the vast majority of the target pests, at least one non-HHP AI was identified. On average, eight non-HHP AI were identified per target pest on rice (minimum = one AI, maximum = 16 AI, median = 7 AI). On average, for maize pests five non-HHP AI were identified (minimum = one AI, maximum = 15 AI, median = three AI). The responses to the farmer questionnaires highlighted the use of three registered HHP AI. In rice production, carbofuran was reported to be used to control birds and rodents and aluminium phosphide to manage weevils during grain storage. For maize, only Beta-cyfluthrin (combined with imidacloprid) was reported to be used to control squirrels and ants. Extension agent questionnaires identified three different HPP AI being recommended to farmers: chlorfenvinphos to control leaf hoppers on rice, mancozeb for blast disease on rice and permethrin (in combination with pirimiphos-methyl) to manage weevils on maize in the field. One other practice that was noted during the study was the use by several rice farmers of Endocet mixed with maize flour to control rodents and birds. Endocet is a combined opioid/non-opioid pain reliever containing oxycodone/paracetamol for use

in humans. While this chemical may be effective, its use might not by appropriate against rodents and the AI are not registered for use as a pesticide. The full list of pests and the lower toxicity alternative pesticides which are registered to manage them are given in Annexes VII and VIII. All pests reported during the study (13 for rice and 17 for maize) have HHP alternative AI which are registered for use in Ghana, also listed in Annexes VII and VIII.

Conclusions

Main findings and recommendations for action

SWOT analysis carried out during the stakeholder workshop

STRENGTHS	WEAKNESSES
Extension services • Existence of a network of public and private (NGOs) extension systems • Existence of a research-extension-farmer linkage approach to technology transfer • Support from development projects **Implementation of IPM in value chains** • Existence of less cumbersome and capital-intensive IPM strategies • Reduction in pesticide use • Existence and knowledge of biopesticides **Pesticide management** • Existence of projects contributing to the elimination of obsolete pesticides • Existence of the Plant and Fertilizer Act 803 and Pesticide Management and Control Act 490 of 1994 • Ghana is a signatory to major international protocols and conventions on pesticides and plant protection	**Extension services** • Inadequate number of personnel • Ageing extension personnel • Experienced personnel leaving • Inadequate extension materials on crop protection • Insufficient documentation of tested experiences of IPM • Insufficient knowledge of AEAs in diagnosing diseases and pest problems (production and post-harvest) • Inadequate knowledge of registered pesticides for the different crops • Weak synergies between research and extension • Poor supervision of extension staff by superiors **Implementation of IPM in value chains** • Weak capacities in identification and analysis of the economic importance of pests and their natural enemies • Weak in-country capacities to determine MRLs • Few farmers trained in IPM • Some IPM strategies are laborious (seen as drudgery) • Poor knowledge of the interaction among economy-human health-environment during the implementation of IPM strategies • Weak institutional and organizational structures of Farmer Based Organizations (FBOs) and chain actors in general **Pesticide management** • Insufficient pesticide inspection personnel prevents systematic pesticide control • Registered pesticides list not readily available • Lack of disposal sites in the country • Inadequate supporting documents for pesticides laws affects implementation • Sanctions for offences relating to pesticides are not severe enough to deter offenders • Law-enforcing agencies unaware of the existence of legislative instruments • Poor knowledge of actors on the major international protocols and conventions on pesticides and plant protection that Ghana is signatory to • Ignorance of actors in the industry about existing local statutes • Inadequate education on available legislation

OPPORTUNITIES	THREATS
Extension services • Presence of communication channels and extension tools • Presence of local trainers (lead farmers) • Presence of input dealers giving technical advice • Presence of projects that facilitate extension services • Increasing demand for extension services **Implementation of IPM in value chains** • Farmers interested in trying new methods of pest control • Meeting national and international quality standards • Boosting consumer confidence by preserving the health of chain actors and the environment • Promotion of contractual models of production and supplies • Engagement of the private sector in biopesticides production • Existence of spray gangs and mechanization service providers, some of which are well trained **Pesticide management** • Pesticide distributors finance the collection and disposal of empty containers • Training and capacity building on the available legislation • Creation of disposable sites at specific locations for containers and obsolete chemicals	**Extension services** • Dwindling budgetary support from projects • Exodus from rural areas to urban areas (farm labour problems) • Institutional instabilities (changing ways of doing things) • Dwindling budgetary support from government **Implementation of IPM in value chains** • Climate change • Degradation of natural resources • Youth not interested in agriculture • Relative low prices of pesticides • Existence of HHPs • Existences of unregistered pesticides on the market • Pesticide distributors give extension advice • Pesticide residues detected in farm produce, leading to rejection by industries and individual consumers • Competition from safe produce **Pesticide management** • Uncontrolled influx of HHPs, which can affect the environment • Influx of counterfeit products • Food contamination • Ban on agriculture exports into international markets • Increased health hazards to human and other biological organisms

Stakeholder perspectives

All participants (see Annex X for list) at the workshop recognized there are gaps in the legislation regarding pesticide management. One of the main issues is the lack of legislative instruments to support the acts which are already in place. There are several ministries and government departments that are mandated to manage pesticide use in one way or another, but it is not always obvious where each department's responsibilities lie and there is much overlap. The biggest concern relating to pesticide legislation seems to relate to the inspectorate and enforcement of the law. Concerns were raised by stakeholders about the lack of coordination of data collection relating to pesticide residues in food and cases of poisoning. The representative from the GSA raised the point that if data is not collected and analysed the country will not be able to set its own MRLs for produce and food, and will have to continue to rely on those set by Codex.

MOFA recognizes that there is a lack of coordination of plant health initiatives at the national and regional levels. It was noted during the interviews and the stakeholder workshop that multiple organizations are implementing similar projects with the same groups of farmers and extension providers. Different technologies are being recommended for the same problems and this creates a lack of consistency and continuity, and ultimately causes confusion amongst farmers about which best practices to use. Ghana has a decentralized extension service and although it has a project coordination unit at the national level there is nothing in place to stop donors and other organizations bypassing the system and going straight to the regional offices. Regarding

extension, the main issue seems to be the lack capacity on the ground. Extension agents also lack knowledge on the common pests and diseases and how to manage them using IPM (including rational pesticide use). There is also a need to provide additional training in this area and also to provide extension agents with good-quality, validated advisory materials.

Issues relating to farming practices raised by stakeholders include the lack of knowledge of IPM and lack of adoption of technologies. Farmers have reasonable knowledge of pesticide management and the use of PPE but they still do not follow the recommended guidelines. Concerns raised regarding pesticides were the quantity of low-quality and counterfeit products on the market, the lack of enforcement of the law by government and the level of training of agro-input shop assistants. The manager or owner of the shop is required by law to attend trainings on a regular basis to maintain a licence but there is no provision in the law for the person selling the pesticide to have undergone the same training. There are also issues with the quality of advice relating to pest and disease management that some shop assistants provide. The stakeholders raise concerns that stocktaking of HHPs need to be carried out in Ghana and lower risk alternatives need to be identified and made available. GIZ/GAIEs staff would like the GIZ procurement category list to be promoted and made more accessible within the organisations in-country offices and low hazard products to be included in the list.

Recommendations for the implementation of priority, innovative measures in crop protection in the selected value chains

For maize the current priority has to be with the management of FAW. The recommendation proposed by this report is to reduce synthetic pesticide applications and to recommend more of the biopesticide products that are becoming available on the market, such as Bt and azadirachtin. PPRSD has just updated its management strategy for FAW and has removed synthetic pesticides from the recommendation and replaced them with low-hazard options. A cost–benefit study would be useful to compare traditional insecticides with biopesticides. Looking at options for the use of Aflasafe to reduce levels of aflatoxin in maize should be considered.

By far the biggest constraint on rice production is birds, which are very difficult to manage. Researchers at the University of Ghana suggest that netting is the best option. There is acknowledgement that netting is expensive and a big outlay for farmers initially. Researchers are currently looking into alternative materials to strengthen and prolong the life of bird nets. Many pest and disease issues in rice can be eliminated in the nursery and only the healthiest plants transplanted to the field. More effort must be made to persuade farmers to employ this method, instead of broadcast sowing directly in the field. To implement this, options for mechanization may also need to be considered as farmers' reasoning for not applying this practice was the high labour input.

More generally, the following points can be considered as actions for consideration:

- Organize events to promote learning on IPM and GAP where experiences are shared and the approach improved to make practices more efficient and effective
- Promote non-chemical control of weeds in rice i.e. tillage and biological control
- Create an enabling environment to make IPM and GAP affordable and desirable to farmers

Priority advisory needs in crop protection in the country

Many stakeholders mentioned that many extension agents have a very limited knowledge of pests and diseases and their management, and this needs to be improved. Extension agents also need to be provided with good-quality extension materials. One of the main issues with producing extension materials is the cost of printing, keeping them updated and the dissemination. As most extension agents now have access to a smart phone a suggestion is to link them with the Plantwise Factsheet App, which can be downloaded and accessed offline. The App provides country-specific pest management disease guides for various diseases and pests. The Plantwise Knowledge Bank also provides pest management information from CABI and many other

organizations on one platform. Dissemination of information by radio should also be supported as farmers highlighted this as the most popular way to receive information. It is important to invest more in face-to-face extension and to avoid conflicting messages in crop health management practices. This can to large extent be supported by audio-visual messages which will help reach more smallholder farmers who are unable to read as well as mitigate the low numbers of extension staff.

Recommendations for pesticide management

- Stocktaking of HHPs registered for use in Ghana and low hazard alternatives identified and publicised
- A small study should be carried out to identify why farmers who have been trained and understand the risks of pesticides still do not use PPE.
- Continue to train farmers who have not been trained on the safe use of pesticides.
- A standardized comprehensive text should be written and validated on pesticide use and safety, which should be included in the GIAE training material.
- Consider local training programmes with other stakeholders for agro-input shop assistants to give basic information on pest and disease control and alternative control strategies.
- Make extension agents and farmers aware of the registered pesticide list and the products contained in it, along with their uses.
- Consideration should also be given to the promotion and investment into grain certification to help address the food safety concerns in the maize and rice trade
- Need to investigate pesticide resistance in weeds and insect pests
- Disseminate measures to avoid pesticide resistance to both extension staff and farmers

Priorities for policy action

- Harmonization of the laws relating to pesticide management should be a priority in Ghana, to prevent duplication of functions and mandates within the government. Where there is clear overlap, responsibilities should be clearly defined. An example of this is the responsibility for inspecting agro-input dealers, which is shared by PPRSD and the EPA.
- Legislative instruments to support the pesticide legislation should be produced and published. Encourage ministries to make all legal documents available in an electronic format online, including the registered pesticide list.
- Some of the areas not covered in the legislation for pesticide management which need to be addressed are the transport of pesticides, requirements for sale, availability and disposal of empty containers, and out-of-date products.

Contacts

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Annexes

Annex I: Cross-national overview of the legal framework for pesticide use

Section / aspect	GH
Adherence to and implementation of international agreements relating to pesticides	
The country is a party to the Montreal Protocol	✓
The country has enacted a provision relating to the implementation of the Montreal Protocol	✓
The country is a party to the Rotterdam Convention	✓
The country has enacted a provision relating to the implementation of the Rotterdam Convention	✓
The country is a party to the Stockholm Convention	✓
The country has enacted a provision relating to the implementation of the Stockholm Convention	✓
The country is a party to the Basel Convention	✓
The country has enacted a provision relating to the implementation of the Basel Convention	✓
The country is a party to the ILO Safety and Health in Agriculture Convention (C184)	✓
The country has enacted a provision relating to the implementation of the ILO Safety and Health in Agriculture Convention (C184)	✓
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 HHP and related regulatory and policy actions	✓
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)	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	X
Regulations related to the manufacture of pesticides	
A regulation addressing the manufacture and packaging of pesticides exists:	X
• It defines appropriate engineering standards and operating practices, including quality-assurance procedures	X
• It defines necessary precautions to protect workers	X
• It ensures the proper siting of plants and stores, and monitoring and control of waste, emissions and effluents	X

Section / aspect	GH
• It ensures that packaging or re-packaging is carried out only on licensed premises that comply with safety standards	X
• It contains provisions for cases of poisoning	X
• It ensures that lists of banned pesticides for manufacture are in harmony with the country's international obligations	X
Legal framework for non-chemical preventive and direct control measures	
Registration is required for non-chemical preventive and direct control measures	X
A subsidy scheme for non-chemical preventive 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 away 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 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 that it 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 preventive and curative control methods	X
• There are provisions for experimental permits for the importation of limited quantities of unregistered pesticides for research, education or registration purposes	✓

Section / aspect	GH
• There are provisions for the use of unregistered pesticides in emergency situations	✓
Low-toxicity / low-risk pesticides are defined	X
The legislation provides a definition of what biopesticides/biocontrol agents are	✓
The legislation addressing registration contains a system designed to encourage the use of fewer or less toxic pesticides	X
• There are fewer data requirements for less toxic products alternatives	X
• There is a special process for biopesticides (or an equivalent grouping for pesticides of natural origin under a different name, e.g. “biocontrol agents”)	✓
• There is an accelerated process or lower fees for the 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:	
○ the identity, biology and ecology of the agent	✓
○ information for the assessment of safety and effects on human health	✓
○ information for the assessment of environmental risks	✓
○ information for the assessment of efficacy, quality control and benefits of use	✓
○ the toxicity for humans and the environment of additives (for microbial biological control agents only)	✓
The legislation contains other provision which aim to facilitate 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 the requirements for label extension	✓
The legislation provides for the 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 the confidentiality of trade secrets	✓
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 AI	✓
• concentration of the AI	✓
• formulation type	✓
• authorized uses, including crops and target pests	✓

Section / aspect	GH
• the name of the registrant	✓
• the period of registration	✓
• user groups (e.g. use of some pesticides is restricted, for example to certified professionals)	X
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	✓
Biocontrol agents which are not covered by the national authority which handles 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:	X
• to carry out pest risk analysis of biological control agents	X
• to obtain, provide and assess documentation as appropriate, relevant to the export, shipment, import or release of biological control agents and other beneficial organisms	X
• 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	X
• to encourage monitoring of the release of biological control agents or beneficial organisms in order to assess impact on target and non-target organisms	X
Packaging and labelling	
The legislation specifies the products to which the packaging and labelling requirements apply (e.g. apply equally to imported and domestically manufactured products)	✓
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)	X
The legislation requires packaging which does not resemble common packaging of consumable goods	✓
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	X
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	✓
• AI name	✓

Section / aspect	GH
• AI concentration	✓
• co-formulants	✓
• net content	✓
• name of supplier	✓
• manufacturer	✓
• batch number	X
• registration number	✓
• hazard and safety information following the GHS	✓
• directions for use	✓
• warning against container reuse, instructions for storage and disposal	✓
• legal requirement that pesticides be used in a way which is consistent with the label	X
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	X
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	✓
• It prohibits the advertising of unregistered or illegal pesticides	✓
• 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	X
• It sets out requirements for vehicles and containers	X
• It prohibits the transport of pesticides in the same vehicle as passengers, animals, food or feed	X
• It requires physical separation in cases where joint transport or storage is unavoidable	X
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 the import / export of counterfeit, substandard or outdated pesticides, or of pesticides otherwise not meeting the prescribed requirements	X

Section / aspect	GH
• It establishes application procedures for a pesticide import permit	X
• It develops procedures and criteria for decisions on import permits	X
• 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	X
• It requires that exported pesticides meet the same quality standards as comparable domestic ones	X
• It requires the use of GHS customs codes on shipping documents	X
Requirements for sale	
The legislation contains a provision specifically addressing the sale of pesticides	✓
• It sets requirements so that only those with competency and training may be licensed to sell pesticides	X
• 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	X
• It prescribes the separation of pesticides from food and medicine	X
• It prescribes that pesticides may only be sold in their undamaged original containers	X
• It prescribes that pesticides may only be sold with a readable label	X
• 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	X
Licensing	
The legislation contains provisions to identify which pesticide-related activities are permitted only to operators that hold a valid licence	✓
• It prescribes the holding of a valid licence for manufacture and packaging	✓
• It prescribes the holding of a valid licence for sale	✓
• It prescribes the holding of a valid licence for transportation, import and export	✓
• It prescribes the holding of a valid licence for special applications	X
• 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 the imposition of conditions, suspension and revocation	✓
• It establishes the term of validity and the procedures for renewal of the licence	X
• It enables the authority to impose fees for services associated with licensing	✓

Section / aspect	GH
• 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 provision 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	✓
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
• Respect of the recommended application	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 licence or permit	X
• for all products and application methods	X
• only for specific products application methods	X

Section / aspect	GH
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	X
Requirements for PPE	
A policy is in place to place to promote the use of PPE which is suitable	X
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	✓
• 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 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	X
• The legislation specifies how and where pesticide products may be stored	X
○ The plant protection products are stored in their original containers and packs	X
○ The plant protection products are stored according to label storage requirements	X
○ 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
○ The plant protection product storage facilities are built in a manner that is structurally sound and robust	X
○ The plant protection product storage facilities have sufficient and constant ventilation of fresh air to avoid a build-up of harmful vapours	X
○ 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	X
○ The plant protection product storage facilities are equipped with shelving that is not absorbent in case of spillage	X
○ 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

Section / aspect	GH
○ 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, 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
○ An accident procedure, including emergency contact telephone numbers, visually displays the basic steps of primary accident care and is accessible by all persons within 10 metres of the plant protection product/chemical storage facilities and designated mixing areas	X
○ All plant protection product/chemical storage facilities and all filling/mixing areas have eye-washing amenities, a source of clean water at a distance of no more than 10 metres, and a first aid kit containing the relevant aid material	X
Disposal of unused pesticides	
A policy is in place to prevent the accumulation of obsolete pesticides and used containers	X
A policy is in place to inventory obsolete or unusable stocks of pesticides and used containers, 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	X
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	X
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	X
Disposal of empty pesticide containers	
The regulation addresses the disposal of pesticide containers	X
• The regulations governing disposal of empty pesticide containers are the same across the country	X
• Appropriate PPE is required when handling empty pesticide containers	X
• 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	X
• After rinsing, the container should be rendered unusable by puncturing, crushing or breaking	X
• The regulation contains specifications for the storage conditions for empty pesticide containers (e.g. bagged, stored in secure, ventilated location)	X
• The regulation bans the reuse 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	X
• 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)	X
• Empty containers are classified as hazardous waste regardless of whether or not they have been decontaminated	X
• Empty containers must be transported in specially licensed vehicles	X
• Empty containers may not be transported with food, beverages, medicines, feed, animals and people	X

Section / aspect	GH
• Users must return containers to the manufacturer or 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	X
• The procedure for disposal is described in legislation (recycling (if available), in a sanitary landfill, by incineration…)	X
• Pesticide waste generators (= pesticide users) are required to establish waste management plans for harm reduction	X
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 / on environmental contamination and adverse effects, including the monitoring pesticide residues in feed, drinking water and/or the environment	X
• It assigns responsibility for mandatory monitoring and data collection with respect to pesticides	✓
• It sets out the powers and responsibilities of the responsible body and the inspection corps with regard to information-gathering	✓
• It imposes reporting requirements on manufacturers, importers, distributors and sellers of pesticides	✓
• It requires reporting of pesticide-related incidents to the competent authority	X
Residue monitoring in food and MRLs	
The legislation contains provisions to regulate and/or monitor pesticide residues in food	✓
• It defines which authority is in charge of the monitoring	✓
• It defines which authority is in charge of setting the MRLs	X
• It applies to domestic production for national consumption as well as to imports / exports	X
• It applies only for a limited number of export crops	X
• It prescribes following 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	X
A policy is in place to carry out health surveillance programmes in respect 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, re-packaging, 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	✓
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

Section / aspect	GH
The legislation designates the national authority responsible for inspection	✓
• It defines the powers of the inspectors	✓
The legislation provides procedures and criteria for inspections	X
• It provides procedures and requirements for sample-taking	X
• It contains provisions for the designation of official laboratories for analysis of samples	X
• It provides clear and effective procedures for intervention if irregularities are found during inspections	X
• It defines the actions that will are considered as offences, including special offences for public officials	✓
• It determines which offences are criminal and which administrative	X
• It determines proportional and deterrent fines and includes mechanisms to adapt the fines if their value declines	X
• 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: Pesticides banned in Ghana

List of banned AI included in the Ghana list of registered pesticides (EPA/CCMA 2017)

No	Name of pesticide
1.	2,4,5-T and its salts and esters
2.	Aldrin
3.	Binapacryl
4.	Captafol
5.	Chlordane
6.	Chlordimeform
7.	Chlorobenzilate
8.	Dichlorodiphenyltrichloroethane (DDT)
9.	Dieldrin
10.	Dinoseb and its salts and esters
11.	Dinitro-*ortho*-cresol (DNOC) and its salts (such as ammonium salt, potassium salt and sodium salt)
12.	Endrin
13.	HCH (mixed isomers)
14.	Heptachlor
15.	Hexachlorobenzene
16.	Parathion
17.	Pentachlorophenol and its salts and esters
18.	Toxaphene
19.	Mirex
20.	Methamidophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l)
21.	Methyl-parathion (emulsifiable concentrates with at or above 19.5% active ingredient and dusts at or above 1.5% active ingredient)
22.	Monocrotophos (Soluble liquid formulations of the substance that exceed 600 g active ingredient/l)
23.	Parathion (all formulations – aerosols, dustable powder (DP), emulsifiable concentrate, granules (GR) and wettable powders (WP) – of this substance are included, except capsule suspensions (CS))
24.	Phosphamidon (Soluble liquid formulations of the substance that exceed 1000 g active ingredient/l)
25.	Dustable powder formulations containing a combination of Benomyl at or above 7%, Carbofuran at or above 10% and Thiram at or above 15%
26.	Methyl bromide
27.	Chlordecone
28.	Alpha hexachlorocyclohexane
29.	Beta hexachlorocyclohexane
30.	Lindane
31.	Pentachlorobenzene
32.	Technical endosulfan and its related isomers

Annex III: Results from the in-country farmer questionnaires

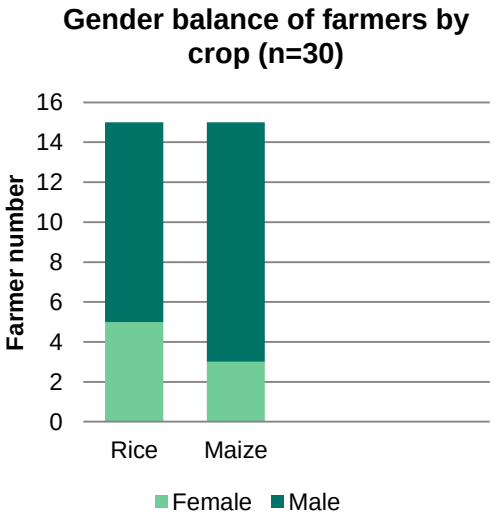

Figure 4. Gender balance of farmers by crop

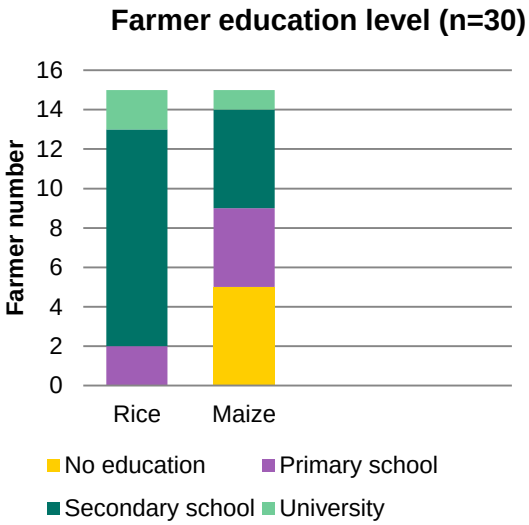

Figure 5. Farmer education level by crop

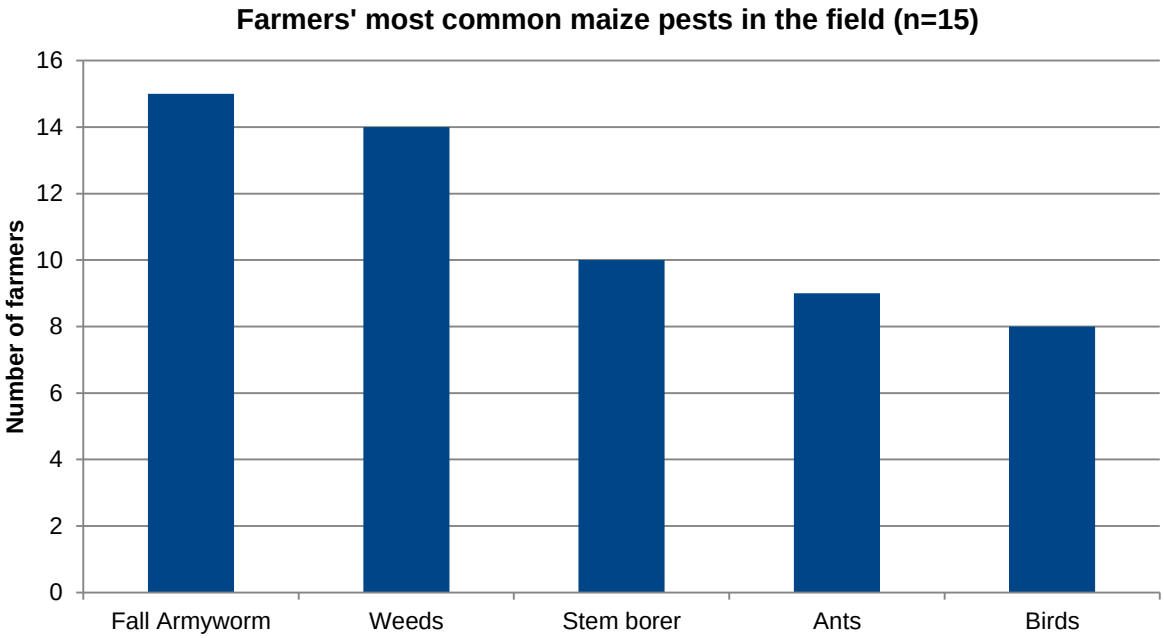

Figure 6. Farmers' most common maize pests in the field

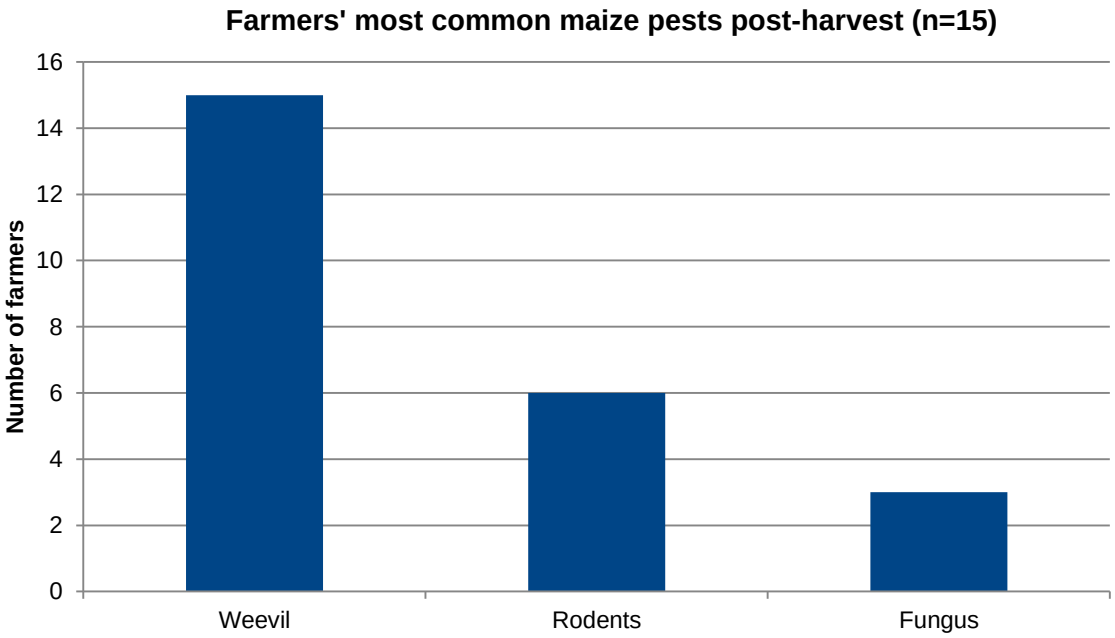

Figure 7. Farmers' most common maize pests post-harvest

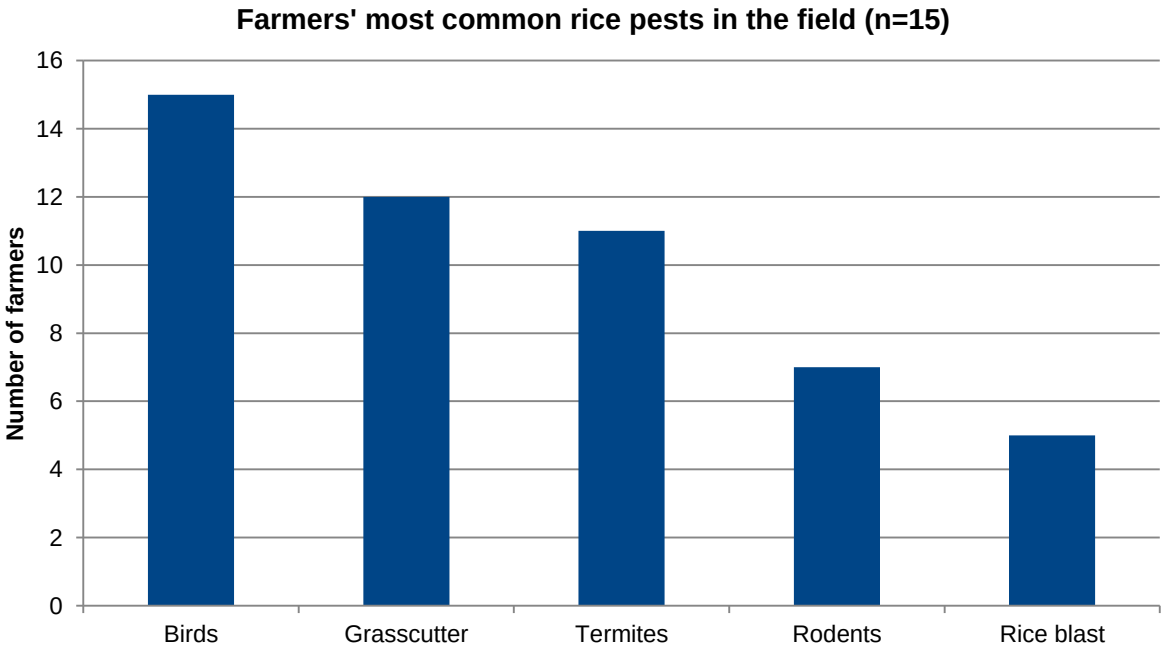

Figure 8. Farmers' most common rice pests in the field

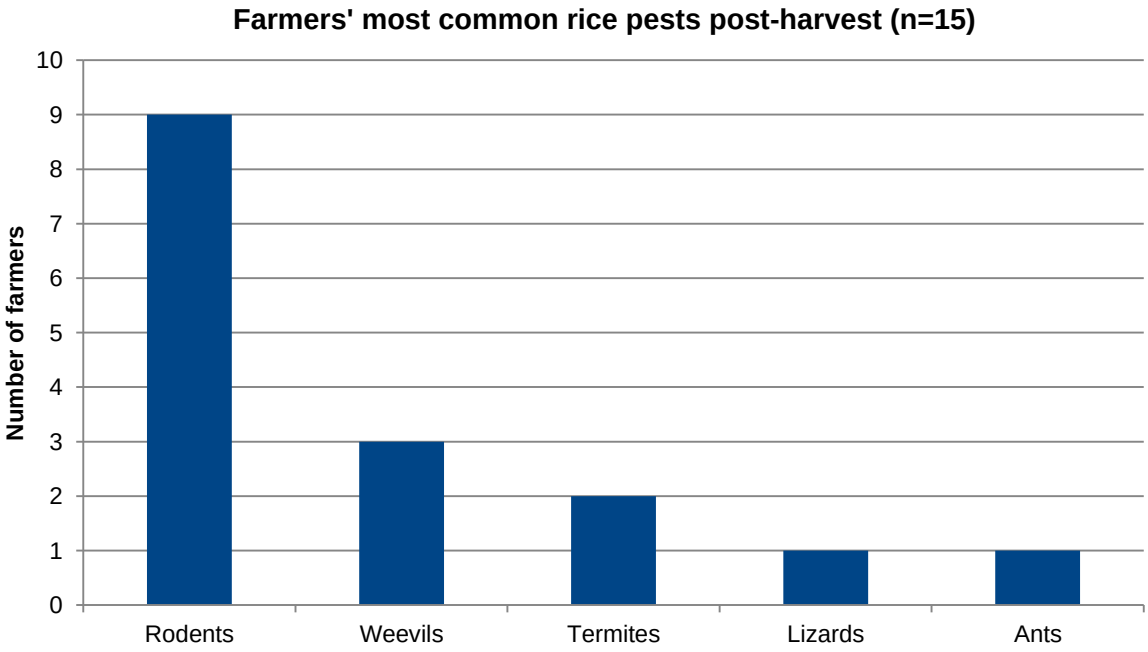

Figure 9. Farmers' most common rice pests post-harvest

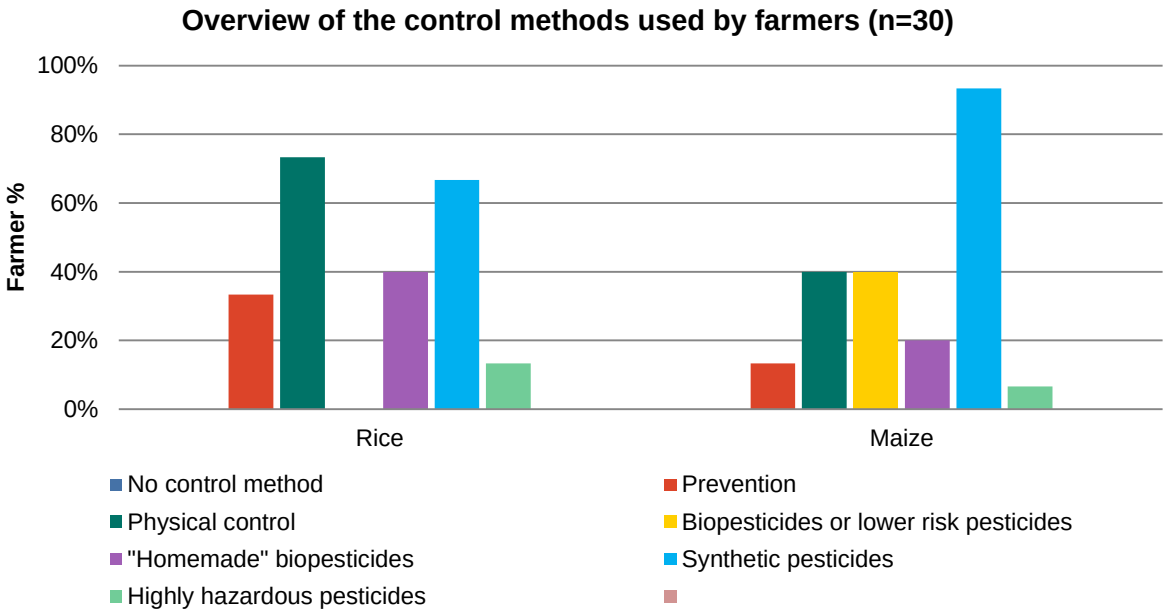

Figure 10. Overview of the control methods used by farmers

Table 6. Maize: field use of pesticides by farmers (n=15)

Pesticide type	Commercial name	AI	Target pest	HHP	Number of farmers using it	% of farmers using it
Insecticide	?	?	Ants; centipedes	?	1	7%
Insecticide	Consider	Imidacloprid	Ants; termites; FAW		2	13%
Insecticide	Dress Force	Imidacloprid + Metalaxyl - M + Tebuconazole	Squirrels; toads		1	7%
Insecticide	K-Optimal	Acetamiprid + Lambda-cyhalothrin	FAW; rodents; ants; termites		5	33%
Insecticide	Karate	Lambda-cyhalothrin	FAW		1	7%
Insecticide	Porslene	?	FAW	?	1	7%
Insecticide	Sankwan	?	Ants	?	1	7%
Insecticide	Super Top	Acetamiprid + Lambda-cyhalothrin	FAW; stemborer; centipedes; ants; birds; toads; rats; termites		8	53%
Insecticide	Sunpyrifos	Chlorpyrifos	FAW		1	7%
Insecticide	Swim	?	FAW	?	2	13%
Insecticide	Thunder	Imidacloprid + Beta-cyfluthrin*	Squirrels; ants		1	7%
Insecticide	Viper	Acetamiprid + Indoxacarb	FAW		2	13%
Biopesticide	Bipel	*Bacillus thuringiensis*	FAW; crickets		5	33%
Selective broadleaf herbicide	?	?	Euphobia herta	?	1	7%
Herbicide	Atrazine based product	Atrazine	Weeds; Spear Grass; Euphobia herta; Striga; weevils		5	33%
Herbicide	By Day	?	Weeds; *Euphobia herta*; Akuffo addo	?	5	33%
Herbicide	Nico Plus	Nicosulfuran	Weeds; *Euphobia herta*; Elephant grass; Akuffo addo		4	27%
Herbicide	Power	Glyphosate	Sqirrels; toads; ants		1	7%
Herbicide	Sarosate	Glyphosate	Akuffo addo		1	7%
Herbicide	Weed Out	?	Weeds	?	1	7%

Table 7. Maize: non-chemical control methods used in the field by farmers (n=15)

Control method	Target pest	Number of farmers using it	% of farmers using it
Ash	Termites	1	7%
Hand-picking	FAW; crickets; frogs	3	20%
Hand-weeding	*Euphobia herta*; Elephant grass; Akuffo addo	3	20%
Neem extract	FAW	1	7%
Rouging	Stemborers	1	7%
Scaring (noise; scarecrow; objects)	Squirrels; birds; livestock; toads	6	40%
Shooting	Squirrels	1	7%
Traps	Squirrels; birds; rodents	3	20%

Table 8. Maize: post-harvest use of pesticides by farmers (n=15)

Pesticide type	Commercial name	AI	Target pest	HHP	Number of farmers using it	% of farmers using it
Pesticide	?	?	Weevils		1	7%
Insecticide	Actellic	Pirimiphos-methyl	Weevils; rodents		3	20%
Insecticide	Akola Nyame	?	Weevils		2	13%
Insecticide	Durdban	Chlorpyrifos	Weevils		2	13%
Insecticide	K-Optimal	Acetamiprid + Lambda-cyhalothrin	Weevils		1	7%
Insecticide	Karate	Lambda-cyhalothrin	Weevils		1	7%
Insecticide	Super Top	Acetamiprid + Lambda-cyhalothrin	Weevils		1	7%

Table 9. Maize: non-chemical control methods used post-harvest by farmers (n=15)

Control method	Target pest	Number of farmers using it	% of farmers using it
Ash	Weevils	3	20%
Hermetic sacks	Weevils	3	20%
Neem extract	Weevils	3	20%
Re-drying	Weevils	3	20%
Traps	Rodents	4	27%

Table 10. Rice: field use of pesticides by Farmers (n=15)

Pesticide type	Commercial name	AI	Target pest	HHP	Number of farmers using it	% of farmers using it
Any agro chemical	?	?	Grasscutter	?	1	7%
Fungicide	Top Cop	Sulphur + Copper	Rice blast;		2	13%
Insecticide	?	?	Stemborer		1	7%
Insecticide	Chlorpyrifos based product	Chlorpyrifos	Termites; rice blast; birds; grasscutter		4	27%
Insecticide	Confidor	Imidacloprid	Rice blast;		1	7%
Insecticide	Dursban	Chlorpyrifos	Birds; grasscutter;		1	7%
Insecticide	Furadan (mixed with seeds)	Carbofuran	Birds; rodents	X	1	7%
Insecticide	Lambda-cyhalothrin based product	Lambda-cyhalothrin	Grasshoppers; crickets		1	7%
Insecticide	Sunpyrifos	Chlorpyrifos	Birds; termites; crickets; insects		1	7%
Insecticide	Termex	Imidacloprid	Termites		1	7%
Insecticide	Termidor	Fipronil	Termites		3	20%
Insecticide	Termise	Imidacloprid	Termites		1	7%
Herbicide	?	?	Weeds	?	1	7%
Herbicide	2, 4-D Amine product	2, 4-D Amine	Grasscutter		3	20%
Herbicide	Bisonrice 400 SC	Bispyribac Sodium	Weeds		3	20%
Drug for human use	Endocet (with maize flour)	Oxycodone + Paracetamol	Birds; rodents	?	2	13%

Table 11. Rice: non-chemical control methods used in the field by farmers (n=15)

Control method	Target pest	Number of farmers using it	% of farmers using it
Catapult	Lizards; birds	3	20%
Coconut branches placed around the field	Grasscutter	2	13%
Fencing	Grasscutter	1	7%
Hand-weeding	Grasscutter; rodents; weeds	9	60%
Oil palm chaff to attract ants	Termites	4	27%
Scaring (noise; scarecrow; objects)	Birds	12	80%
Shooting	Grasscutter	1	7%
Smoke (e.g. burning old tyres)	Grasscutter; birds	3	20%
Strong scented perfume placed around edges of the field (e.g. lavender oil)	Rodents; Grasscutter	3	20%
Traps	Grasscutter; birds	2	13%

Table 12. Rice: post-harvest use of pesticides by farmers (n=15)

Pesticide type	Commercial name	AI	Target pest	HHP	Number of farmers using it	% of farmers using it
Synthetic pesticides	?	?			1	7%
Insecticide	?	?	Termites	?	1	7%
Insecticide	Phostoxin T	Aluminium phosphide	Weevils	X	1	7%
Insecticide	Gastoxin	Aluminium phosphide	Weevils	X	1	7%
Rodenticide	?	?	Rodents	?	1	7%
Drug for human use	Endocet (with maize flour)	Oxycodone + Paracetamol	Rodents	?	4	27%

Table 13. Rice: non-chemical control methods used post-harvest by farmers (n=15)

Control method	Target pest	Number of farmers using it	% of farmers using it
Clearing storage room	Rodents	2	13%
Traps	Rodents	3	20%

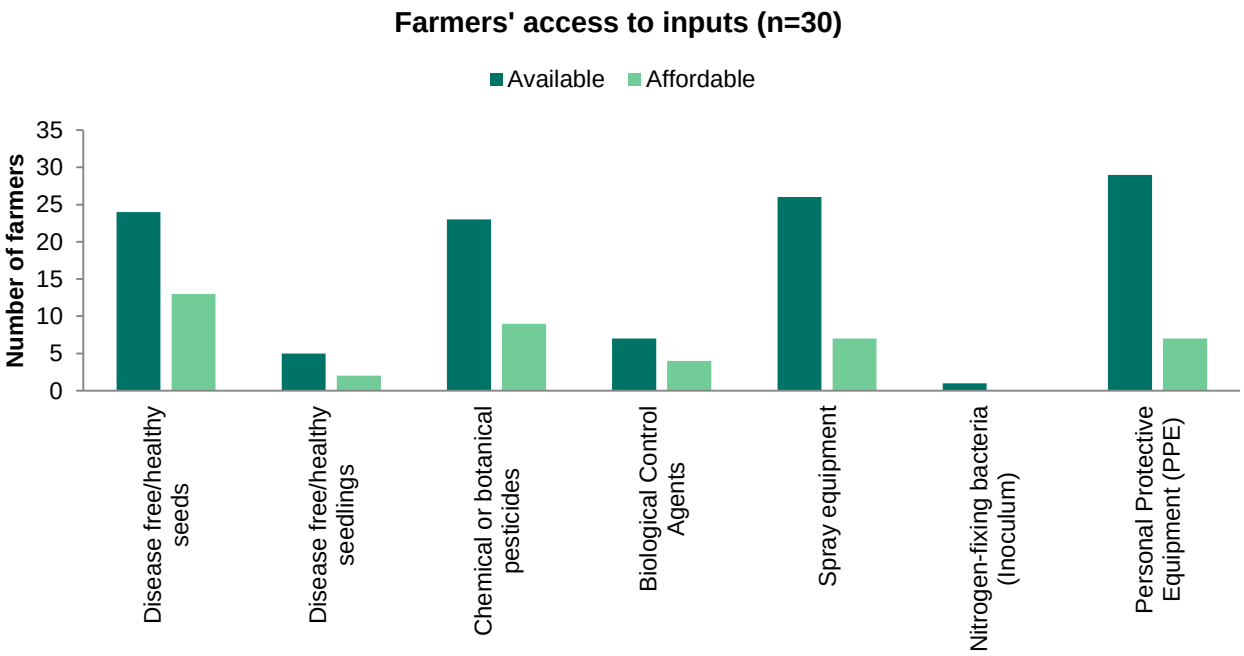

Figure 11. Farmers' access to inputs

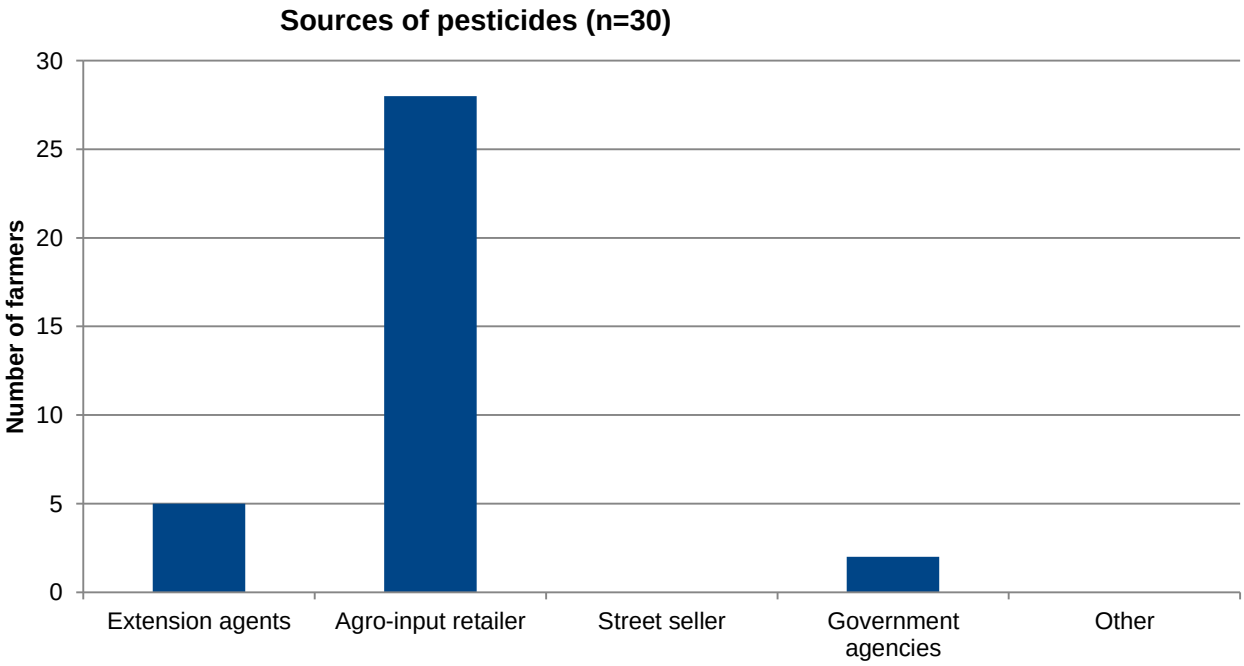

Figure 12. Sources of pesticides

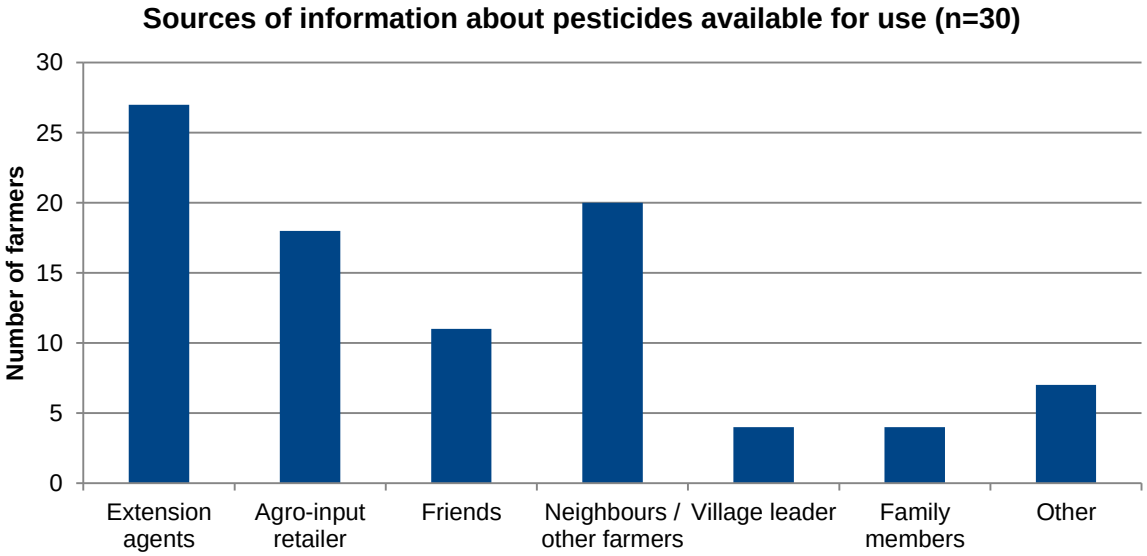

Figure 13. Sources of information about pesticides available for use

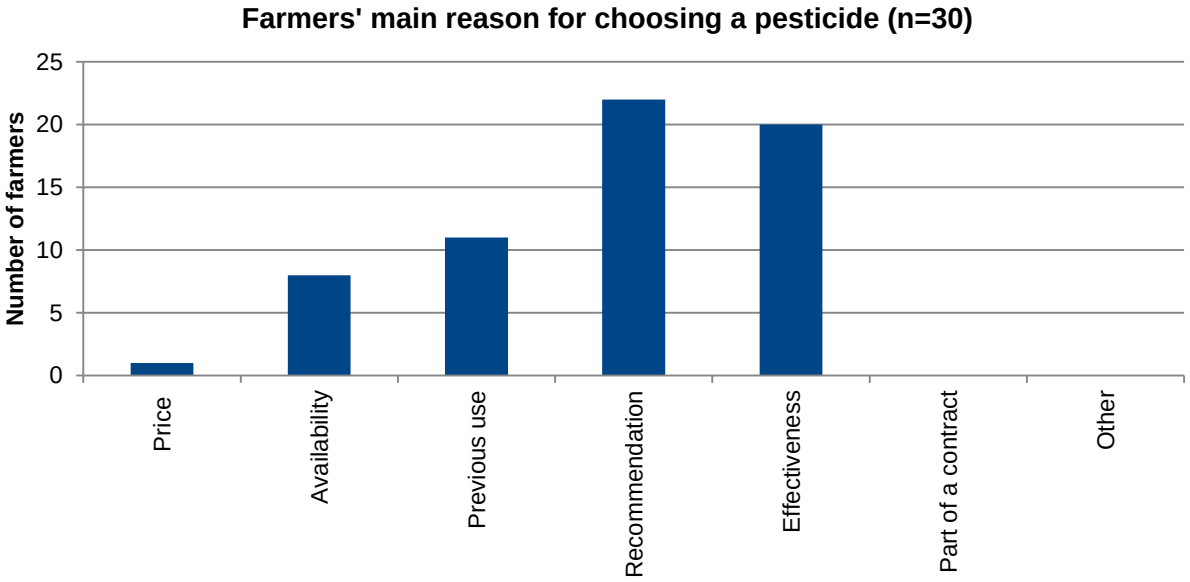

Figure 14. Farmers' main reason for choosing pesticides

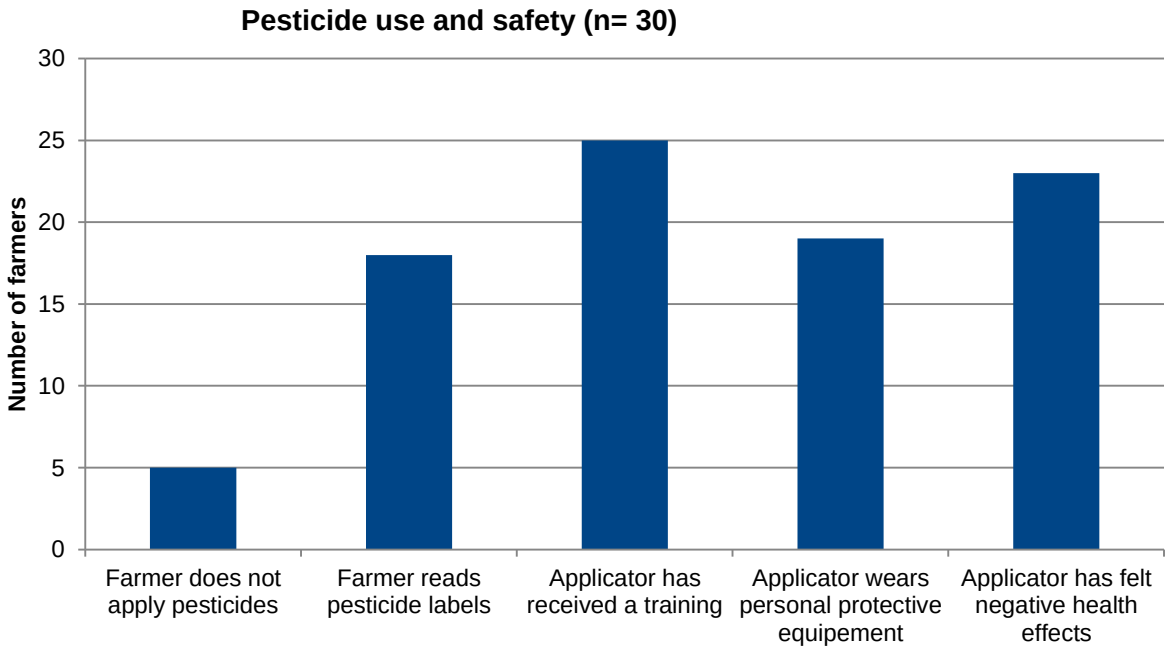

Figure 15. Pesticide use and safety

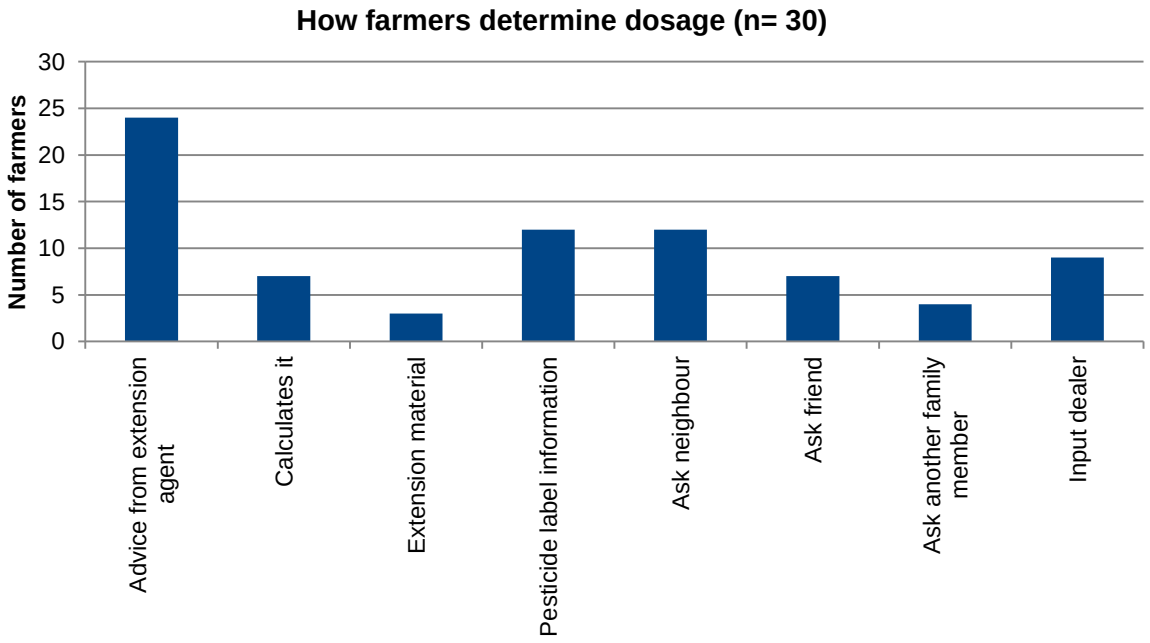

Figure 16. Determination of the correct dosage

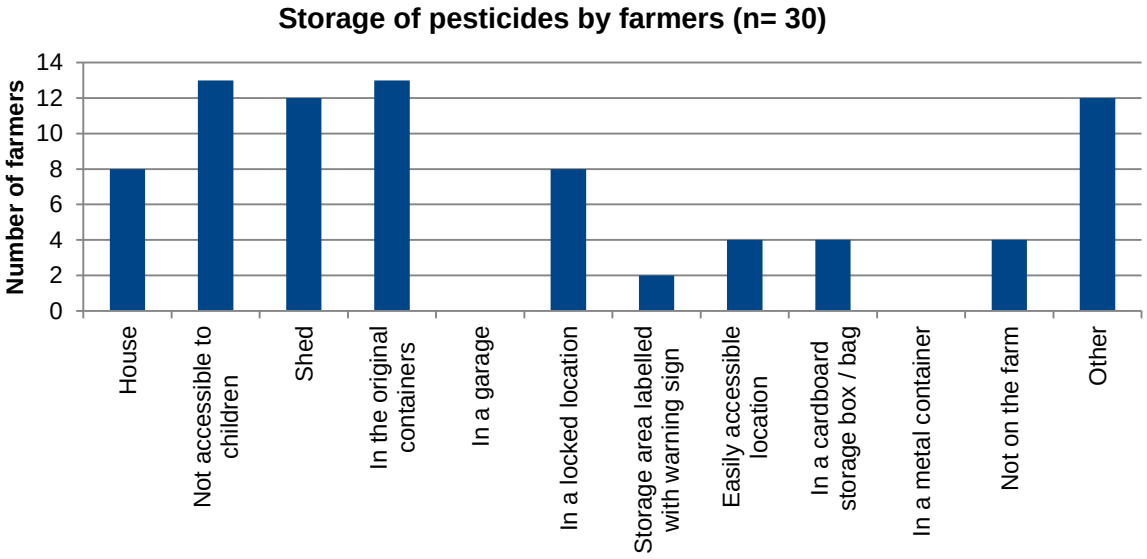

Figure 17. Storage of pesticides by farmers

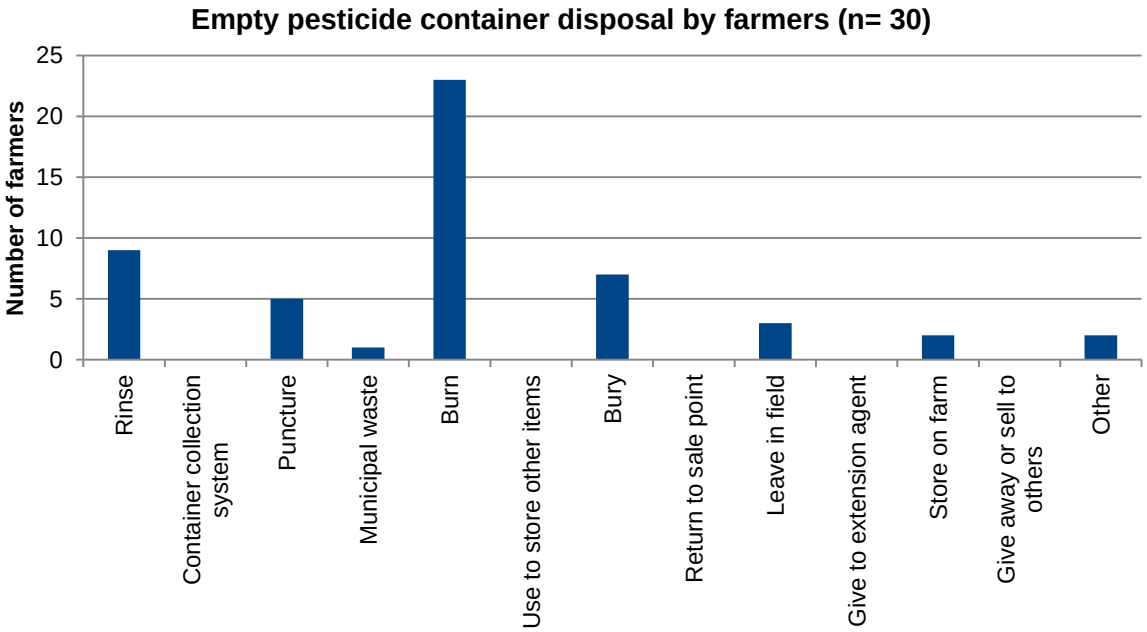

Figure 18. Empty pesticide container disposal by farmers

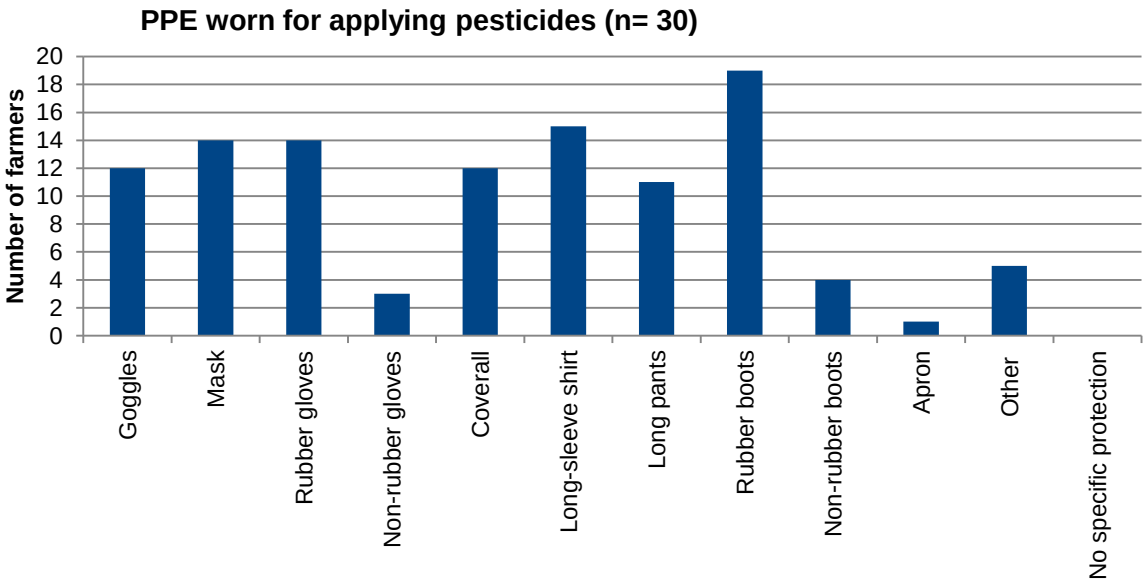

Figure 19. PPE worn for applying pesticides

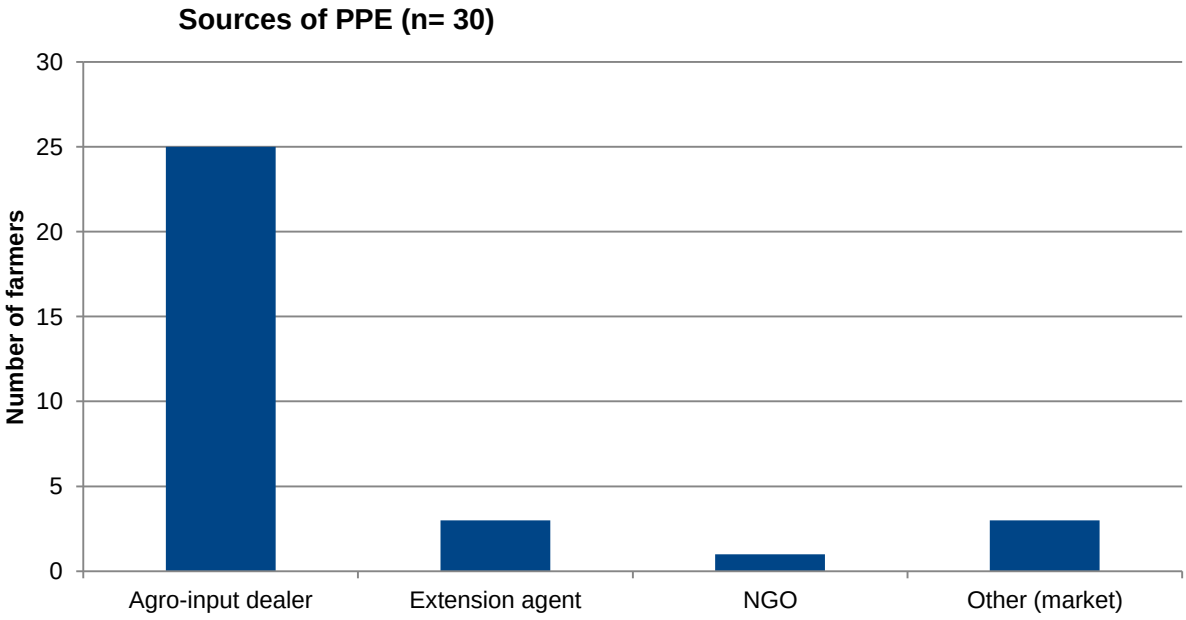

Figure 20. Sources of PPE

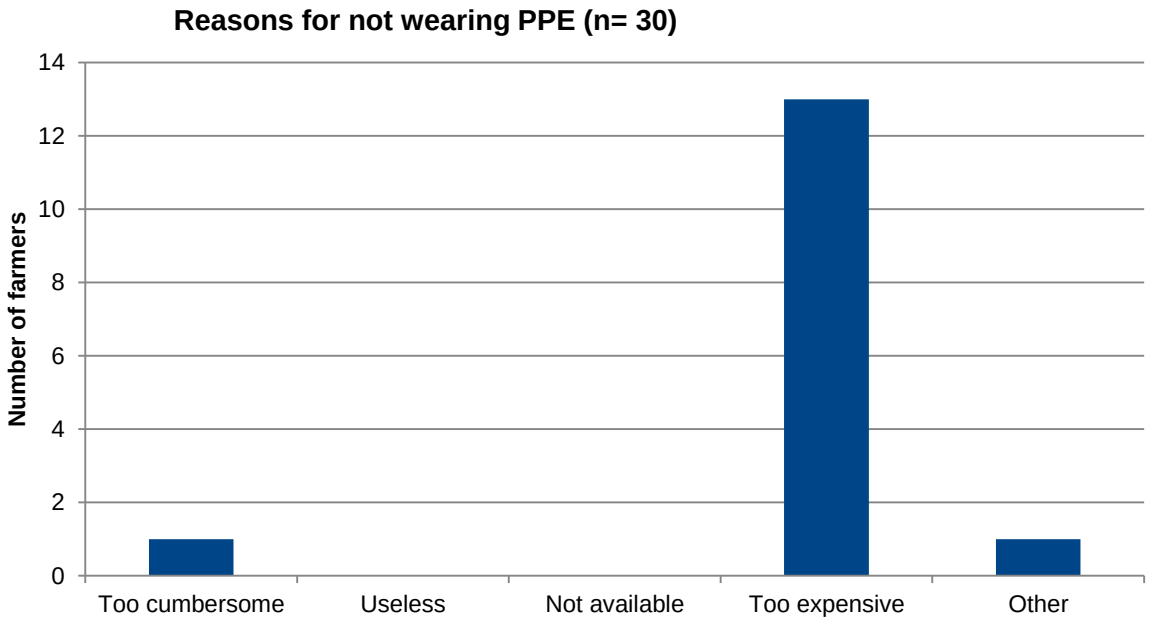

Figure 21. Reasons for not wearing PPE

Figure 22. IPM training received by farmers

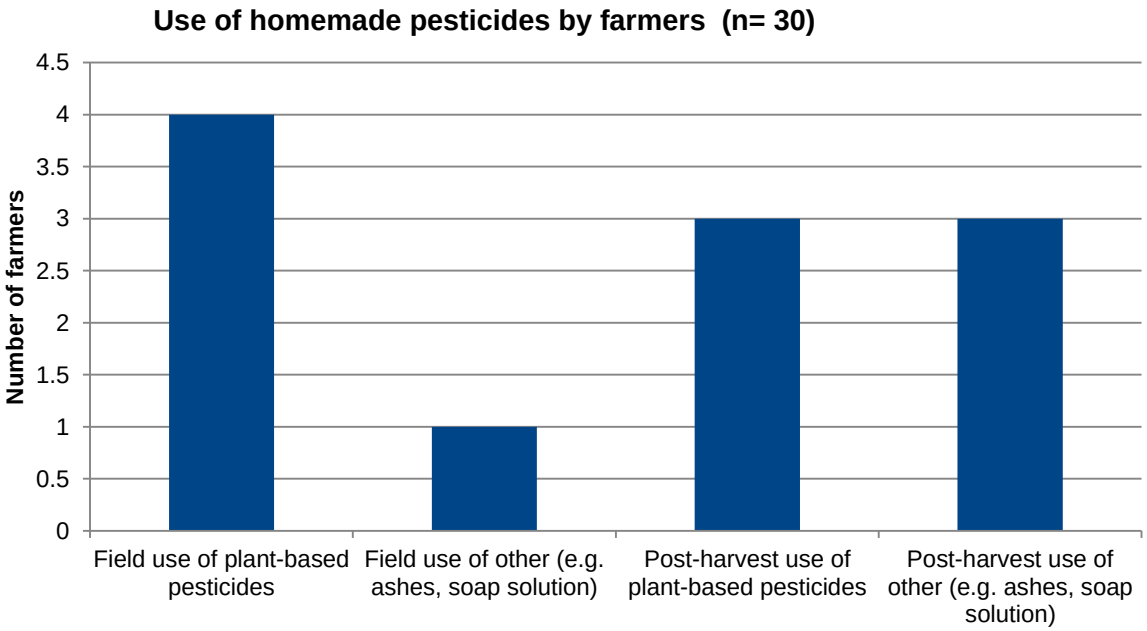

Figure 23. Use of homemade pesticides by farmers

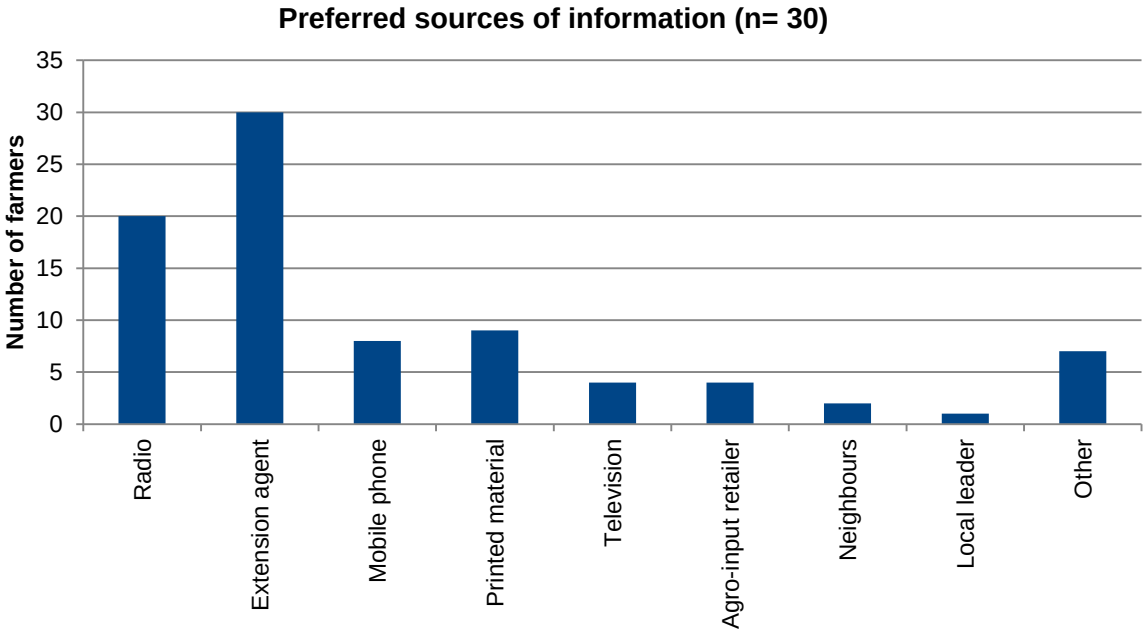

Figure 24. Preferred sources of information

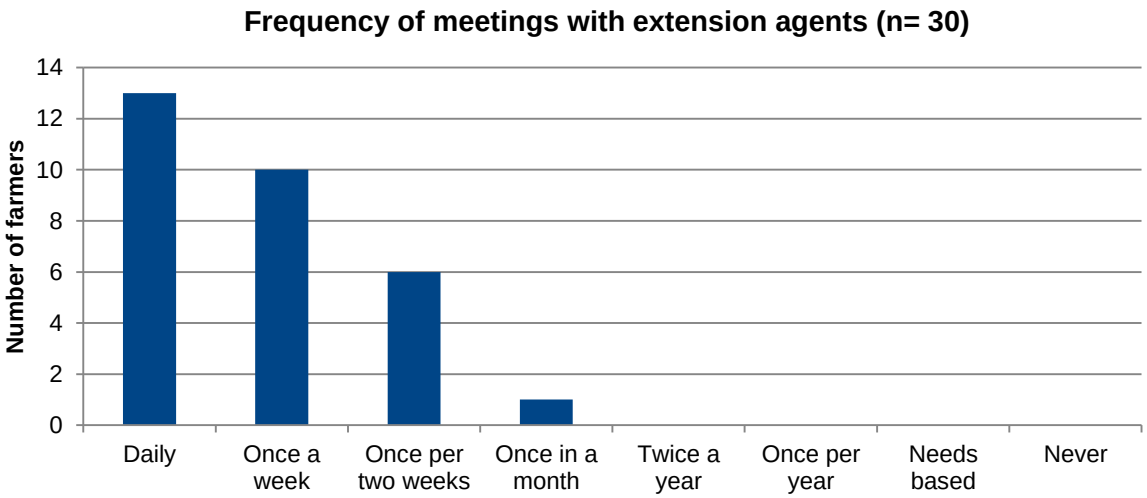

Figure 25. Frequency of meetings with extension agents

Annex IV: Results from the in-country AEAs questionnaires

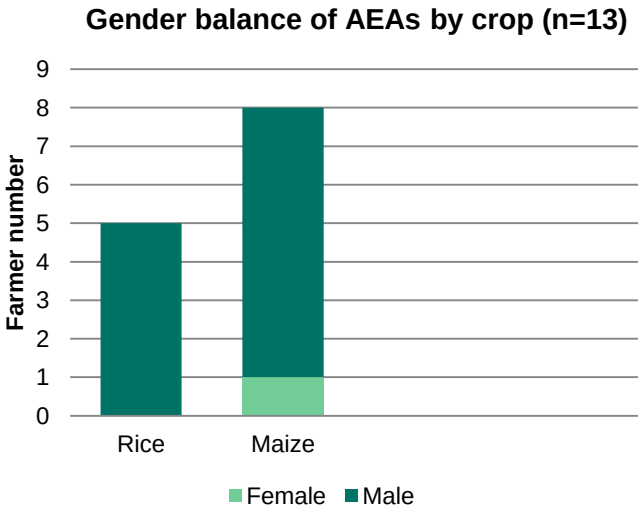

Figure 26. Gender balance of AEAs by crop

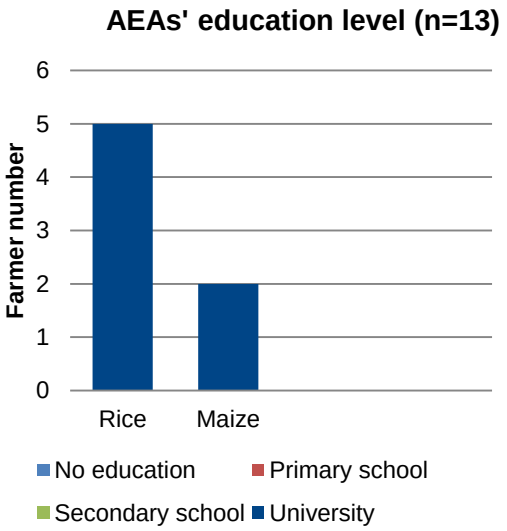

Figure 27. Education level of AEAs' by crop

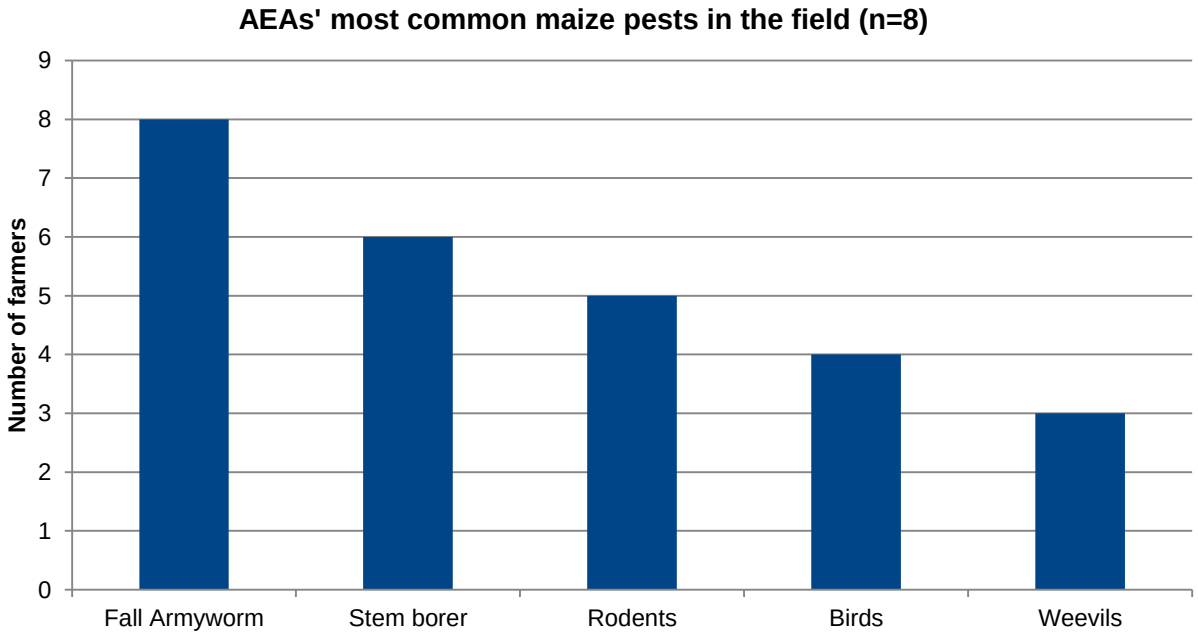

Figure 28. Most common maize pests in the field reported by AEAs

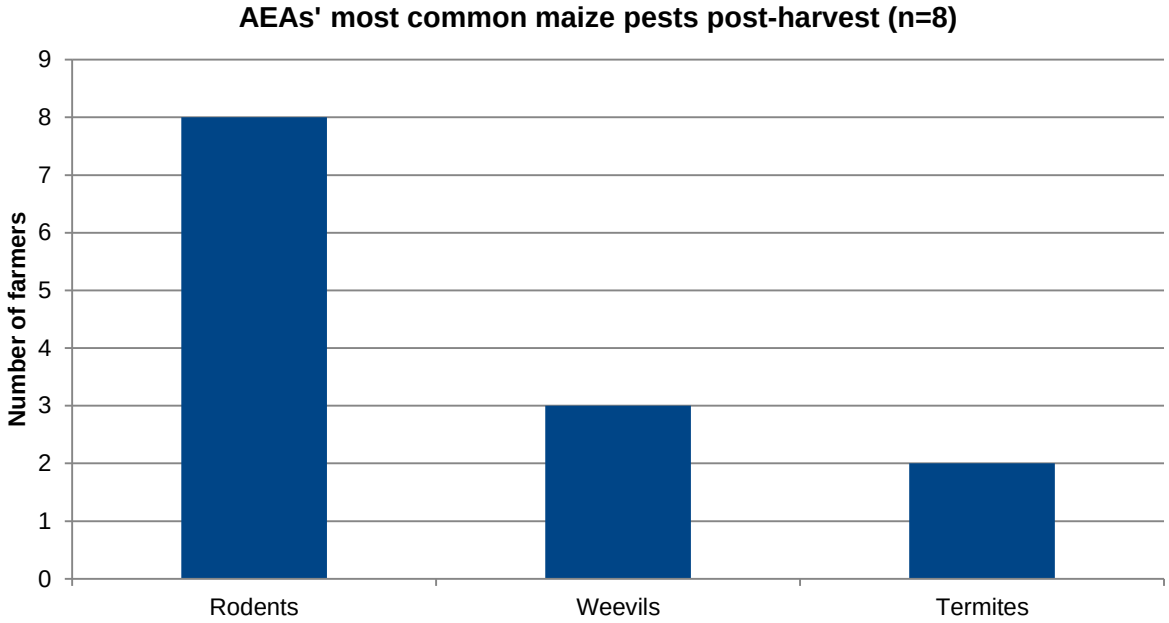

Figure 29. Most common post-harvest maize pests reported by AEAs

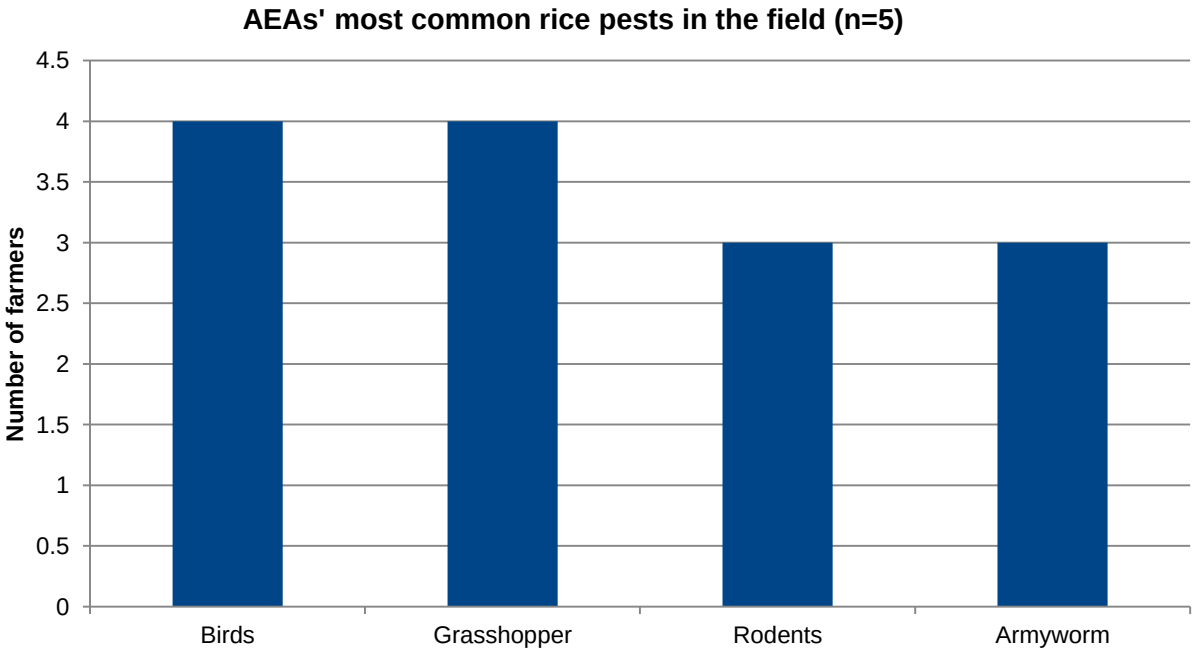

Figure 30. Most common rice pests in the field reported by AEAs

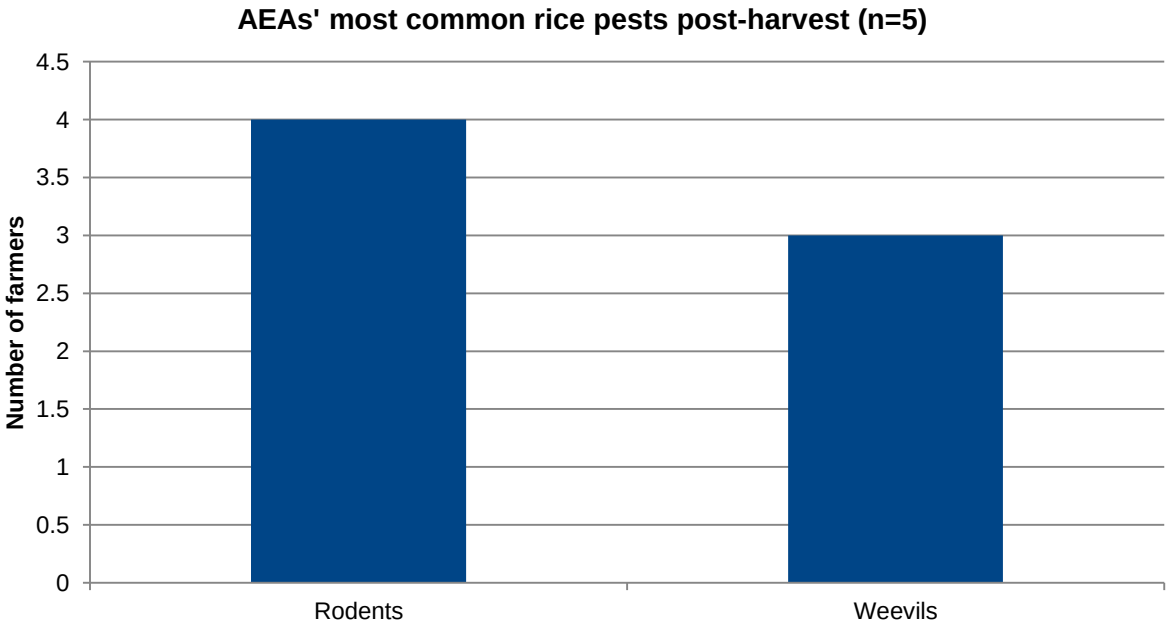

Figure 31. Most common post-harvest rice pests reported by AEAs

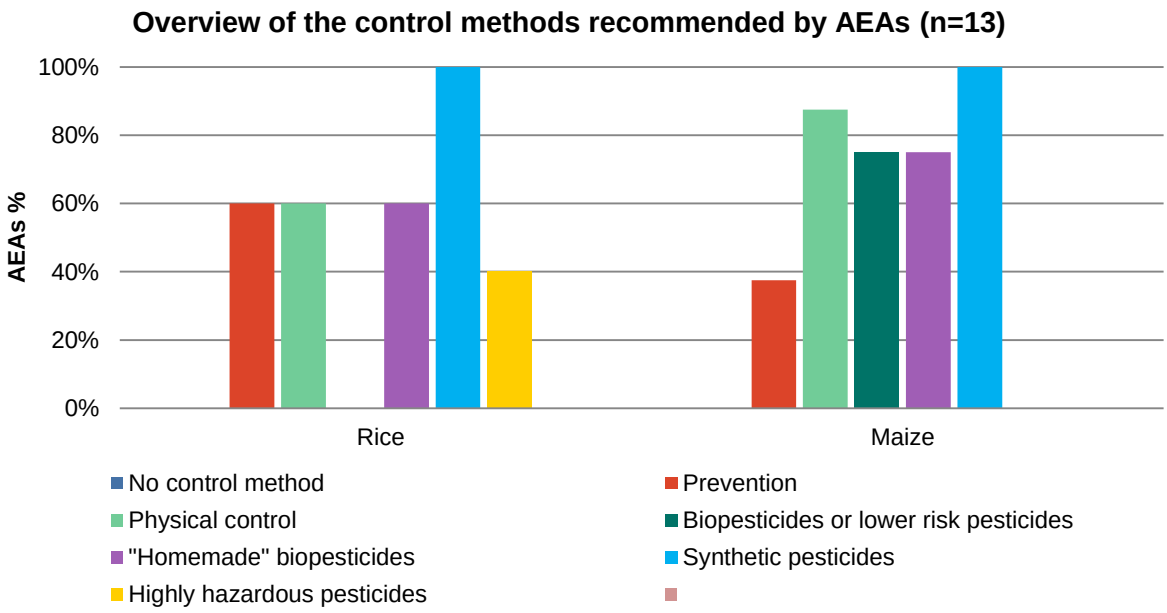

Figure 32. Overview of the control methods recommended by AEAs

Table 14. Maize: pesticides recommended by AEAs for field use (n=8)

Pesticide type	Commercial name	AI	Target pest	HHP	Approved for use in organic agriculture	Number of AEAs recommending it	% of AEAs recommending it
Unspecified pesticide	?	?	Seed dressing for weevils	?		1	13%
Insecticide	Actellic Super	Pirimiphos-methyl	Weevils			1	13%
Insecticide	Betallic Super	Pirimiphos-methyl + Permethrin	Weevils	X		1	13%
Insecticide	Combat	?	Stem borer	?		1	13%
Insecticide	Confidor	Imidacloprid	FAW			3	38%
Insecticide	Cypermethrin based product	Cypermethrin	FAW			1	13%
Insecticide	D-ban Super	Chlorpyrifos	FAW			1	13%
Insecticide	Dress Force	Imidacloprid + Metalaxyl - M + Tebuconazole	Toads; squirrels; birds; rodents			1	13%
Insecticide	K-Optimal	Acetamiprid + Lambda-cyhalothrin	Stemborer			1	13%
Insecticide	Lambda Super	Lambda-cyhalothrin	Stemborer			2	25%
Insecticide	Sunpyrifos	Chlorpyrifos	Armyworm; Stemborer			2	25%
Insecticide	Super top	Acetamiprid + Lambda-cyhalothrin	FAW			3	38%
Insecticide	Viper	Acetamiprid + Indoxacarb	FAW			1	13%
Biopesticide	Bypel	*Bacillus Thuringiensis*	FAW		✓	5	63%
Biopesticide	NeemAzal	Azadirachtin A	FAW; stemborer		✓	2	25%
Herbicide	Atrazine based product	Atrazine	Weeds			1	13%
Herbicide	By day	?	Weeds	?		1	13%
Herbicide	Lagon	Isoxaflutole + Aclonifen	Weeds			1	13%
Herbicide	Landlord	Glyphosate	Weeds			1	13%
Herbicide	Nico King	?	Weeds	?		1	13%
Herbicide	Nico Plus	Nicosulfuran	Weeds			2	25%

Table 15. Maize: non-chemical control methods recommended by AEAs for field use (n=8)

Control method	Target pest	Number of AEAs recommending it	% of AEAs recommending it
Ash (wood)	Toads	1	13%
Alata samina	FAW	1	13%
Burning	FAW	1	13%
Garlic extract	FAW	2	25%
Hand-picking	Insects	1	13%
Hand-weeding	Weeds	2	25%
Mulching	Weeds	1	13%
Natural enemies (encouraging)	FAW	1	13%
Neem extract	Toads; FAW; weevils; stemborer; termites; birds	6	75%
Pepper extract	FAW	1	13%
Rouging	Stemborer	1	13%
Sunlight (expose to)	FAW	1	13%
Tolerant varieties	Maize streak	1	13%
Traps	Birds; rodents; squirrels	2	25%

Table 16. Maize: pesticides recommended by AEAs for post-harvest use (n=8)

Pesticide type	Commercial name	AI	Target pest	HHP	Approved for use in organic agriculture	Number of AEAs recommending it	% of AEAs recommending it
Insecticide	Actellic Super	Pirimiphos-methyl	Weevils			3	38%

Table 17. Maize: non-chemical control methods recommended by AEAs for post-harvest use (n=8)

Control method	Target pest	Number of AEAs recommending it	% of AEAs recommending it
Ash	Weevils	1	13%
Drying	Weevils	1	13%
Haematic bags	Weevils; beetles	6	75%
Neem extract	Weevils	1	13%
Neem leaves	Weevils	3	38%
Traps	Rodents	5	63%

Table 18. Rice: pesticides recommended by AEAs for field use (n=5)

Pesticide type	Commercial name	AI	Target pest	HHP	Approved for use in organic agriculture	Number of AEAs recommending it	% of AEAs recommending it
Unspecified insecticide	?	?	Birds; rodents			2	40%
Insecticide	Attack	Emamectin Benzoate	Grasshopper; stemborer			1	20%
Insecticide	Best Farmer	?	Grasshopper; stemborer	?		1	20%
Insecticide	Cydim Super	Dimethoate + Cypermethrin	Red ants;			1	20%
Insecticide	Defiance	Chlorfenvinphos	Leaf hoppers	X		1	20%
Insecticide	Dursban	Chlorpyrifos	Termites; Armyworm			3	60%
Insecticide	K-Optimal	Acetamiprid + Lambda-cyhalothrin	Armyworm; stemborer; rice bugs; crickets;			2	40%
Insecticide	Lamsafe	Lambda-cyhalothrin				1	20%
Insecticide	Lambda-cyhalothrin based product	Lambda-cyhalothrin	Ants; rodents; mole cricket			1	20%
Insecticide	Lambda Super	Lambda-cyhalothrin	Termites			1	20%
Insecticide	Pyrinex	Chlorpyrifos	Grasshopper; ants; rice hopper; Armyworm			2	40%
Insecticide	Regent	Fipronil	Termites			1	20%
Insecticide	Termex	Imidacloprid	Termites			1	20%
Fungicide	Ivory 80	Mancozeb	Rice blast	X		1	20%
Fungicide	Mancozeb based product	Mancozeb	Rice blast	X		1	20%
Fungicide	Top Cop	Sulphur + Copper	Rice blast		✓	1	20%

Table 19. Rice: non-chemical control methods recommended by AEAs for field use (n=5)

Control method	Target pest	Number of AEAs recommending it	% of AEAs recommending it
Ash (wood)	Ants; Armyworm	1	20%
Good land preparation	Stem borers	1	20%
Hand-picking	Crickets; rice hopper	1	20%
Hand-weeding	Grasshoppers; grasscutter	2	40%
Neem extract	Armyworm; grasshopper	1	20%
Onion extract	Armyworm; grasshopper	1	20%
Palm chaff	Termites	1	20%
Resistant varieties	Armyworm; stemborer	2	40%
Scaring	Birds	2	40%
Traps	Rodents; grasscutter; birds	2	40%
Water management	Termites	1	20%

Table 20. Rice: pesticides recommended by AEAs for post-harvest use (n=5)

Pesticide type	Commercial name	AI	Target pest	HHP	Approved for use in organic agriculture	Number of AEAs recommending it	% of AEAs recommending it
Unspecified insecticide	?	?	Rodents			1	20%
Insecticide	Pyrinex	Chlorpyrifos	Weevils			1	20%

Table 21. Rice: non-chemical control methods recommended by AEAs for post-harvest use (n=5)

Control method	Target pest	Number of AEAs recommending it	% of AEAs recommending it
Clearing storage room	Rodents	1	20%
Sunlight exposure	Weevils	1	20%
Traps	Rodents	2	40%

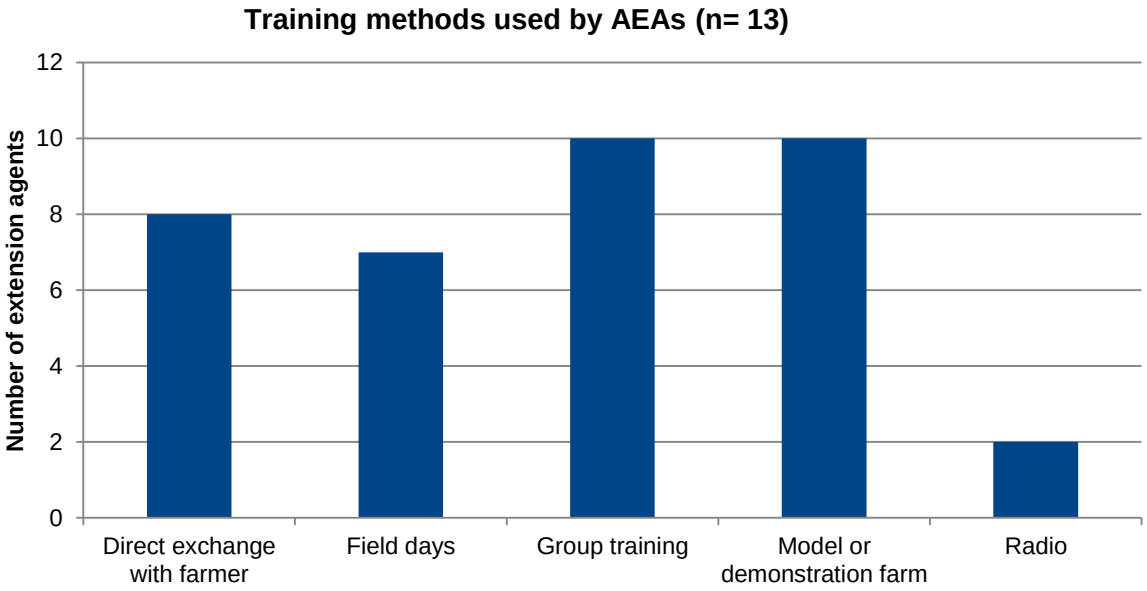

Figure 33. Training methods used by AEAs

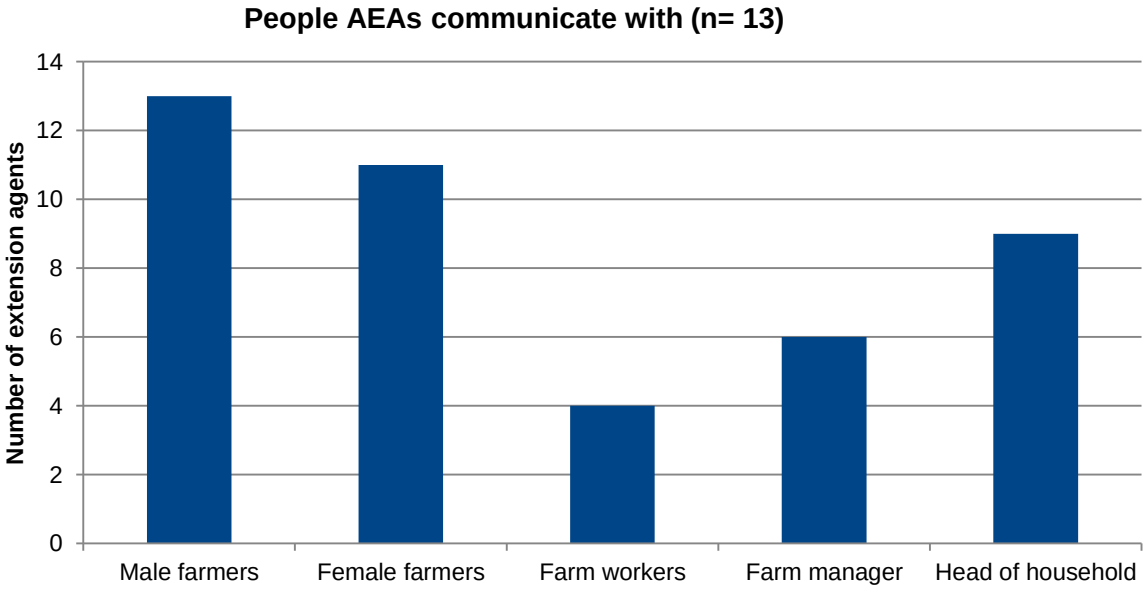

Figure 34. People AEAs communicate with

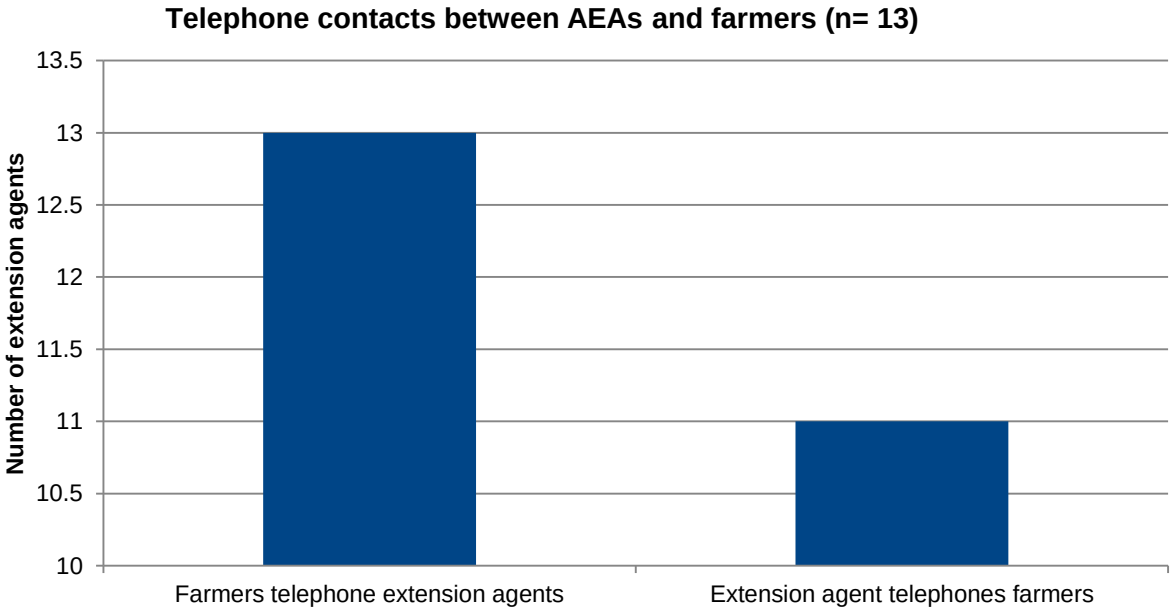

Figure 35. Telephone contacts between AEAs and farmers

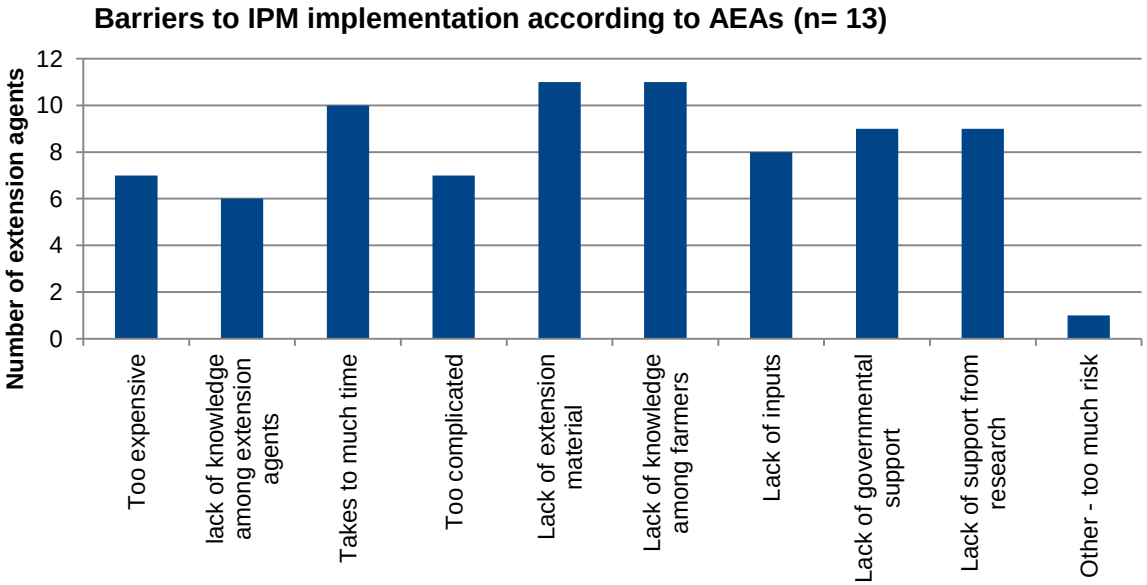

Figure 36. Barriers to IPM implementation according to AEAs

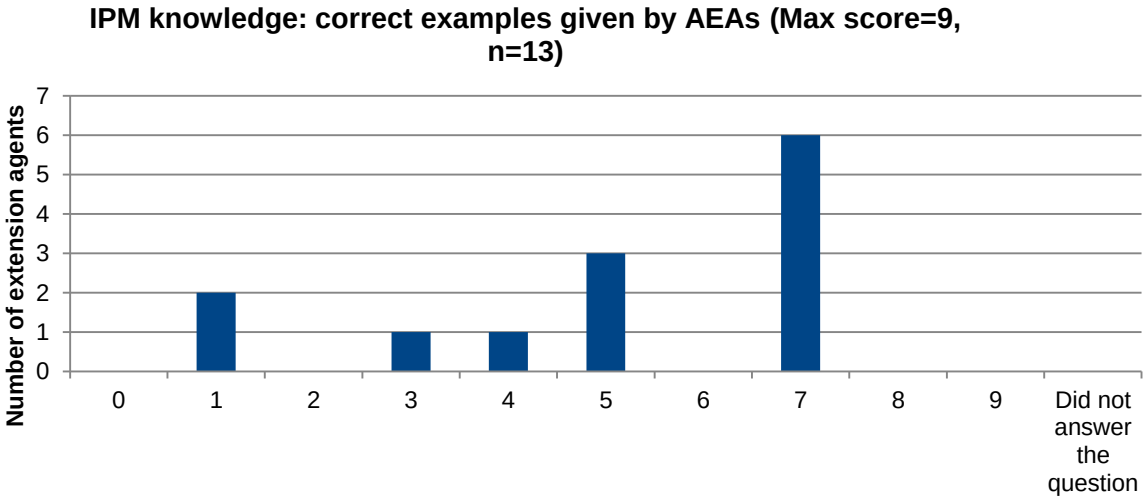

Figure 37. IMP knowledge: correct examples given by AEAs

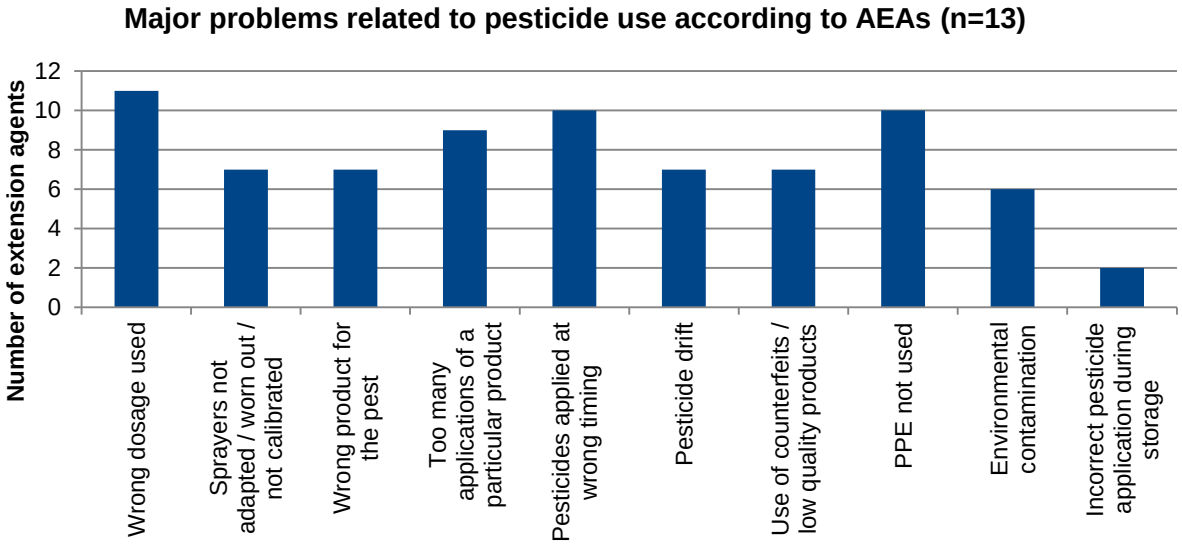

Figure 38. Major problems related to pesticide use according to AEAs

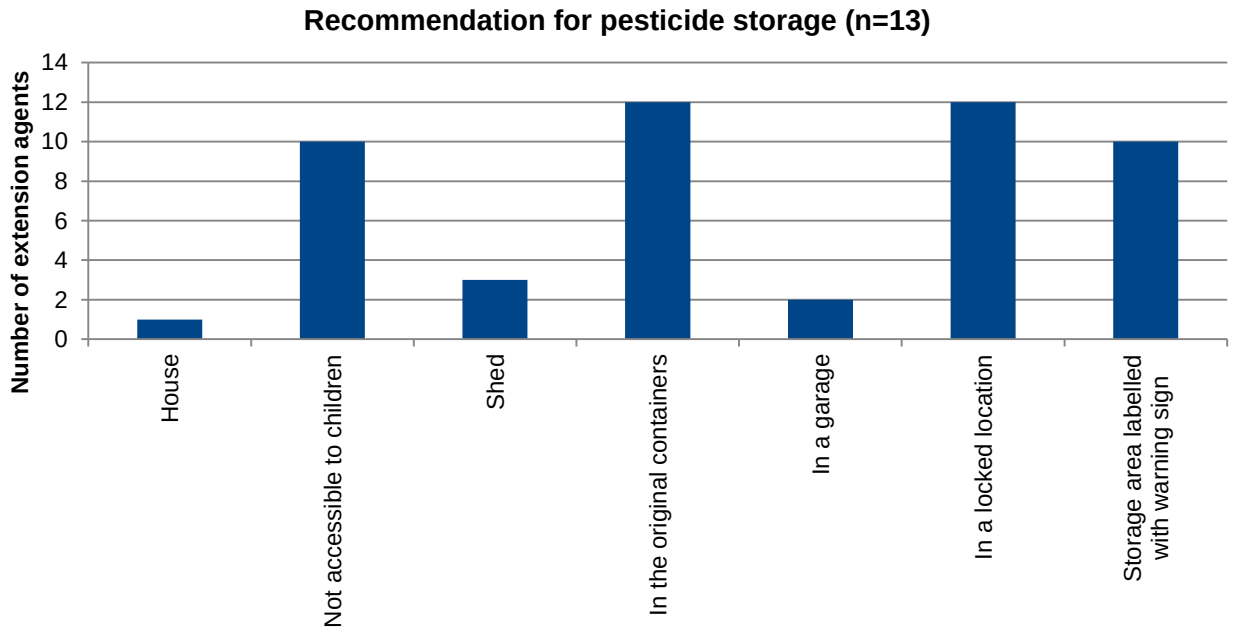

Figure 39. Recommendations for pesticide storage

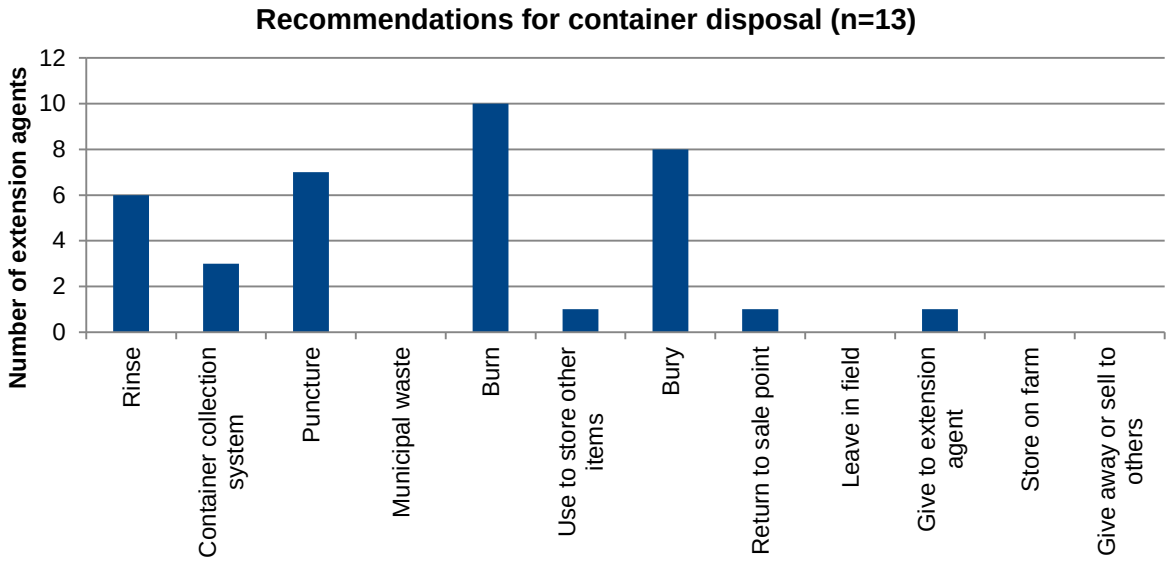

Figure 40. Recommendations for container disposal

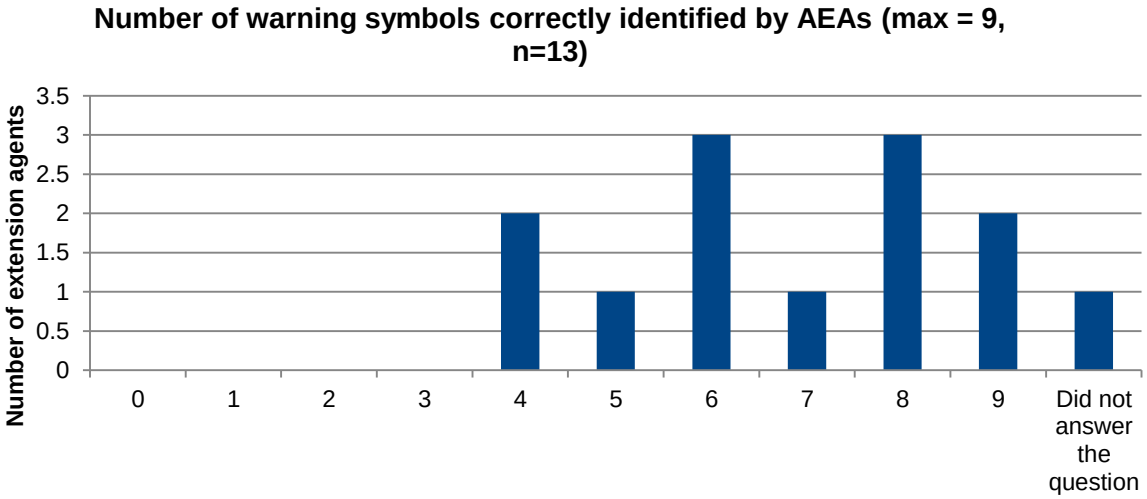

Figure 41. Number of warning symbol correctly identified by AEAs

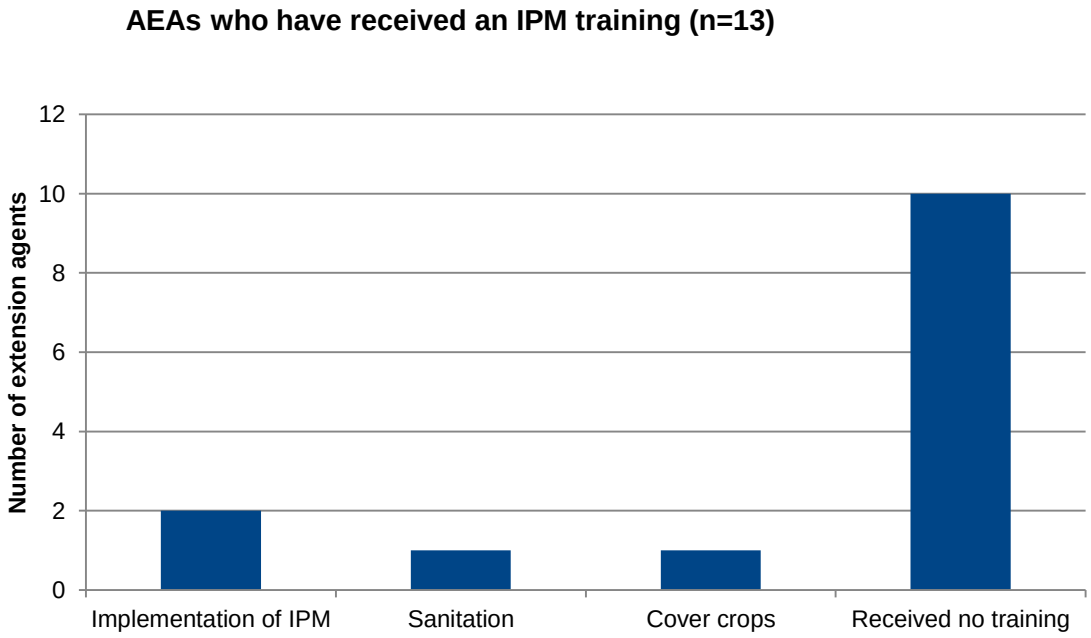

Figure 42. AEAs who have received IPM training

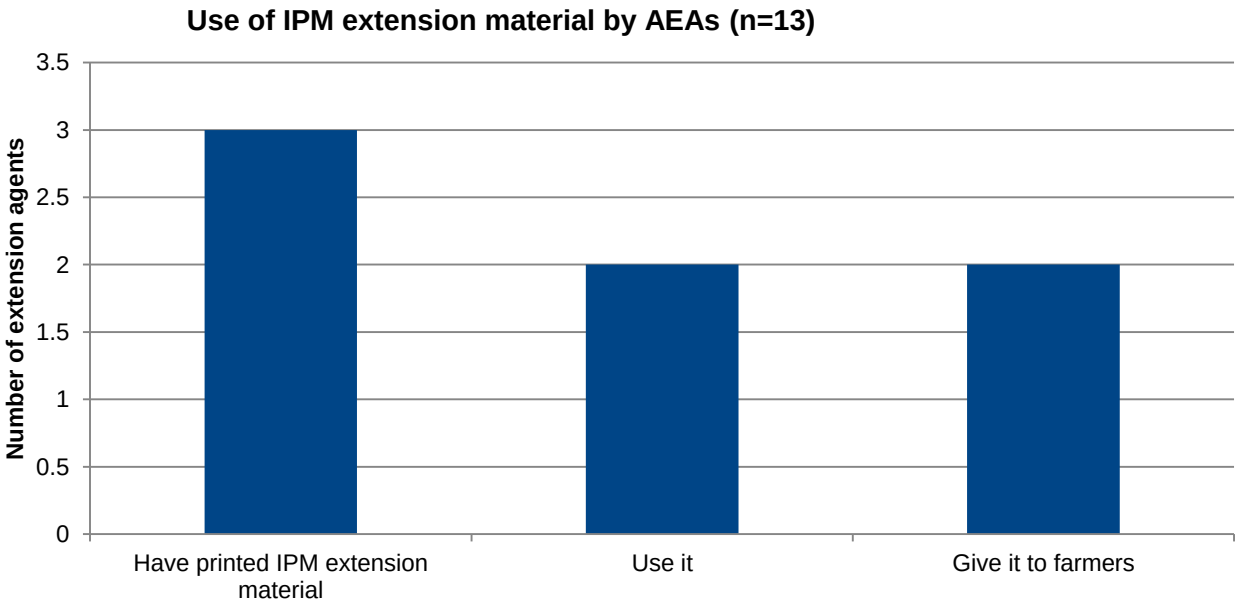

Figure 43. Use of IPM extension material by AEAs

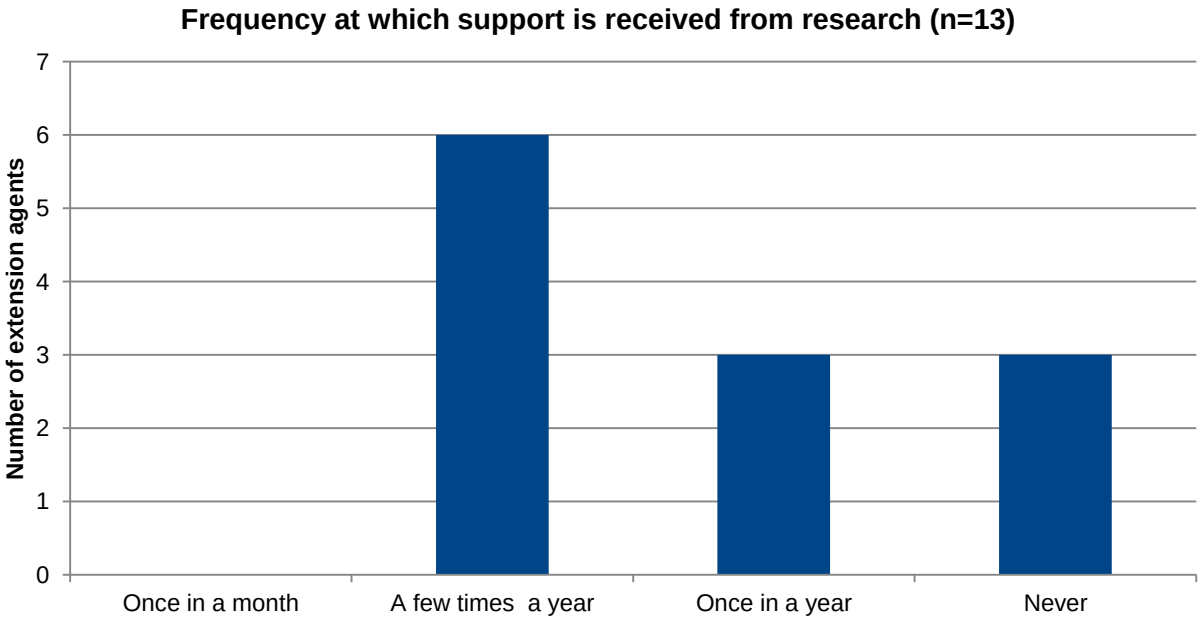

Figure 44. Frequency at which support is received from research

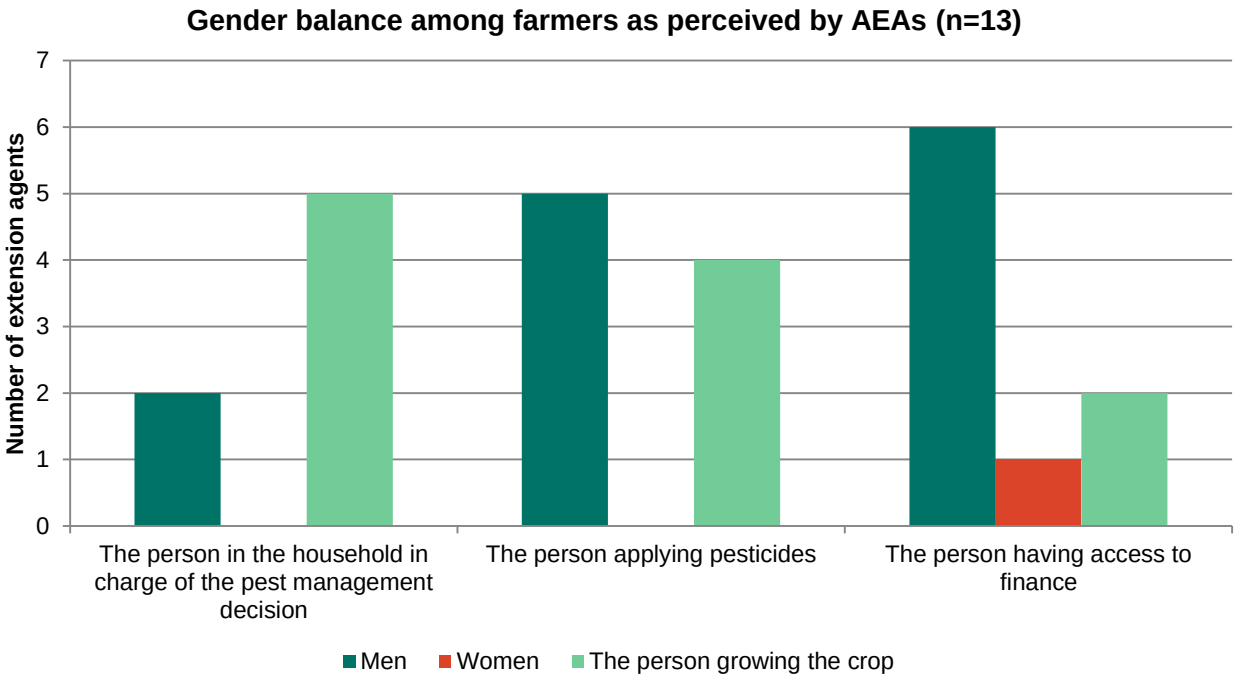

Figure 45. Gender balance among farmers as perceived by AEAs

Annex V. List of HHP AI registered for use in Ghana

HHP AI	Chemical class	Use type	HHP1 Acute toxicity	HHP2 Carcinogenicity	HHP3 Mutagenicity	HHP4 Reproductive toxin	HHP5 POP	HHP6 PIC	HHP7 ODS	PAN HHP	EU-approved	GIZ classification
ABAMECTIN	Macrocyclic Lactone - avermectin	Insecticide	1	N	N	2	N	N	N	Y	Approved	B
ALUMINIUM PHOSPHIDE	Fumigant	Insecticide, rodenticide	1	N	N	N	N	N	N	Y	Approved	B
BETA-CYFLUTHRIN	Pyrethroid	Insecticide	1B	N	N	2	N	N	N	Y	Approved	A
BROMADIOLONE	Coumarin	Rodenticide	1A	N	N	N	N	N	N	Y	Approved	A
BUTACHLOR	Amide	Herbicide	3	1B	N	N	N	N	N	Y	Not approved	B
CADUSAFOS	Organophosphorus	Insecticide	1B	N	N	N	N	N	N	Y	Not approved	A
CAPTAN	phthalimide	Fungicide	U	1B	N	N	N	N	N	N	Approved	B
CARBENDAZIM	benzimidazole	Fungicide	U	2	1A / 1B	1A / 1B	N	N	N	Y	Not approved	A
CARBOFURAN	carbamate	Insecticide, nematicide	1B	N	2	N	N	Y	N	Y	Not approved	A
CHLOROTHALONIL	aromatic fungicide	Fungicide, oomycide	U	1B	N	N	N	N	N	Y	Approved	B
COPPER SULFATE	Inorganic - copper	Fungicide, oomycide, bactericide	2	1A / 1B	N	N	N	N	N	N	Approved	C
CYFLUTHRIN	Pyrethroid	Insecticide	1B	N	N	2	N	N	N	Y	Not approved	A
DIAZINON	Organophosphorus	Insecticide	2	2	N	1B	N	N	N	Y	Not approved	B
DIURON	urea	Herbicide	3	1B	N	N	N	N	N	Y	Approved	B
GLUFOSINATE AMMONIUM	organophosphorus	Herbicide	N	N	N	1A / 1B	N	N	N	Y	Not listed	A
HALOXYFOP-P-METHYL	phenoxy	Herbicide	2	1B	N	N	N	N	N	Y	Approved	B
HYDRAMETHYLNON	unclassified	Insecticide	2	2	N	1B	N	N	N	N	Not approved	B
ISOXAFLUTOLE	oxazole	Herbicide	N	1B	N	2	N	N	N	Y	Approved	B
KRESOXIM-METHYL	strobilurin	Fungicide	N	1B	N	N	N	N	N	Y	Approved	B
MANCOZEB	dithiocarbamate	Fungicide, oomycide	U	1B		2	N	N	N	Y	Approved	B
MANEB	carbamate	Fungicide	U	1B	N	1B	N	N	N	Y	Not approved	B
METHOMYL	carbamate	Insecticide	1B	N	N	N	N	N	N	Y	Approved	A
OXADIARGYL	oxadiazolone	Herbicide	N	N	N	1A / 1B	N	N	N	N	Not approved	B
OXAMYL	carbamate	Insecticide, nematicide	1B	N	N	N	N	N	N	Y	Approved	A
OXYFLUORFEN	diphenyl ether	Herbicide	U	1B	N	N	N	N	N	Y	Approved	B
PERMETHRIN	Pyrethroid	Insecticide	2	1B	N	N	N	N	N	Y	Not approved	B
QUIZALOFOP-P-TEFURYL	phenoxy	Herbicide	2	N	2	1A / 1B	N	N	N	Y	Approved	A
THIACLOPRID	neonicotinoid	Insecticide	2	1B	N	2	N	N	N	Y	Approved	B
THIOPHANATE-METHYL	benzamidazole	Fungicide	U	1B	2	2	N	N	N	Y	Approved	B
TOPRAMEZONE	pyrazole	Herbicide	-	N	N	1A / 1B	N	N	N	N	Pending	#N/A

Annex VI: List of AI which are registered in Ghana which require exceptional authorization for recommendation or procurement

Pesticide AI	Chemical class	Use type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU
ABAMECTIN	Macrocyclic Lactone - avermectin	Insecticide	HHP	N	N	Y	Approved
ACETOCHLOR	Chloroacetamide	Herbicide	Warning	N	Y	Y	Not approved
ALUMINIUM PHOSPHIDE	Fumigant	Insecticide, rodenticide	HHP	N	N	Y	Approved
AMETRYN	Triazine	Herbicide	Danger	N	N	N	Not approved
ATRAZINE	Triazine	Herbicide	Warning	N	Y	Y	Not approved
BACILLUS SPHAERICUS	Biopesticide - Microbial	Insecticide	Missing data	N	N	N	Not approved
BENDIOCARB	carbamate	Insecticide	Danger	N	N	Y	Not approved
BIFENTHRIN	Pyrethroid	Insecticide	Danger	N	Y	Y	Approved
BIOALLETHRIN	Pyrethroid	Insecticide	Warning	N	N	N	Not approved
BROMACIL	Uracil	Herbicide	Warning	N	N	N	Not approved
BUTACHLOR	Amide	Herbicide	HHP	N	N	Y	Not approved
CAPTAN	phthalimide	Fungicide	HHP	N	N	N	Approved
CARBOSULFAN	carbamate	Insecticide	Danger	N	Y	Y	Not approved
CHLORANTRANILIPROLE	pyrazole / diamide	Insecticide	Warning	N	N	Y	Approved
CHLORFENAPYR	pyrrole	Insecticide, acaricide	Danger	N	Y	Y	Not approved
CHLOROTHALONIL	aromatic fungicide	Fungicide, oomycide	HHP	N	N	Y	Approved
CHLORPYRIFOS	Organophosphorus	Insecticide, Acaricide	Danger	N	N	Y	Approved
COPPER HYDROXIDE	Inorganic - copper	Fungicide, oomycide, bactericide	Danger	N	N	Y	Approved
CYPERMETHRIN	Pyrethroid	Insecticide, acaricide	Danger	N	N	Y	Approved
DELTAMETHRIN	Pyrethroid	Insecticide	Danger	N	N	Y	Approved
DIAZINON	Organophosphorus	Insecticide	HHP	N	Y	Y	Not approved
DICHLOROPHEN	Hetrocyclic	Fungicide, herbicide, bactericide, algicide	Warning	N	Y	N	Not approved
DIMETHOATE	Organophosphorus	Insecticide	Danger	N	N	Y	Approved
DIQUAT DIBROMIDE	quaternary ammonium	Herbicide	Danger	N	N	Y	Approved
DIURON	urea	Herbicide	HHP	N	N	Y	Approved
ETOFENPROX	Pyrethroid	Insecticide	Danger	N	N	Y	Approved
FENITROTHION	Organophosphorus	Insecticide	Danger	N	Y	Y	Not approved
FENVALERATE	Pyrethroid	Insecticide	Danger	N	N	Y	Not approved
FIPRONIL	pyrazole	Insecticide	Danger	N	Y	Y	Not approved
FLUAZIFOP-P-BUTYL	phenoxy	Herbicide	Warning	N	Y	N	Not listed
FOLPET	phthalimide	Fungicide	Warning	N	Y	Y	Approved
GLYPHOSATE	organophosphorus	Herbicide	Danger	N	N	Y	Approved
HALOXYFOP-P-METHYL	phenoxy	Herbicide	HHP	N	N	Y	Approved
HYDRAMETHYLNON	unclassified	Insecticide	HHP	N	N	N	Not approved
IMAZAPYR	Imidazolinone	Herbicide	Warning	N	Y	N	Not approved
IMAZETHAPYR	Imidazolinone	Herbicide	Warning	N	N	N	Not approved
IMIDACLOPRID	neonicotinoid	Insecticide	Warning	N	N	Y	Approved
INDOXACARB	oxadiazine	Insecticide	Danger	N	N	Y	Approved
ISOXAFLUTOLE	oxazole	Herbicide	HHP	N	N	Y	Approved
KRESOXIM-METHYL	strobilurin	Fungicide	HHP	N	N	Y	Approved
LAMBDA-CYHALOTHRIN	Pyrethroid	Insecticide	Danger	N	N	Y	Approved
MANCOZEB	dithiocarbamate	Fungicide, oomycide	HHP	N	N	Y	Approved
MANEB	carbamate	Fungicide	HHP	N	N	Y	Not approved
MEFENACET	amide	Herbicide	Warning	N	N	N	Not approved
METOLACHLOR	amide	Herbicide	Danger	N	N	N	Not approved
METRIBUZIN	triazinone	Herbicide	Danger	N	N	Y	Approved
NITENPYRAM	neonicotinoid	Insecticide	Warning	N	N	Y	Not approved
NOVALURON	insect growth regulator	Insecticide	Warning	N	N	N	Not approved
OXADIARGYL	oxadiazolone	Herbicide	HHP	N	N	N	Not approved
OXYFLUORFEN	diphenyl ether	Herbicide	HHP	N	N	Y	Approved
PARAQUAT	quaternary ammonium	Herbicide	Danger	N	Y	N	Not approved

Pesticide AI	Chemical class	Use type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU
PARAQUAT DICHLORIDE	quaternary ammonium	Herbicide	Danger	N	Y	Y	Not listed
PERMETHRIN	Pyrethroid	Insecticide	HHP	N	Y	Y	Not approved
PIRIMIPHOS-METHYL	Fumigant, Organophosphorous	Fumigant, insecticide, acaricide	Warning	N	N	Y	Approved
PRALLETHRIN	Pyrethroid	Insecticide	Danger	N	N	Y	Not listed
PRETILACHLOR	amide	Herbicide	Danger	N	N	N	Not approved
PROPANIL	amide	Herbicide	Warning	N	Y	N	Pending
PROPISOCHLOR	amide	Herbicide	Warning	N	Y	N	Not approved
SPINOSAD	Biochemical biopesticides - Microbial extracts / fermentation products / enzymes	Insecticide	Warning	N	N	Y	Approved
TERBUTRYN	triazine	Herbicide	Warning	N	N	Y	Not approved
TETRAMETHRIN	Pyrethroid	Insecticide	Warning	N	N	Y	Not approved
THIACLOPRID	neonicotinoid	Insecticide	HHP	N	N	Y	Approved
THIAMETHOXAM	neonicotinoid	Insecticide	Warning	N	N	Y	Approved
THIOPHANATE-METHYL	benzamidazole	Fungicide	HHP	N	N	Y	Approved

Annex VII: List of the key pests of maize with the HHP and non-HHP AI which are used for their management

GIZ procurement category in parentheses. **Bold:** Recommended by AEAs; Underlined: Used by farmers

Black text: Registered; Orange text: Not registered for the crop / pest combination; Brown text: Not registered

Target pest common names	Stage	AI effective against target pest which are registered, recommended or used and are not HHPs	HHPs which are registered, recommended or used to manage the target pest
Akuffo addo	Field	GLYPHOSATE (B); NICOSULFURON (D);	
Ants	Field	ACETAMIPRID (D); ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); EMAMECTIN BENZOATE (D); FIPRONIL (B); GLYPHOSATE (B); IMIDACLOPRID (B); IMIDACLOPRID (B) + LAMBDA-CYHALOTHRIN (B); LAMBDA-CYHALOTHRIN (B); THIAMETHOXAM (B)	IMIDACLOPRID (B) + BETA-CYFLUTHRIN ();
Birds	Field	ACETAMIPRID (D); ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); **IMIDACLOPRID** (B) + **METALAXYL-M** (C) + **TEBUCONAZOLE** (C); ; METHYL ANTHRANILATE (NL)	
Centipedes	Field	ACETAMIPRID (D); ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); LAMBDA-CYHALOTHRIN (B)	
Crickets	Field	ACETAMIPRID (D); BACILLUS THURINGIENSIS (D); EMAMECTIN BENZOATE (D); FENITROTHION (B); FIPRONIL (B); IMIDACLOPRID (B) + LAMBDA-CYHALOTHRIN (B); THIAMETHOXAM (B)	
Elephant grass	Field	NICOSULFURON (D);	
Euphobia herta	Field	ATRAZINE (B); NICOSULFURON (D);	

Target pest common names	Stage	AI effective against target pest which are registered, recommended or used and are not HHPs	HHPs which are registered, recommended or used to manage the target pest
FAW, Armyworm	Field	ACETAMIPRID (D); ACETAMIPRID (D) + INDOXACARB (B); ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); AZADIRACHTIN (D); BACILLUS THURINGIENSIS (D); CHILLI EXTRACT (NL); CHLORPYRIFOS (B); CYPERMETHRIN (B); EMAMECTIN BENZOATE (D); FENITROTHION (B); FIPRONIL (B); GARLINC EXTRACT (D); IMIDACLOPRID (B); IMIDACLOPRID (B) + LAMBDA-CYHALOTHRIN (B); LAMBDA-CYHALOTHRIN (B); TEBUFENOZIDE (D) + EMAMECTIN BENZOATE (D); THIAMETHOXAM (B)	ABAMECTIN (B);
Rats, rodents	Field, Post-harvest	ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); IMIDACLOPRID (B) + METALAXYL-M (C) + TEBUCONAZOLE (C)	BROMADIOLONE (A)
Spear grass	Field	ATRAZINE (B)	
Squirrels	Field	IMIDACLOPRID (B) + METALAXYL-M (C) + TEBUCONAZOLE (C); GLYPHOSATE (B)	BROMADIOLONE (A) IMIDACLOPRID (B) + BETA-CYFLUTHRIN (A);
Stemborer	Field	ACETAMIPRID (D); ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); AZADIRACHTIN (); CHLORPYRIFOS (B); DELTAMETHRIN (B); EMAMECTIN BENZOATE (D); FENITROTHION (B); FENVALERATE (B); FIPRONIL (B); IMIDACLOPRID (B) + LAMBDA-CYHALOTHRIN (B); LAMBDA-CYHALOTHRIN (B); TEBUFENOZIDE (D) + EMAMECTIN BENZOATE (D); THIAMETHOXAM (B)	ABAMECTIN (B);
Striga	Field	ATRAZINE (B)	

Target pest common names	Stage	AI effective against target pest which are registered, recommended or used and are not HHPs	HHPs which are registered, recommended or used to manage the target pest
Termites	Field	ACETAMIPRID (D); ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); EMAMECTIN BENZOATE (D); FENITROTHION (B); FIPRONIL (B); IMIDACLOPRID (B); IMIDACLOPRID (B) + LAMBDA-CYHALOTHRIN (B); LAMBDA-CYHALOTHRIN (B); THIAMETHOXAM (B)	
Toads	Field	ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); GLYPHOSATE (B); **IMIDACLOPRID** (B) + **METALAXYL-M** (C) + **TEBUCONAZOLE** (C)	
Weeds	Field	2,4-D (C); ACETOCHLOR (B); ACLONIFEN (D); **ATRAZINE** (B); BENTAZONE (C); **GLYPHOSATE** (B); HALOXYFOP-P-METHYL (B); IMAZAPYR (B); IMAZETHAPYR (B); METOLACHLOR (B); **NICOSULFURON** (D); OXYFLUORFEN (B); PARAQUAT DICHLORIDE (B); PENDIMETHALIN (C); TEMBOTRIONE (D) + ISOXADIFEN-ETHYL (NL)	**ISOXAFLUTOLE** (B) + **ACLONIFEN** (D); TOPRAMEZONE (NL) + DICAMBA (C)
Weevils	Field, post-harvest	ACETAMIPRID (D) + LAMBDA-CYHALOTHRIN (B); ATRAZINE (B); LAMBDA-CYHALOTHRIN (B); **PIRIMIPHOS-METHYL** (B); PIRIMIPHOS-METHYL (B) + THIAMETHOXAM (B)	**PIRIMIPHOS-METHYL** (B) + **PERMETHRIN** (B)

Annex VIII. List of the key pests of rice with the HHP and non-HHP AIs which are used for their management

GIZ procurement category in parentheses. **Bold:** Recommended by AEAs; Underlined: Used by farmers

Black text: Registered; Orange text: Not registered for the crop / pest combination; Brown text: Not registered

Target pest common names	Stage	AIs effective against target pest which are registered, recommended or used and are not HHPs	HHPs which are registered, recommended or used to manage the target pest
Ants, red ants	Field	**CHLORPYRIFOS** (B); **DIMETHOATE** (B) **+ CYPERMETHRIN** (B)**;** FENITROTHION (B); IMIDACLOPRID (B); **LAMBDA-CHALOTHRIN** (B)	CARBOFURAN (A)
Armyworm	Field	**ACETAMIPRID** (D) **+ LAMBDA-CYHALOTHRIN** (B)**;** BEAUVERIA BASSIANA (D); **CHLORFENAPYR** (B); **CHLORPYRIFOS** (B); **CYPERMETHRIN** (B); DIMETHOATE (B); FENITROTHION (B); IMIDACLOPRID (B); **INDOXACARB** (B); **LAMBDA-CYHALOTHRIN** (B); TEBUFENOZIDE (D) + EMAMECTIN BENZOATE (D); THIAMETHOXAM (B); THIAMETHOXAM (B) + LAMBDA-CYHALOTHRIN (B)	CARBOFURAN (A)
Birds	Field	METHYL ANTHRANILATE (NL)	CARBOFURAN (A)
Crickets, mole crickets	Field	**ACETAMIPRID** (D) **+ LAMBDA-CYHALOTHRIN** (B); CHLORPYRIFOS (B); DIMETHOATE (B); FENITROTHION (B); FIPRONIL (B); IMIDACLOPRID (B); **LAMBDA-CYHALOTHRIN** (B); THIAMETHOXAM (B); THIAMETHOXAM (B) + LAMBDA-CYHALOTHRIN (B)	CARBOFURAN (A)
Grasscutter	Field	-	BROMADIOLONE (A)

Target pest common names	Stage	AIs effective against target pest which are registered, recommended or used and are not HHPs	HHPs which are registered, recommended or used to manage the target pest
Grasshoppers	Field	DIMETHOATE (B); **EMAMECTIN BENZOATE** (D); LAMBDA-CYHALOTHRIN (B); THIAMETHOXAM (B); THIAMETHOXAM (B) + LAMBDA-CYHALOTHRIN (B)	CARBOFURAN (A)
Insects	Field	DIMETHOATE (B); CHLORPYRIFOS (B); FENITROTHION (B); FIPRONIL (B); IMIDACLOPRID (B); LAMBDA-CYHALOTHRIN (B); THIAMETHOXAM (B); THIAMETHOXAM (B) + LAMBDA-CYHALOTHRIN (B)	CARBOFURAN (A)
Leaf hoppers	Field	CHLORPYRIFOS (B); DIMETHOATE (B); FENITROTHION (B); FIPRONIL (B); IMIDACLOPRID (B); LAMBDA-CYHALOTHRIN (B); THIAMETHOXAM (B); THIAMETHOXAM (B) + LAMBDA-CYHALOTHRIN (B)	CARBOFURAN (A); **CHLORFENVINPHOS (A)**
Rice hopper	Field	CHLORPYRIFOS (B); DIMETHOATE (B); FIPRONIL (B); IMIDACLOPRID (B); LAMBDA-CYHALOTHRIN (B); THIAMETHOXAM (B); THIAMETHOXAM (B) + LAMBDA-CYHALOTHRIN (B)	CARBOFURAN (A)
Rice blast	Field	AZOXYSTROBIN (D); CHLORPYRIFOS (B); **COPPER SULFATE** (C); IMIDACLOPRID (B); TRICHODERMA VIRIDE (NL)	CARBENDAZIM (A); **MANCOZEB (B)**
Rice bugs	Field	**ACETAMIPRID** (D) + **LAMBDA-CYHALOTHRIN** (B); CHLORPYRIFOS (B); DIMETHOATE (B); LAMBDA-CYHALOTHRIN (B); THIAMETHOXAM (B); THIAMETHOXAM (B) + LAMBDA-CYHALOTHRIN (B)	CARBOFURAN (A)

Target pest common names	Stage	AIs effective against target pest which are registered, recommended or used and are not HHPs	HHPs which are registered, recommended or used to manage the target pest
Rodents	Field, post-harvest	-	BROMADIOLONE (A); CARBOFURAN (A)
Stemborer	Field, post-harvest	**ACETAMIPRID** (D) + **LAMBDA-CYHALOTHRIN** (B); CHLORPYRIFOS (B); DIMETHOATE (B); **EMAMECTIN BENZOATE** (D); FENITROTHION (B); FIPRONIL (B); IMIDACLOPRID (B); INDOXACARB (B); LAMBDA-CYHALOTHRIN (B); TEBUFENOZIDE (D) + EMAMECTIN BENZOATE (D); THIAMETHOXAM (B); THIAMETHOXAM (B) + LAMBDA-CYHALOTHRIN (B)	CARBOFURAN (A)
Termites	Field, post-harvest	**CHLORPYRIFOS** (B); DIMETHOATE (B); FIPRONIL (B); IMIDACLOPRID (B); **LAMBDA-CYHALOTHRIN** (B)	CARBOFURAN (A); HYDRAMETHYLNON (B)
Weeds	Field	2,4-D (C); BISPYRIBAC SODIUM (D); BENTAZONE (C); BISPYRIBAC SODIUM (D); CLOMAZONE (C); GLYPHOSATE (B); HALOXYFOP-P-METHYL (B); IMAZETHAPYR (B); MEFENACET (B); METOLACHLOR (B); NICOSULFURON (D); PARAQUAT DICHLORIDE (B); PENDIMETHALIN (C); PENOXSULAM (D); PRETILACHLOR (B); PROPANIL (B)	BUTACHLOR (B); OXADIARGYL (B)
Weevils	Post-harvest	PIRIMIPHOS-METHYL (B)	ALUMINIUM PHOSPHIDE (B); CARBOFURAN (A)

Annex IX. Overview of the requirements of major voluntary standards

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

	Point /criteria	Organic	Fair Trade	RFA	UTZ	Global GAP	RTRS
IPM	Site selection						
	Preventive 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 a training						
	The use of PPE is an explicit requirement						
	Observance of re-entry intervals						
	Observance of pre-harvest intervals						
	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 46. Overview of the requirements of major voluntary standards.

The black colour in the corresponding square indicates that the point is not addressed by the standard. The colour red indicates high-level guidance (e.g. prevention [of pests] by implementing GAP). The 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 grey colour indicates that the requirements are detailed and that major GAP are followed.

[i] RTRS: Restrictions limited to 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 waste 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] Fair Trade: Training limited to IPM and agrochemical management; GlobalGAP: limited to health and safety.

Annex X. List of participants who took part in the stakeholder workshop

Plant Protection Study Stakeholder Workshop					
Date:	23 - 24 January, 2018				
Venue:	Sunlodge Hotel, Tesano				
Participants' list					
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