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

# Cross Country Report

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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.

# Contents

## Acronyms

| | |
|---|---|
| ACA | African Cashew Alliance |
| AI | Active ingredient |
| BSCI | Business Social Compliance Initiative |
| CABI | Centre for Agriculture and Bioscience International |
| EC | European Commission |
| FAO | UN Food and Agriculture Organization |
| FGD | Focus group discussion |
| GAP | Good agricultural practices |
| GIAE | Grüne Innovationszentren in der Agrar-und Ernährungswirtschaft (in English: “Green innovation centres for the agriculture and food sector”) |
| GIZ | Corporation for International Cooperation (in English: “Gesellschaft für Internationale Zusammenarbeit”) |
| HHP | Highly hazardous pesticide |
| IGOs | Inter-governmental organization |
| IPM | Integrated pest management |
| IPPC | International Plant Protection Convention |
| KII | Key informant interview |
| MRL | Maximum residue level |
| PAN | Pesticide Action Network |
| PPE | Personal protective equipment |
| PPP | Public–private partnership |
| UNEP | United Nations Environment Programme |

# Executive summary

The 'Green Innovation Centres for the Agriculture and Food Sector' (GIAE) initiative is being implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the German Corporation for International Cooperation, under the special initiative 'One World – No Hunger', to increase the incomes of smallholder farmers, boost employment and improve food security. The programme is currently active in 14 countries: Tunisia, Burkina Faso, Benin, Togo, Mali, Ghana, Cameroon, Nigeria, Kenya, Ethiopia, Mozambique, Malawi, Zambia and India.
GIZ has mandated CABI to lead a baseline study on pest and pesticide management across the 14 countries to promote the implementation of safe and sustainable pest management strategies in order to improve the livelihoods of smallholder farmers. This study assessed the legal framework for pest and pesticide management in each country and evaluated the hazards posed by pesticides registered for sale and being used by farmers. A review of the scientific literature on pest management practices for the major pests of the 16 GIAE focal crops provided a compilation of proven pest management options. For eight countries: Tunisia, Burkina Faso, Mali, Ghana, Cameroon, Kenya, Malawi and India – the study included in-country data collection via interviews with key stakeholders, including government representatives, extension agents, retailers and farmers. This provided additional information on stakeholder roles, responsibilities and knowledge and practice relating to pest and pesticide management. The findings were discussed and validated during in-country stakeholder workshops in each of the 14 countries. The study findings and recommendations are presented in individual country reports and separate two-page country summaries. The main findings and recommendations from the study are as follows:

**National pesticide legislation**

*Evidence:* The alignment of national pesticide legislation with international standards, including the FAO International Code of Conduct on Pesticide Management, selected OECD guidance and the ILO Safety and Health in Agriculture, ranged from good to poor across the 14 countries. Regulations covering key steps in the pesticide life cycle management, from registration and sale, through to safe application and disposal of empty containers, are sometimes not addressed in the national legislation or are only partially addressed.

*Recommendation:* Using the study findings as a guide, GIAEs could seek to proactively engage with national regulatory authorities in order to support the development or revision of key national pesticide management regulations in accordance with recognised international standards and codes of conduct. Through relevant partners, GIAEs should also provide technical support for the implementation and enforcement of priority regulations.

**Pesticide management and safety**

*Evidence:* Across the 14 countries, almost 20% of registered pesticides are classed as highly hazardous pesticides (HHPs). FAO's Guidelines on Highly Hazardous Pesticides defines HHPs as pesticides that "*present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems*". HHPs are widely available in the GIAE countries and are used by farmers. The risks of using pesticides, HHPs in particular, are exacerbated by a general lack of available safety information and by limited

awareness of safe pesticide handling among pesticide retailers and extension workers from whom farmers seek advice. Personal protective equipment (PPE) is also neither readily available nor affordable and its use is not being routinely advised or promoted by extension agents. Few low-toxicity products or biological products are registered and a specific pathway for the registration of biological control products is in place in only six of the 14 study countries. Absence of this pathway slows down the registration process for low-toxicity products and thus also restricts their availability. Many GIAEs already provide advice through their trainings on the safe handling of pesticides, but this is not always consistent. GIZ programmes, including GIAEs, have also already adopted a policy which aims at excluding any recommendation, procurement or use of HHPs within their programmes.

*Recommendation:* GIAEs should ensure that adequate advice is provided in each case where pesticide use is being recommended. The GIZ policy related to excluding any recommendation, procurement or use of HHPs should also be clearly communicated to all partners to ensure that it is consistently applied. At the national level generally, a gradual phasing-out of HHPs from the country's supply chain is recommended. This should be coupled with policies to increase the availability and affordability of safer, low-toxicity alternatives. Options include, working with regulatory systems on simplifying the registration processes and putting in place subsidy programmes for pesticides of known low-toxicity, such as biological control products. In addition, the availability and affordability of biological control products specifically, can be increased through the support of distribution and storage systems and the establishment of facilities for local production. This should be done in partnership with the private sector. National policies to promote awareness and use of low toxicity products should also be supported. This could include, for example, the development of extension material and/or ICT tools highlighting registered and available biological control products and other low toxicity products that can be used in place of more toxic chemical pesticides. For example, development of a free and easy to access national biopesticides database and portal could be considered. Where phasing-out HHPs is not immediately practical, risk reduction measures should be implemented, including capacity building on pesticide safety for retailers and extension agents. Availability and use of appropriate PPE can be encouraged through subsidy programmes. Options for engagement with the private sector exist around the production and supply of protective clothing and implementation of pesticide container collection and disposal schemes.

**Integrated pest management (IPM)[1] awareness and knowledge**

*Evidence*: National policies to promote the implementation of IPM are in place in some of the GIAE countries. However, on a practical level, implementation is restricted by weak capacity within national advisory services and agri-input suppliers. Generally, knowledge of IPM within public and private advisory services is low in most countries due to lack of investment in training and an absence of freely accessible and practical pest management information. The GIAEs are making progress to strengthen these services, but scale is currently limited. Although several GIAE

[1] Integrated Pest Management (IPM) means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment (FAO).

programmes have established successful links with national and international research institutes, generally these agencies are often under resourced and this is limiting context-specific innovations and new technology from reaching farmers and being developed in collaboration with farmers. GIAEs are also promoting the implementation of IPM through their own trainings at different stakeholder levels. In addition, the GIAE in Tunisia is working with the German start-up PEAT to provide extension agents with an ICT pest diagnosis tool.

*Recommendation:* To achieve a greater impact on IPM knowledge and its implementation, further key stakeholders should be supported and incentivised to promote and implement IPM. These should include existing public and private advisory services, and agri-input suppliers as well as women and youth trained through self-employment creation schemes to provide technical support and advisory services to farmers implementing a voluntary IPM standard. Quality of this service will be assured through training and assessment. A certification of 'competence' can be awarded to individuals demonstrating sufficient knowledge, allowing them to practice as advisors to support farmers on implementing the standard. All stakeholders should also be given free access to pest management information and toolkits such as the Plantwise Knowledge Bank. Farmer-facing extension methods with different impact pathways should be used in complementary ways to reach more farmers. These can include wide reaching methods such as radio and TV, combined with more targeted methods such as specific plant health campaigns. Integration of innovative ICT extension methods can also help to increase extension reach and improve the timeliness and uptake of IPM advice, while at the same time lowering extension service costs. Digitally aware farmers can be targeted with free, user-friendly apps providing access to pest management fact sheets and on-line chat groups monitored by extension agents, allowing farmers to receive remote and coordinated plant protection advice. Digital technology can also be used to share information on weather and provide pest alerts. Development of ICTs through public-private partnership should be further supported. In this context, the PEAT diagnostic tool Plantix requires further development to increase its capacity to diagnose a broader range of crop-pest problems and improve the quality of recommendations provided for the management of plant health problems.

**Voluntary standards**

*Evidence*: Voluntary standards can be an economically viable option where there is strong and guaranteed customer base for certified produce in both national and international markets. International voluntary standards (e.g. organic and Fairtrade) are currently being applied only to selected export crops in the GIAE countries. In some countries, GIAEs are providing support for the adoption of these standards, such as in the cocoa value chain in Cameroon. Voluntary standards such as good agricultural practices (e.g. Global G.A.P), are mostly only applied by business-oriented farmers. This restricts access to national and international markets for a large number of small-holder farmers who lack the capacity to meet the required standards.

*Recommendation:* The GIAEs should promote relevant voluntary standards among young transitional farmers in particular and support farmer compliance with the standards (including IPM implementation). This in turn will potentially open up new structured markets to these farmers. A coordinated systems approach involving other key actors (e.g., advisory services, agro-input dealers) could be considered. This would harmonise and reinforce the messaging

transmitted to farmers. A training and 'certification' system for advisors or agro-input dealers, including a periodic evaluation process, would be one way to create consistency while also promoting those who comply. When this would be achieved, the younger female and male farmers would also be incentivised to remain in the agriculture sector due to the potential business opportunities offered, rather than migrating into urban centres to find employment. GIAEs should look more closely into the implementation of local voluntary standards for better national market access and a stepping stone towards GlobalG.A.P certification required for international markets.

**Fall armyworm (FAW): a new invasive insect pest in Africa**

*Evidence*: Fall armyworm is now a major invasive pest in Africa as confirmed by a recent evidence note by CABI. It is present on maize, rice, sorghum, millet, sugarcane, groundnut, soybean, tomato, potato, cabbage and cotton in Africa. However, the pesticides and/or pesticide application practices being promoted and used to tackle FAW are often unsafe. Adopting IPM is the safest long-term solution to control FAW (see evidence note summary). GIZ is already working with manufacturers of biological control products to promote the development and uptake of safe and practical solutions. CABI is also combatting FAW and other invasive species in Africa through its Action on Invasives programme, which is currently particularly active in Ghana, Zambia and Kenya. Furthermore, international experts have formed working groups under the FAO-led framework for partnership for the sustainable management of Fall Armyworm in Africa. GIAE staff members are aware of this initiative and in some cases are contributing to some coordination activities.

*Recommendation:* GIAEs should support the establishment of policies, including subsidies and awareness-raising activities, to promote lower-risk control options. Potential low-risk biological control products that have already been identified should be fast-tracked for field-testing and registration within fall armyworm-affected countries and countries likely to be affected. GIAEs should also consider supporting the establishment of further public private partnerships to ensure that the required testing, scaling-up of production and dissemination of products is rapidly achieved. Coordinated efforts between GIAEs and CABI's Action on Invasives programme could contribute to the scaling-up of this programme to cover further countries. GIAEs should explore possible linkages with other groups, such as the International Working Group on Maize Insect Pests of the International Organisation for Biological Control (www.iwgo.org). In addition, the GIAEs could also explore linking up with the team comprising the International Institute of Tropical Agriculture (IITA), the International Centre of Insect Physiology and Ecology (icipe) and CABI in order to support and further increase the development and implementation of biological-based pest management approaches in Africa.

The findings from this study were used by CABI to develop a set of priority recommendations, including actionable policy- and field-level solutions and strategies for each GIAE programme, and for a range of stakeholders. These are included in detail in the individual country reports and are summarised in this cross-country report. The findings and recommendations from this study will support better integration of crop and post-harvest protection in the innovation activities of the

GIAEs, and will contribute to the GIAE initiative's goal of improving food security and increasing the incomes of smallholder farmers.

# 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 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 control methods. These non-chemical methods contribute to reducing pest pressure and damage, but also contribute to reducing the externalities of the agriculture sector as regards the environment and human health. However, farmers around the world still rely on pesticides to control pest outbreaks.

The GIAE initiative, led by GIZ, under the special initiative 'One World – No Hunger', aims to increase smallholder farmer productivity and improve the whole value chain to maximize farmers' benefits. The programme is currently active in 14 countries: Tunisia (TN), Burkina Faso (BF), Benin (BJ), Togo (TG), Mali (ML), Ghana (GH), Cameroon (CM), Nigeria (NG), Kenya (KE), Ethiopia (ET), Mozambique (MZ), Malawi (MW), Zambia (ZM), and India (IN). In order to align its GIAEs to the best practices in pest and pesticide management, GIZ has mandated CABI to lead a baseline study on crop and post-harvest protection across the 14 countries.

The study took place between July 2017 and April 2018 and included an assessment of the national legislation for pest and pesticide management in each country, analysis of the registered pesticides (including those for use in the focal crops), and a literature review of pest management practices for major pests. For eight countries – Tunisia, Burkina Faso, Mali, Ghana, Cameroon, Kenya, Malawi and India – the study also included in-country data collection to provide information on pest management knowledge and practice in each country. The initial findings were complemented and validated during in-country stakeholder workshops. The study covered the value chains of 16 focal crops across the 14 GIAEs, shown in Figure 1. The crops were: rice, soybean, groundnut, maize, potato, sweet potato, cassava, tomato, faba bean, cowpea, mango, cashew, wheat, sesame, cocoa, and baobab.

Within this study, the term 'pest' is used to describe any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products.

**In particular, this study addressed the following specific areas of interest to GIZ, which are presented in this report:**

- an analysis of the legal framework for pest and pesticide management. This included pest management at the pre-planting stage (e.g. seed or plant material treatment, resistant or tolerant varieties) and at the post-harvest stage, to which the same regulations apply. This also covered subsidy policies for pesticides, application equipment or personal protective equipment (PPE), and other incentives

- an assessment of the alignment of the legal framework for pest and pesticide management and/or related policies with international best practice guidelines

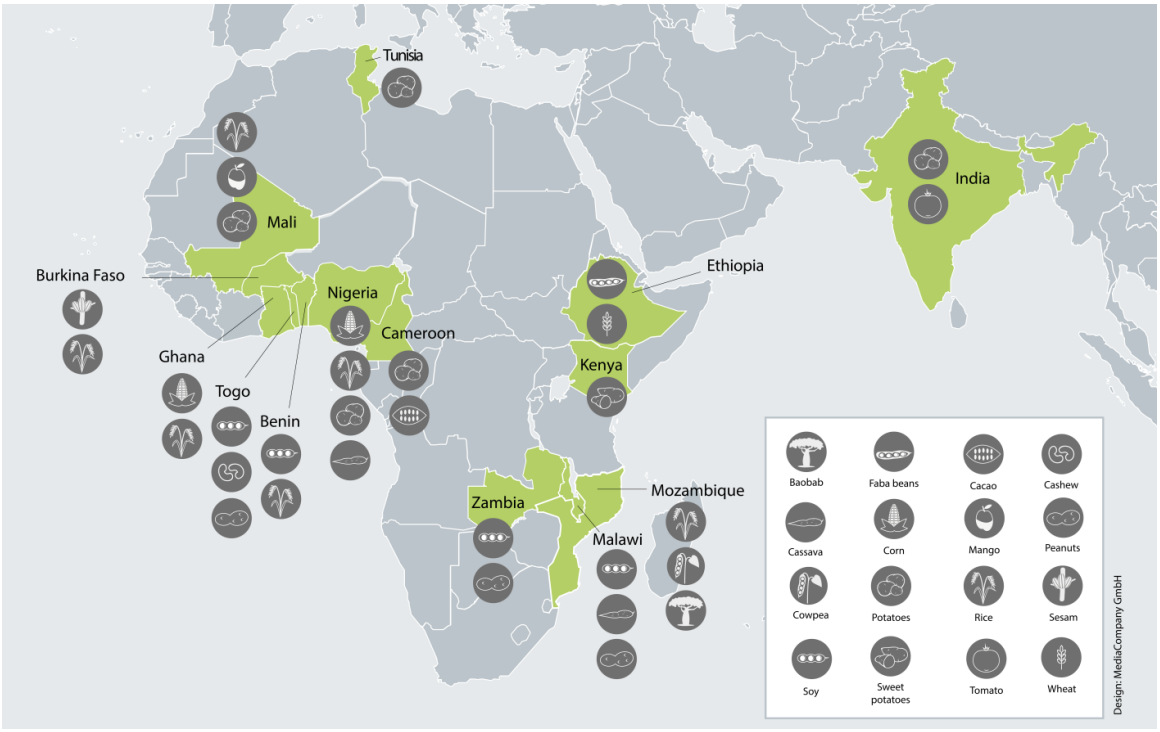



**Figure 1 Countries, crops and value chains covered by the study**

- a review of the IPM and GAP knowledge of extension agents and farmers identification of advisory needs – in particular, of national authorities and extension agents
- an assessment of the challenges in pest management and in the implementation of IPM, including farmers' access to inputs
- identification of the list of registered pesticides in each country, including an assessment of the associated hazards
- a review of the pest management practices implemented by farmers or recommended by extension agents, including practices that are approved for use in organic agriculture
- a review of the implementation of voluntary standards, such as GAP or organic agriculture in the focal crop value chains
- a review of partnerships with the private sector that are relevant to pest management
- a review of advisory material used within the GIAE initiative, where available

**Further areas of interest to GIZ are presented in the individual country reports:**

- a review of the stakeholders in the focal crop value chain with relevance to pest and pesticide management
- a literature review on field and post-harvest pest management for the key pests of the focal crops
- recommendations for the implementation of sustainable, IPM-compatible pest management practices for the focal crops
- a list of registered, less toxic, alternative active ingredients (AIs) to the HHPs that are registered for use on the focal crops, used by farmers or recommended by extension agents

The information gathered through the study and the in-country data collection allowed the bottlenecks and challenges in crop and post-harvest protection to be identified across different levels for each value chain in the 14 countries. CABI used this information to identify priority needs and to develop a set of actionable recommendations tailored to suit the different key value chain stakeholders in each GIAE programme.

In addition to this cross-country report, the outputs for this study include 14 detailed country-specific reports describing the findings and recommendations for each country, and separate two-page country summaries.

# Methodology

The approaches and tools for the desk study and in-country data collection were developed by CABI Switzerland, based on experience from previous studies. The methodology for the study was devised in such a way that it could be implemented consistently in all 14 countries, without any major changes in the approach. The desk study was conducted first and the findings were used to refine the in-country data collection tools to ensure that information gaps were filled. The study tools were also shared in advance with the GIAEs to allow for some local adaptation where required.

## Desk study

The analysis of the national legislation and policies relating to pest and pesticide management in each country was conducted using a standardized tool. This tool allowed the content of national legislation and policies to be compared against specific best practice recommended by the UN Food and Agriculture Organization (FAO) and WHO International Code of Conduct on Pesticide Management (FAO 2013) and other guidance from the International Plant Protection Convention (IPPC) and OECD.

The state of the science on crop protection for the specific focal crops in each country was established from a review of the literature existing in the public domain and from documents

internal to CABI. Where relevant, this review also covered crop protection against Fall Armyworm (Spodoptera frugiperda).

Where available, pest management advisory documents were also collected from GIAE stakeholders and an assessment was made of the quality of the guidance provided. This assessment focused on the comprehensiveness of the pest management information and on the inclusion of best practices for the safe use of pesticides.

The national lists of registered pesticide were analysed and toxicological profiles of each AI were developed. This included information on the status of the registered AI according to the WHO Recommended Classification of Pesticides by Hazard (WHO 2009) and the classification system used in the Globally Harmonized System (UN 2011) and the Pesticide Action Network (PAN). This classification took into account a measure of each pesticide's acute toxicity, as well as chronic effects of exposure (e.g. whether the pesticide is a carcinogen, etc). In addition, the analysis was used to assess the availability of lower-toxicity alternatives to the HHPs in each country. For each key pest for which an HHP is registered, recommended or being used, a list containing the non-HHP AIs that are registered and that are effective against the pest was provided. This list also includes information on the GIZ procurement classification of the lower-toxicity alternatives it contains.

## In-country data collection

The in-country data collection was designed to gather information to complement the desk study. Specifically, information was sought on the implementation and enforcement of national pest and pesticide management legislation and policies, and on the knowledge, attitudes and practices of stakeholders in relation to pest and pesticide management. The tools used to collect this information included key informant interviews (KIIs), focus group discussions (FGDs) and questionnaires. All study tools were shared in advance with the GIAEs to allow for their input and some adaptation if required. KIIs were held with each major stakeholder in a given value chain, including representatives of the ministry of agriculture, ministry of health and ministry of the environment, research institutes, agro-input manufacturers and suppliers, voluntary standards and certification bodies, where these exist, as well as trade and processing sector actors. Questionnaires and FGDs were conducted with farmers growing the focal crop relevant for the study country, and with extension agents. These stakeholders were participants in the GIAE programme and were selected by the GIAE and national partners. The interviews were conducted in the local language where this was feasible, and via interpreters when this was required. Information on non-chemical and chemical control methods being recommended by extension agents and implemented by farmers was also gathered.

Analysis of the questionnaire data and information gathered from FGDs and KIIs was carried out by CABI staff. A standardized procedure was used to analyse and present the country data in order to enable cross-comparisons and global evaluation. Findings from the questionnaires are presented in detail in each country report.

The information gathered during the course of this study should be viewed with reference to the following constraints: the data collection in some countries took place outside the growing season for the crops of interest; in addition, the geographic focus of the study and the number of

respondents who could be interviewed was also restricted due to the limited time available. During interviews, the way in which the question was phrased, particularly if it was translated, and interpretation of the question by the respondent will have varied between countries and this could account for some of the differences between countries. The findings covered in this cross country report have been extracted from the more comprehensive individual country studies. In so doing, selection of content has been necessary to reflect what were considered to be the most relevant and interesting findings. Please refer to the individual country reports for more detailed information.

Note on the presentation of information in tables: In many cases, the questionnaire design allowed respondents to provide multiple answers to individual questions. In order to simplify the data for cross country comparison, only selected answers are presented in each table. The percentage values for responses shown in the tables are therefore not cumulative. Please refer to the individual country reports for more detailed findings.

## Study findings and recommendations

This cross-country report presents the study findings and recommendations. The report is divided into three sections: Part A, Part B and the annexes. Part A summarizes the key findings and related recommendations. It contains cross-references to Part B, where selected findings and related recommendations are described in more detail. The selection of the topics presented in Part B was based on the interests expressed by stakeholders during in-country workshops and on the interests expressed by the GIZ team during a presentation held at GIZ in Bonn. Finally, the annexes include a list of the extension material reviewed by the CABI country teams, along with CABI toolkits. The CABI toolkits contain a collection of successful approaches led by CABI to support the implementation of IPM.

# Part A. Overall study findings and recommendations

## A. 1. Pest and pesticide management

### The legal framework

**National pesticide legislation**

The study included an analysis of the legal framework for pest and pesticide management in the 14 countries where the GIAE initiative is being implemented. This included an analysis of the legislation and policies in place to reduce pesticide use, to regulate the key steps in pesticide life cycle management and to mitigate associated hazards and risks. Legislation covering the chemical treatment of seeds and planting material was also assessed. National legislation and policies were compared to the best practices guidance from the FAO, WHO, IPPC and OECD, including the International Code of Conduct on Pesticide Management. Although none of the study countries are perfectly aligned with this guidance, India, Kenya, Malawi, Togo and Tunisia demonstrate good practice. Significant gaps were identified in the legislation in Ghana, Mali and Nigeria. More detailed findings are presented below

**Pesticide management legislation**

Key steps in the pesticide life cycle from registration and sale, through to safe application and disposal of empty containers, are sometimes missing or only partially covered in legislation in the 14 countries. For instance, all countries have established a mandatory registration procedure for pesticides, but the list of registered pesticides is not publicly available in some countries (Benin, Ethiopia and Zambia). In six countries, a separate pathway is in place for the registration of biological control products, and this can facilitate the registration of these products. Regarding regulations on the sale of pesticides, just over half of the countries require that pesticide retailers hold a licence that is granted based on competency and training. However, where a licensing scheme is in place, information gathered through interviews with stakeholders indicates that day-to-day sales are carried out by untrained employees that are unable to provide appropriate advice to the pesticide buyer. Regulations that require employees to take necessary measures to protect the health of farm workers are in place in all study countries except Ghana and Mali. Our survey comprised almost exclusively family farmers and it was not possible to verify whether these regulations are being implemented or not. Consumer protection through pesticide residue monitoring in food is in place in only eight countries. Where this is the case, its implementation is limited by the availability of financial resources and sampling is done systematically only for export crops. Finally, regulations covering pesticide storage and pesticide container disposal are in place in just over half of the countries, and where they are in place, the provisions contained are not fully aligned with best practice. No country has a mandatory empty container collection system, although Tunisia is developing one, which is now in the pilot phase. Countries should be encouraged to update their regulations based on the guidance included in the International Code of Conduct on Pesticide Management and other best practice guidelines. However, regulations need to be enforced to have an impact. Countries therefore need to set in place proportional and deterrent fines for offenders. Alignment of national regulations for pesticide management with recognized international best practice will ensure that adequate provisions covering the key steps

in pesticide life cycle are in place. The enforcement of regulations will contribute to minimizing the risks linked to pesticides.

Policies to facilitate access to information on matters including pesticide hazards and risks, to raise awareness of the importance to protect human health and the environment, or to promote the use of PPE that is appropriate, are in place in nine out of 14 countries. No policies of this kind are in place in Tunisia, Cameroon, Nigeria, Mozambique and Zambia. Countries should be encouraged to implement such policies in order to reduce the risks to pesticide users and consumers. Such policies will also ensure that farmers are aware of the risks linked to pesticide use and have sufficient knowledge to handle them safely. Input availability is often reported to be a barrier to the implementation of IPM and subsidy schemes can contribute to reducing this problem. At present, subsidy schemes for pest control products are in place in only two of the study countries: in Zambia and in some states in India. In India the subsidy schemes are implemented at state level and are usually restricted to biological control products and this has largely contributed to their affordability. For example, a credit based subsidy scheme for commercial production of biopesticides.

None of the study countries have subsidy schemes for PPE in place. Finally, policies to promote research on alternatives to existing pesticides are in place in only five countries. Such policies should be supported to facilitate the affordability of lower risk alternatives or PPE and to facilitate validation and adaptation of non-chemical control methods at the local level. The implementation of targeted subsidy schemes or policies to promote research on alternatives to existing pesticides will help to ensure that new products continue to be developed. Once developed, applying pricing subsidies to new and safer products will increase initial awareness and uptake by farmers.

Further information on regulatory frameworks is provided in Part B of this report: See B.2 for details and related recommendations on pesticide registration; B.3 for packaging and labelling, B.4 for input supply, B.5 for pesticide handling, B.6 for maximum residue levels (MRLs, B.7 for pesticide storage and B.8 for empty container disposal.

In general, and using the study findings as a guide, GIAEs could seek to proactively engage with national regulatory authorities in order to support the development or revision of key national pesticide management regulations in accordance with recognised international standards and codes of conduct. Through relevant partners, GIAEs should also provide technical support for the implementation and enforcement of priority regulations.

**Policies to promote IPM**

The findings show that policies to promote the implementation of IPM are in place in 8 out of the 14 countries. Likewise a policy to promote the adoption of voluntary standards (e.g. organic agriculture or Global G.A.P.) is in place in 8 of the 14 countries; See Part B.1 for details on policies to promote IPM and related recommendations.

Voluntary standards can be an economically viable option where there is strong and guaranteed customer base for certified produce in both national and international markets. In some countries, GIAEs are providing support aimed at the adoption of these standards, such as in the cocoa value chain in Cameroon. Higher level voluntary standards such as Global G.A.P, are mostly

only applied by business-oriented farmers for international market access. This restricts access to national and international markets for a large number of small-holder farmers who lack the capacity to meet the required standards.

The GIAEs should promote relevant voluntary standards among young transitional farmers in particular and support farmer compliance with these standards (including IPM implementation). This in turn will potentially open up new structured markets to these farmers. When this would be achieved, the younger female and male farmers would be incentivised to remain in the agriculture sector due to the potential business opportunities offered, rather than migrating into urban centres to find employment. Therefore it is proposed that GIAEs should look more closely into the implementation of local voluntary standards for improved national market access and as a stepping stone towards GlobalG.A.P certification for international market access. Involvement of the private sector (particular retailers), NGOs, certification bodies and intergovernmental organization (IGOs) can contribute to these efforts.

## Stakeholder knowledge and practice: farmers, extension agents and the agro-input sector

**IPM knowledge**

National policies to promote the implementation of IPM are in place in some of the GIAE countries. However, on a practical level, implementation is restricted by weak capacity within national advisory services and agri-input suppliers, and this in turn affects farmers' knowledge and practice.

Implementation of IPM by farmers requires a basic understanding of the agro-ecosystem. This includes knowledge of pests and their natural enemies. However, in most of the countries, farmers have difficulty in precisely identifying the main pests and the economic pest thresholds required to determine the timing of interventions – particularly for pesticide application. Identifying locally relevant economic pest thresholds will help to reduce unnecessary pesticide use. Different approaches can be used to foster the uptake of IPM by farmers; recommendations for their implementation are detailed in Part B.1. A farmer-facing extension approach based on reach versus impact will help to identify a variety of complementary extension methods to reach a greater number and broader range of farmers, including methods preferred by women and young farmers. These include the direct training of farmers on IPM and non-chemical pest management through interactive trainings, the development of written training material that is adapted to the farmers' needs and level of education as well as increasing farmers' access to information on pest management and IPM through popular media such as radio combined with more targeted mobile phone messaging. Digitally aware farmers can be targeted with free, user-friendly apps providing access to pest management fact sheets and on-line chat groups monitored by extension agents. The latter will allow farmers to receive remote, up to date and coordinated plant protection advice. Digital technology can also be used to share information on weather and provide pest alerts along with other services. Integration of innovative ICT extension methods will help to improve the timeliness and uptake of IPM advice, while at the same time lowering extension service costs in the long term. The implementation of these recommendations will contribute to effective knowledge transfer and adoption of IPM approaches by farmers.

Extension agents' knowledge of IPM is also often limited. Extension agents in Ghana, Kenya and Tunisia have a reasonably to good understanding of IPM, while extension agents in other countries often have a low level of understanding. In all countries except Tunisia, some extension agents have difficulties naming pests or providing recommendations for their control. Globally, just under half of the extension agents have received IPM training or have access to printed extension material. Across all the countries, about two-thirds of extension agents indicated that a lack of extension material was a barrier to the implementation of IPM, and one half of extension agents cited lack of knowledge among extension agents as a barrier.

GIAEs are promoting the implementation of IPM through their own trainings at different stakeholder levels and are making progress in strengthen the capacity of existing extension services, but scale is currently limited. To achieve a greater impact on IPM knowledge and its implementation a multiplier system could established. This will involve further key stakeholders being supported and incentivised to promote and implement IPM. These stakeholders can also be trained and certified to provide advisory services to farmers who want to implement IPM, under a voluntary IPM standard, for example. All stakeholders, including public and private advisory services and agri-input suppliers, should be given free access to pest management information such as the Plantwise Knowledge Bank which contains free online and downloadable resources. Other methods that can be used to reinforce the knowledge and capacity of extension agents include practical and field-based training, providing support for the production of IPM extension material, and the use of innovative e-learning training tools as well as 'serious' games to improve diagnostic and IPM skills. Different extension methods with different impact pathways should be used in complementary ways to reach a wider number and range of extension agents. This can include the integration of innovative ICT extension methods. Development of these ICTs through public-private partnership should also be supported. In this context, the PEAT diagnostic tool Plantix requires further development to increase its capacity to diagnose a broader range of crop-pest problems and improve the quality of recommendations provided for the management of plant health problems.

Although several GIAE programmes have established successful links with national and international research institutes, generally these agencies are often under resourced and this is limiting the development of context-specific innovations and new technology as well as limiting the transfer of technology that already exists to farmers via the extension services. Developing linkages among stakeholders could improve this knowledge transfer from research to extension. In addition, the GIAE in Tunisia is working with the German start-up PEAT to provide extension agents with an ICT pest diagnosis tool. Recommendations are described in more detail in Part B.1.

**Pesticide management**

Farmers in all countries have limited knowledge of safe pesticide management. They have a limited knowledge of important safety information used on pesticide packaging and labels: for example, overall only about 20% of the farmers have a good understanding of the concept of re-entry interval. They also have limited knowledge of hazard symbols and advice pictograms and often only recognize the most obvious warnings: e.g. the hazard symbols for "wear rubber gloves", which bears a pictogram of a glove. Although about two-thirds of the farmers indicated using some kind of PPE, the protection worn is often not appropriate. Overall, only about half of

the farmers indicated wearing rubber gloves or rubber boots for spraying pesticides and many farmers use a simple scarf to protect their face. The reasons mentioned for not using PPE include availability and price but some farmers also do not understand – or choose to disregard – the fact that pesticides can be harmful. In many cases, the storage of pesticide by farmers does not follow basic safety precautions, except in Tunisia, Cameroon and Kenya where the majority of farmers said they were storing pesticides in a locked location or out of reach of children. Across all countries, the majority of farmers do not safely dispose of empty pesticide containers. In order to reduce the risks linked to pesticide use, the following approaches could be considered. Farmers should be trained on appropriate pesticide handling and informed of the need to wear PPE. This should be supported through a scheme to subsidize PPE in order to make it more affordable. Advisory services should ensure that farmers have the necessary training and the appropriate PPE required for the pesticides that they are recommending. There is also a need for advisory services to be trained on the use of safe pesticide management in order to allow them to provide appropriate information to farmers. The agro-input sector also has an important role to play in promoting the safe use of pesticides. Agro-input retailers' knowledge of safe pesticide handling should be enhanced through capacity-building activities, and their capacity monitored and updated regularly. They should be further supported through the provision of awareness-raising information on the safe handling of pesticides that they can display and disseminate to farmers. Finally, agro-input retailers should stock PPE that is appropriate for the pesticides they sell, and should be able to provide advice to farmers on the safe handling of pesticides. These recommendations will ensure that agro-input retailers and extension agents have a sound knowledge of pesticide management so that they can in turn appropriately inform farmers. Approaches that directly target farmers will contribute to raising their awareness of the risks linked to pesticide use and reduce the impact on human health and the environment. See Part B for details and related recommendations on the understanding of pesticide labels (B.3), input supply (B.4), pesticide handling (B.5), MRLs compliance (B.6), pesticide storage (B.7) and empty container disposal (B.8).

## A. 2. Registered pesticides and linked hazards

The number of pesticide AI registered in the study countries varies greatly, ranging from 41 in Benin to 319 in Kenya. The AI registered differ in terms of their overall hazard level: from 17% to 31% meet one or more of the HHP criteria. "Low hazard" AI are not registered at all in Togo and Benin and represent only up to 10% in Kenya. However, 36% to 47% of the registered AI fall into the category "Warning", which corresponds to a relatively low toxicity (e.g. harmful or may be harmful if swallowed or inhaled). However, a much lower number of pesticides are registered, if any, for use on minor crops, including some focal crops: e.g. sesame, soybean or baobab.

According to the FAO's Guidelines on Highly Hazardous Pesticides, there are three main steps for addressing HHPs: (i) identify which HHPs are being used; (ii) assess HHP risks and needs; and (iii) put in place mitigation measures. The study identified the HHPs that are registered, recommended by extension agents and used by farmers for control of the major pests of the focal crops in each country. For most of the pest/crop combinations, the study identified and listed less toxic alternatives according to information in the GIZ procurement category (included in country reports). However, in Benin and Togo, less toxic alternatives are often not available at all or are not registered for use on the focal crops. This is due to the very low number of pesticide

products registered in these countries. Countries should be encouraged to phase out HHPs. Where alternatives to HHPs are not available and where totally phasing out an HHP is not practicable, mitigation measures should be put in place to reduce the risk when using such HHPs. Where challenges in phasing out an HHP persist despite the identification of suitable alternatives, follow-up is required to understand the underlying issues: e.g. price or availability. More generally, in order to reduce the risks linked to pesticide use by farmers, the pesticides with the lowest risk should be prioritized when making recommendations and the PPE required for their application should be used. In particular countries where commercial pest control options are limited and farmers themselves are therefore more at risk of exposure, the local production of biological control products should be considered. This would help to improve the availability and distribution of low-risk alternatives to pesticides currently in use. Following the above recommendation will contribute to reducing the availability of HHPs, ensure that mitigation measures are implemented where their use continues and facilitate farmer access to lower risk alternatives such as biological control products. See Part B.9 for detailed information about the hazards linked to the pesticides that are registered in the study countries, and related recommendations.

## A. 3. Pest management practices in focal crops

The study findings revealed the range of crop and post-harvest pest management options being applied by farmers and recommended by extension agents. Most farmers use a mixture of chemical and non-chemical pest control methods. In some cases no synthetic pesticides are used and farmers rely on cultural and physical control, such as crop rotation, removing pests by hand and field hygiene. The use of homemade botanicals is also common. Although many farmers covered by the study are already implementing appropriate non-chemical control methods, further support could be provided to improve practice: further or novel non-chemical control options could be explored and promoted, and the use of proven methods further disseminated. This will support the use of non- chemical control methods among farmers and thus contribute to reducing agriculture's externalities. Detailed information for two crops, potato and rice, is provided in Part B. 10. See Part B. 1 for details regarding training of, and knowledge transfer to, extension agents and farmers.

## A. 4. Voluntary standards

Relevant stakeholders, including the private sector, should be involved in the promoting of sustainable farming practices in general and more particularly of IPM and GAP. International voluntary standards contribute to the uptake of IPM or GAP by farmers but in the study countries these are only applicable to exports crops. Among the GIAEs' focal crops, voluntary standards are applied to cashew, cocoa, mango, sesame, soybean and sweet potato. International voluntary standards can be an economically viable option where there is a strong and guaranteed customer base for certified produce. National voluntary standards can also contribute to the uptake of IPM and GAP and their implementation should be considered where they are recognized by the national trade sector. To support farmers in complying with voluntary standards, consideration could be given to a systems approach in which other key actors (e.g., advisory services, agro-input dealers) are working towards the same goals. This would harmonise and reinforce the messaging

transmitted to farmers. A training and 'certification' system for advisors or agro-input dealers, including a periodic evaluation process, would be one way to create consistency while also promoting those who comply. For more details about the implementation of voluntary standards in the focal crops, see Part B.11.

## A. 5. Partnerships

Although public-private partnerships are already in place in some of the study countries, this approach could be strengthened. With relevance to crop protection, PPPs with input suppliers can provide farmers with access to resistant varieties, to certified disease-free seeds, to lower-risk pesticides (such as biological control products), or to PPE. Such PPPs could also help provide information about the risks linked to pesticide use and their safe handling. There are multiple incentive systems to attract agro-input dealers or other private advisory services. Linked to the statement above in Part A.4, one possibility is to provide a certification, and the associated benefits, to those who comply with agreed standards. While this approach would work for targeting existing service providers, it could also create opportunities for job creation, which would in turn address the issue of too few advisors trying to meet the demand from farmers.

PPPs with the trade sector should also be considered as this sector has an interest in ensuring that the quantity and quality of the produce sold by farmers meet their requirements. The trade sector can contribute to the implementation of IPM by subsidizing low-toxicity inputs or by supporting the implementation of IPM guidelines and local voluntary standards. See Part B. 12 for further information on PPPs in the study countries.

Interaction and engagement of the GIAEs with national and international research institutes could be increased in some countries. This engagement could provide the GIAEs with access to new crop varieties and crop protection technology, as well as allowing farmers with GIAE programmes to benefit from potential on-farm research. Collaboration on the production of crop protection extension material and guidance would be mutually beneficial. A closer cooperation with extension services can further contribute to the uptake of IPM. For instance, such collaboration could be used to set up field trials to validate the efficacy of non-chemical control methods at the local level and to teach extension agents and farmers how these methods should be implemented, as well as to demonstrate the benefits they bring.

National pesticide registration authorities play an important role in ensuring that lists of registered pesticides and accompanying safety and advisory information are publicly available. Regulatory authorities should be supported to help raise awareness about HHPs, and about the need to facilitate registration processes for lower-risk alternatives, such as biological control products.

Engaging in PPPs will increase the impact of a programme and achieve a greater scale, but also make it more sustainable. Partnerships with research will contribute to improving farmer access to knowledge and new technologies while engaging with national authorities will support the alignment of the legal framework for pest and pesticide management with international best practice.

## A. 6. Extension materials produced by GIAEs and partners

Extension and training materials used by the GIAEs were also reviewed as part of this study in order to assess the quality of the pest management advice provided. Out of the 10 sets of materials obtained from GIAEs, seven include information on pest management. Extension materials used by the Cameroon and Kenya GIAE provide an example of good quality advice in the most appropriate format. Areas for general improvement in the GIAE extension materials include the need for more comprehensive coverage of IPM – and, specifically, more detailed information on monitoring, preventive control and practical explanations of non-chemical control measures. Guidance on recommended pesticides should always be accompanied by detailed information on the use and safe handling of the pesticide. Materials should also be adequately illustrated. These recommendations will contribute to an efficient and comprehensive transfer of knowledge to extension agents and farmers. A comprehensive review of the current scientific literature on crop and post-harvest protection gathered information on practical IPM solutions to address the main pests for the value chain crops in each country. The review primarily focused on field trial results obtained in the respective country or region. This information, which is detailed in each country report, can be used by the GIAEs to develop IPM guidelines or to update and reinforce existing guidance material and thus contribute to the uptake of sustainable pest management practices by farmers. See Part B. 13 for more details on the extension materials produced by GIAEs and partners, and related recommendations for improvement.

# Part B. Specific study findings and recommendations by topic

## B.1. IPM implementation: Legal framework, stakeholder knowledge and attitudes

**Why is it important?**

An understanding of IPM will allow farmers to protect their crops using the optimal combination of cultural crop production practices, integrated with biological control and the rational use of low-toxicity pesticides, where appropriate. Farmers often require advice from advisory services to achieve this balance. It is therefore important that advisory personnel also have sufficient knowledge and resources to support farmers. A national policy is also required to ensure this support is in place and to incentivize the application of the IPM approach.

**Legislative level**

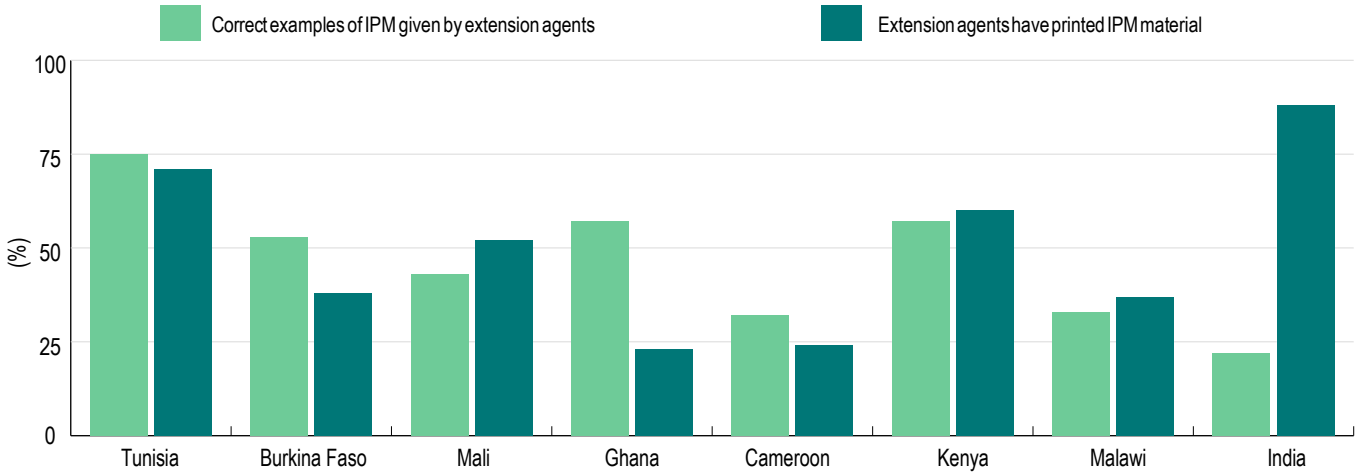
Policies to promote the implementation of IPM or to promote the adoption of voluntary sustainable agriculture standards (e.g. organic agriculture, Global G.A.P.) have the potential to catalyse change. Such policies are in place in just over half of the study countries (Table B.1.-1). Policies to promote research on alternatives to existing pesticides are needed so that funds are allocated to enable research to identify locally relevant strategies to reduce pesticide use or to identify pesticides that pose fewer risks. However, such policies are in place in only five countries. For more details about the implementation of voluntary standards in the study countries and focal crops, see Part B.11.

**Table B.1.-1 Implementation of policies to promote sustainable farming in the study countries**

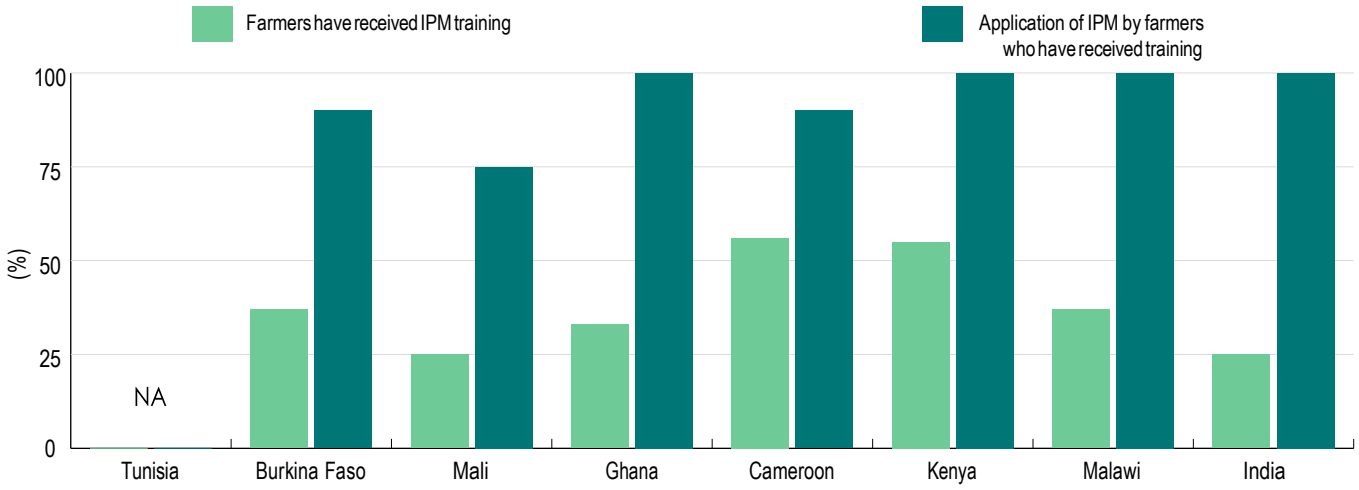
| Indicator | Country | | | | | | | | | | | | | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TN | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | |
| A **policy** is in place to develop and **promote IPM** | ✗ | ✓ | ✗ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | 8 |
| A **policy** is in place to **promote** the adoption of **GAP, organic pro**duction and/or **voluntary standards** | ✓ | ✗ | ✗ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | 8 |
| A **policy** is in place to **promote research** on **alternatives to existing pesticides**[1] | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | 5 |

[1] Alternatives that pose fewer risks, such as non-chemical preventive and direct control measures

**IPM knowledge and training – extension agents**




**IPM training – farmers**



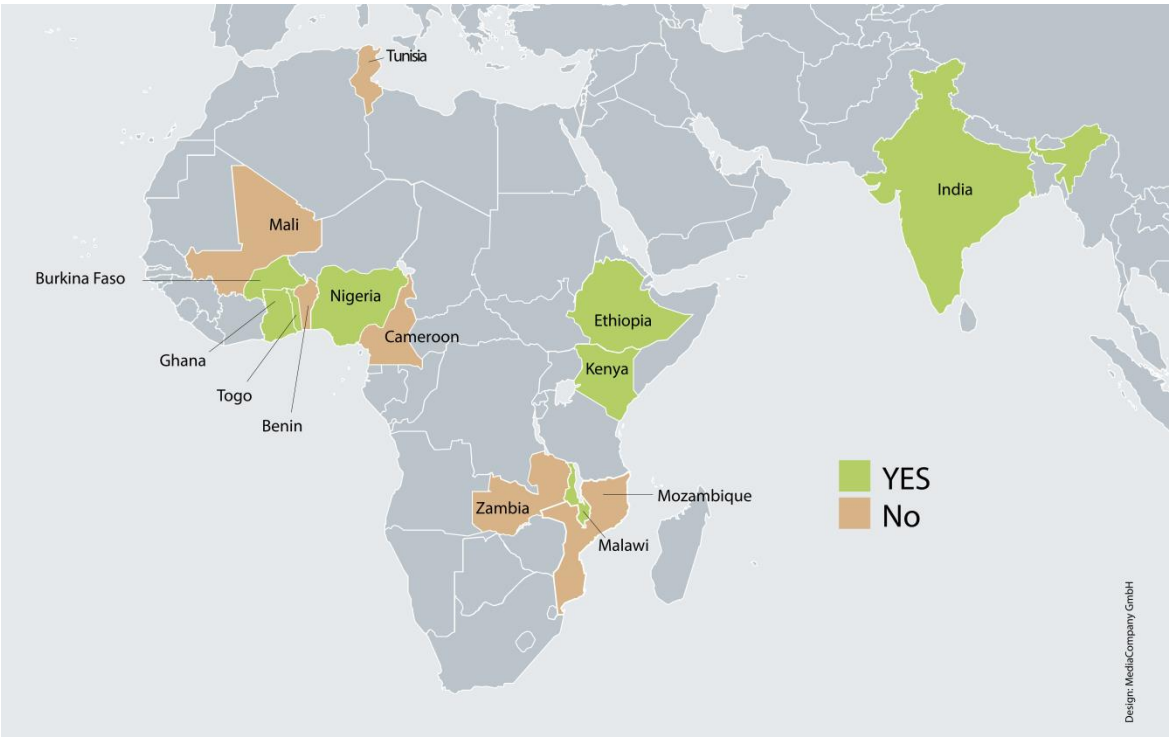



**Figure 2 Policy in place to develop and promote the use of IPM**

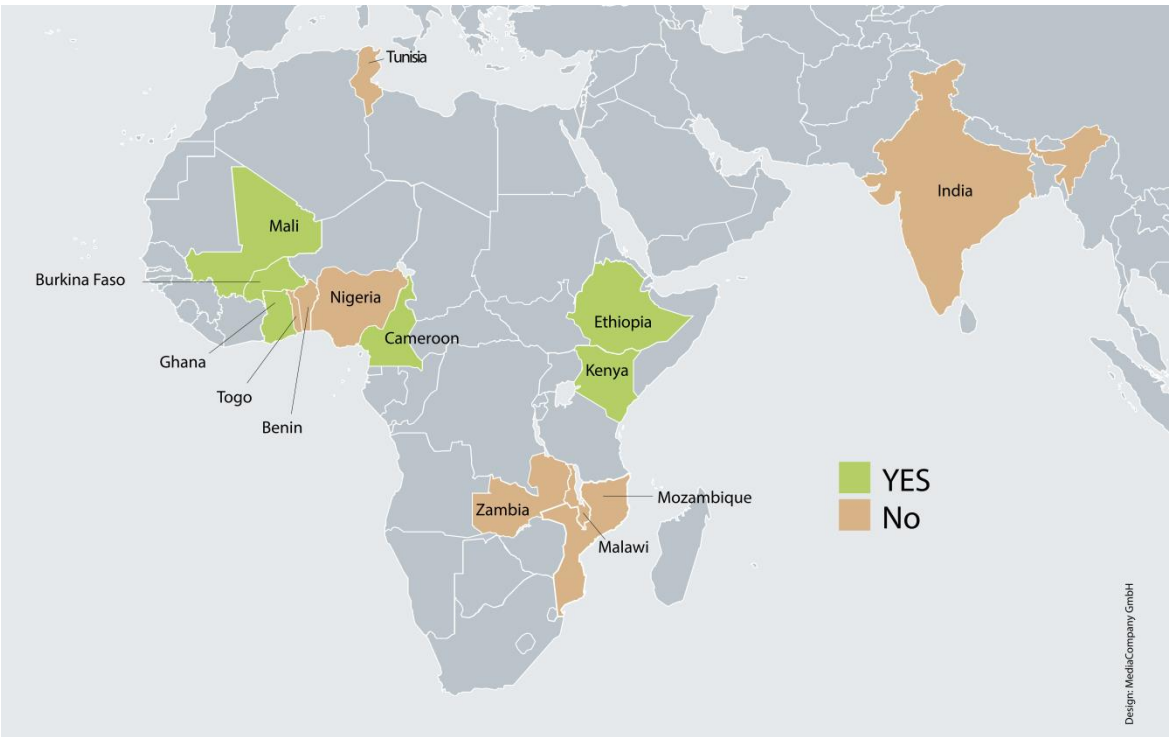



**Figure 3 Policy in place to encourage the use of fewer or less toxic pesticides**

### Recommendations

1. Governments should be encouraged to develop a policy to promote IPM implementation, where one is not already in place. Relevant government authorities (ministry of agriculture, of environment) should take responsibility for this. Policies that promote the adoption of a sustainable agriculture standard can also be used to contribute to IPM implementation. For example, under its environmental policy, Ethiopia indirectly promotes integrated management and control of pests and diseases by ensuring sustainable crop and livestock production using organic farming, and the Zambia National Agricultural Policy 2012–2030 includes aspects of IPM within a conservation farming approach.

2. Where such policies are in place, governments should be supported by relevant stakeholders (researchers, NGOs/IGOs, extension agents) in their implementation efforts (e.g. through technical backstopping).

**Extension level**

In India and Kenya, most extension agents have received IPM training (Table B.1.-2). However, in the other study countries, only a minority of the extension agents have received training. Responses to this question covered all IPM training received. This could be provided under the GIAE programme or by agencies outside of the GIAE programme.

The IPM knowledge of extension agents is often limited, although extension agents in Tunisia, Ghana, Kenya and Burkina Faso perform better. The correlation between agents receiving IPM training and knowledge of IPM is variable. In some countries, e.g. Tunisia – even though less than half of extension agents said they had received training, three quarters were able to provide correct examples of IPM. Conversely, all extension agents in India said they had received IPM training but less than one quarter could provide correct examples of IPM. This gap may be due to several reasons, including the quality and appropriateness of the training versus extension agents' gaining IPM knowledge via their general on-the-job experiences.

According to extension agents, the major barriers to IPM implementation are the lack of knowledge among farmers and the lack of extension materials. About half of the extension agents also indicated that they lacked IPM knowledge and support from research. On the positive side, except in India and Ghana, relatively few extension agents mentioned that IPM was too complicated; underlining that IPM constitutes a viable solution. Extension agents in most countries have limited access to extension materials and rarely distribute extension materials to farmers.

**Table B.1.-2 Extension agents' knowledge of IPM, availability of extension materials and extension agents' perceptions of the barriers to IPM implementation**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=7 | BF n=16 | ML n=23 | GH n=13 | CM n=19 | KE n=20 | MW n=19 | IN n=8 | |
| | % of extension agents | | | | | | | | |
| **IPM training** | | | | | | | | | |
| Extension agents who have received | 43 | 31 | 48 | 15 | 24 | 89 | 11 | 100 | **54** |
| **Extension agents' understanding of IPM** | | | | | | | | | |
| Correct examples given by extension | 75 | 53 | 43 | 57 | 32 | 57 | 33 | 22 | **47** |
| **Barriers to IPM implementation according to extension agents** | | | | | | | | | |
| Lack of knowledge among extension | 57 | 56 | 70 | 46 | 50 | 35 | 68 | 11 | **49** |
| Too complicated | 0 | 6 | 27 | 54 | 6 | 25 | 16 | 100 | **29** |
| Lack of extension materials | 86 | 50 | 70 | 85 | 61 | 55 | 63 | 33 | **63** |
| Lack of knowledge among farmers | 100 | 81 | 78 | 85 | 72 | 95 | 63 | 100 | **84** |
| Lack of support from research | 71 | 25 | 57 | 69 | 56 | 60 | 68 | 13 | **52** |
| **Use of IPM extension materials by extension agents** | | | | | | | | | |
| Have printed IPM extension materials | 71 | 38 | 52 | 23 | 24 | 60 | 37 | 88 | **49** |
| Use them | 57 | 38 | 43 | 15 | 18 | 60 | 21 | 88 | **43** |
| Give them to farmers | 29 | 13 | 17 | 15 | 18 | 35 | 37 | 88 | **32** |

Green = positive/good practices, orange = negative/weak practices

### Recommendations

1. Extension agents' access to information should be improved: for example, through free access to online repositories, such as the CABI Plantwise Knowledge Bank or crop-specific apps. Information should be available to extension agents in a variety of innovative formats designed to help them make appropriate IPM decisions.

2. Extension agents should be provided with relevant and up-to-date IPM extension materials covering the major pests of the focal crops. These extension materials should be made available in a variety of formats to ensure maximum reach to field-based staff, usability and ease of updating.

3. Where locally relevant, high-quality extension materials do not exist, relevant stakeholders (e.g. researchers, extension services) should receive support for their development-

4. Extension agents' IPM knowledge should be reinforced though refresher trainings. These should focus on practical and field-based training.

5. Younger generations of extension agents respond positively to innovative training tools and their use should be considered: for example, serious games to improve diagnostic

skills. Serious games are reality-based learning tools, which allow the player to make different pest management decisions, with each decision or collection of decisions leading to a different outcome. Through repeated playing, the player learns which pest management decisions lead to the best outcomes.

6. Relevant stakeholders, such as extension agents, researchers and NGOs/IGOs, should develop linkages to improve knowledge transfer from research to extension agents, who can in turn transfer this to farmers. Extension agents should be provided with adequate support from research and governments: for example, technical backup.

7. To achieve a greater impact on IPM knowledge and its implementation a multiplier system could also be established. This will involve further key stakeholders, beyond current extension services, being supported and incentivised to promote and implement IPM, but working in coordination with national extension services. These stakeholders can also be trained and certified to provide advisory services to farmers who want to implement IPM, under a voluntary IPM standard, for example.

**Farmer level**

Very few farmers mentioned that they had a good understanding of IPM (Table B.1.). Only a minority of farmers have received IPM training, but the vast majority of farmers who have received training mentioned that they applied what they had learnt, indicating that IPM training is effective. Across all countries, extension agents are by far the most preferred source of information, although radio is highly popular in Kenya, Malawi and Ghana, and mobile phones are very popular in India and Cameroon. This highlights the key role played by extension agents in knowledge transfer to farmers but also the variability in preferences. Farmers regularly meet extension agents in Tunisia, Ghana and Kenya, but a significant number of farmers in Cameroon, Malawi, Mali and Burkina Faso rarely or never meet extension agents.

**Table B.1.-3 Farmers' knowledge of IPM and sources of information**

| | Country | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **TN** n=20 | **BF** n=30 | **ML** n=44 | **GH** n=30 | **CM** n=18 | **KE** n=20 | **MW** n=20 | **IN** n=12 | **Avg.** |
| **Indicator** | **% of farmers** | | | | | | | | |
| **Farmers' understanding of IPM** | | | | | | | | | |
| Have never heard about it | 70 | 55 | 60 | 28 | 83 | 12 | 24 | 33 | **46** |
| Have a good understanding | 30 | 4 | 10 | 24 | 5 | 29 | 24 | 17 | **18** |
| **IPM training received by farmers** | | | | | | | | | |
| Have received a training | 0 | 37 | 25 | 33 | 56 | 55 | 37 | 25 | **34** |
| Apply what they have learned (of those who have received a training) | - | 90 | 75 | 100 | 90 | 100 | 100 | 100 | **94** |
| **Farmers' preferred sources of information** | | | | | | | | | |
| Radio | 10 | 50 | 25 | 67 | 17 | 95 | 89 | 25 | **47** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Extension agent | 95 | 77 | 86 | 100 | 83 | 89 | 58 | 25 | **77** |
| Mobile phone | 20 | 20 | 9 | 27 | 61 | 42 | 26 | 75 | **35** |
| **Frequency of meetings with extension agents** | | | | | | | | | |
| At least once in a month | 90 | 65 | 53 | 100 | 23 | 75 | 52 | 100 | **70** |
| Once per year / never | 0 | 8 | 25 | 0 | 39 | 0 | 42 | 0 | **14** |

Green = positive/good practices, Orange = negative/weak practices

### Recommendations

1. Efforts to train farmers in IPM should be pursued and strengthened. Where this is not yet taking place, the IPM approach should be introduced to farmers. Farmers need to be made aware of the benefits of using preventive measures and other non-chemical methods. Farmers' IPM training needs and preferences should be reviewed and appropriate training materials developed. For example, interactive trainings or farmer field schools might be preferred over formal classroom trainings – in particular, where farmer literacy is low. Relevant stakeholders to be involved include researchers, NGOs / IGOs, extension agents and the trade sector.

2. Farmers' access to information on pest management should be increased. This should to be based on farmers' preferred sources. The use of mass media should be considered where these are popular and where simple, one-way messaging is adequate. Both radio and mobile phones can be used to inform farmers about specific topics that can be put into practice at the time of the year the announcement is made: for example, how to monitor for pests, non-chemical control etc.

3. Digitally aware farmers can be targeted with free, user-friendly apps providing access to pest management fact sheets and on-line chat groups monitored by extension agents, allowing farmers to receive remote and coordinated plant protection advice. Digital technology can also be used to share information on weather and provide pest alerts with farmers.

4. Gender aspects should be considered when planning training of farmers. This should take local cultural aspects into account: for example, are women in charge of the field work? Do women take decisions regarding the management of the crop? Do women have access to finance? Are women allowed to speak with male strangers or is it necessary to train female extension agents in order to reach female farmers?

## B. 2. Pesticide registration

**Why is it important?**

Registration of pesticides is the process by which the responsible authority approves the sale and use of new pesticide products or reapproves existing pesticides. Registration is an important step in the management of pesticides as it enables authorities, retailers and users to determine which products are permitted to be used and for what purposes. Registration ensures that pesticides are fit for the proposed purpose and that the risk they represent is acceptable.

**Legislative level**

Although all countries have established a mandatory pesticide registration procedure, the procedures in place are often not best practice, as illustrated in Table B.2.-1. Pesticide registration is based on a risk evaluation in all countries except Zambia. Only 11 countries make the list of registered pesticides available. It is necessary to make the list publicly available so that pesticide users will be aware of the products that are nationally registered. Including information on target pests and host crops in this list will let pesticide users know the uses for which the product is effective. There are provisions for the use of unregistered pesticides in emergency situations in nine of the study countries, and this could facilitate rapid action against invasives: for example, Fall Armyworm. In six countries, a separate pathway is in place for the registration of biological control products, and this can simplify and speed up the registration of such products. However, a process for the registration of predators and parasitoids of insect pests that are not otherwise covered is in place in only four countries. In six countries, a mechanism is in place for regional coordination/harmonization of pesticide registration, and this can facilitate the availability of pesticides – in particular, for minor crops/pests.

**Table B.2.-1 Overview of key regulations covering pesticide registration process**

| Indicator | Country | | | | | | | | | | | | | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TN | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | |
| There is a mandatory **registration system** for pesticides | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | **14** |
| The registration process involves **risk-based evaluation** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | **13** |
| The list of registered pesticides is made **publicly available** | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ | ✓ | **11** |
| The list of registered pesticides includes **authorized uses**, including **crops and target pests** | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✓ | NA | ✓ | **9** |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| There is a **separate registration pathway for biological control pro**ducts | ✗ | ✓ | ✗ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | 6 |
| The legislation contains provisions addressing the **release of biological control agents** and other **beneficial organisms** | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | 4 |
| There is a mechanism in place for **regional coordination/harmoniza**tion of the registration of pesticides | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | 6 |
| There are provisions for the **use of unregistered pesticides in emerge**ncy situations | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | 9 |

## Recommendations

1. National pesticide registration processes should be updated in order to align them with international standards.

2. Governments should be encouraged to facilitate the registration of lower-risk products, e.g. reducing registration fees for lower-risk products or by setting in place a specific registration pathway for biological control products. This should be coupled with policies to increase the availability and affordability of safer, low-toxicity alternatives and putting in place subsidy programmes for pesticides of known low-toxicity, such as biological control products.

3. Where feasible, countries should work together to develop a harmonized registration procedure that is valid at a regional level. This will facilitate the registration of pesticides for which there is only a niche market: for example, minor crops and pests and lower-risk pesticides, such as biological control products. The relevant governmental authorities should take responsibility for addressing this.

4. Government should ensure that a number of different stakeholders (advisory services, regulators, input suppliers and retailers, farmer organizations, etc.) are made aware of the regulations and of the national list of registered pesticides, so that they can in turn inform farmers. The national lists of registered pesticides should be published in a variety of media and freely available, to ensure open and widespread public access. This access will support compliance and enforcement where necessary.

5. The national lists of registered pesticides should be updated at regular intervals.

6. Governments should be encouraged to work with neighbouring countries to develop a harmonized registration procedure at the regional level in order to prompt manufacturers to register lower-risk pesticides for minor uses by increasing the size of the market for which the registration is valid.

Further recommendation can also be found in section B. 9.

**Extension level**

According to extension agents the lack of appropriate and good quality inputs – in particular, pesticides – is problematic. Most of them consider that the use of counterfeits or low-quality products by farmers is a major problem (Table B.2.-2). In some countries, they also indicated that the lack of inputs (in particular lack of lower-risk pesticides / biological control agents) is an important barrier to IPM, and this underlines the importance of a system that facilitates the registration of lower-risk pesticides / biological control products.

**Table B.2.-2 Extension agents' perceptions of pesticide availability**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | **TN** n=7 | **BF** n=16 | **ML** n=23 | **GH** n=13 | **CM** n=19 | **KE** n=20 | **MW** n=19 | **IN** n=8 | |
| | **% of extension agents** | | | | | | | | |
| Agree that "use of counterfeits / low-quality products is a major problem related to pesticide use" | 57 | 75 | 78 | 54 | 89 | 74 | 53 | 50 | **66** |
| Agree that "lack of inputs is a barrier to IPM implementation" | 71 | 31 | 26 | 62 | 50 | 60 | 47 | 0 | 43 |

**Recommendations**

1. Extension agents should be provided with training on the identification of counterfeit products, with the objective of supporting the national authorities (e.g. pesticide control board or standards agency) in identifying and reporting counterfeit products.

2. Where a register/list of licensed pesticide retailers exists, this list should be made accessible to extension agents so they are aware of which retailers are legally able to sell pesticides. Extension agents can then pass this information on to farmers, enabling them to make an informed choice about which retailers they purchase products from.

## B. 3. Pesticide packaging and labelling

**Why is it important?**

Pesticide packaging needs to be designed in a way that will prevent leakages and spillage when stored and handled. A pesticide label should contain important information on the directions for use, including for which pests the product can be used, the correct dosage and under what conditions it can be applied. Information should also be provided on handling and safety, including hazard symbols and advice pictograms showing the type of PPE to be worn. The information on labels must be legible and presented in a standardized format that is easy to understand regardless of the country or the literacy level of the user.

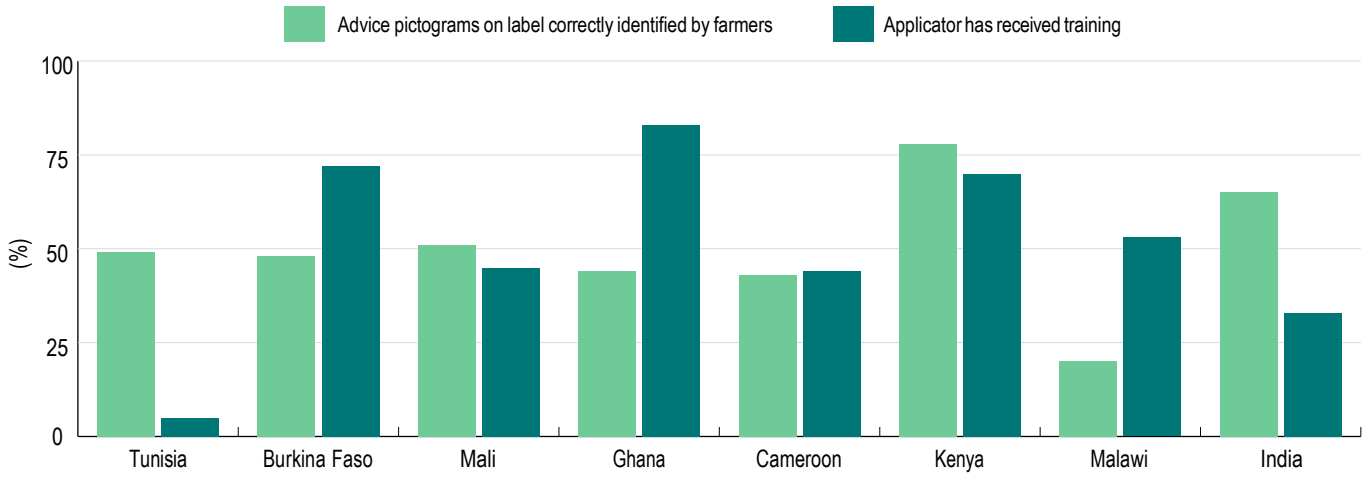
**Legislative level**

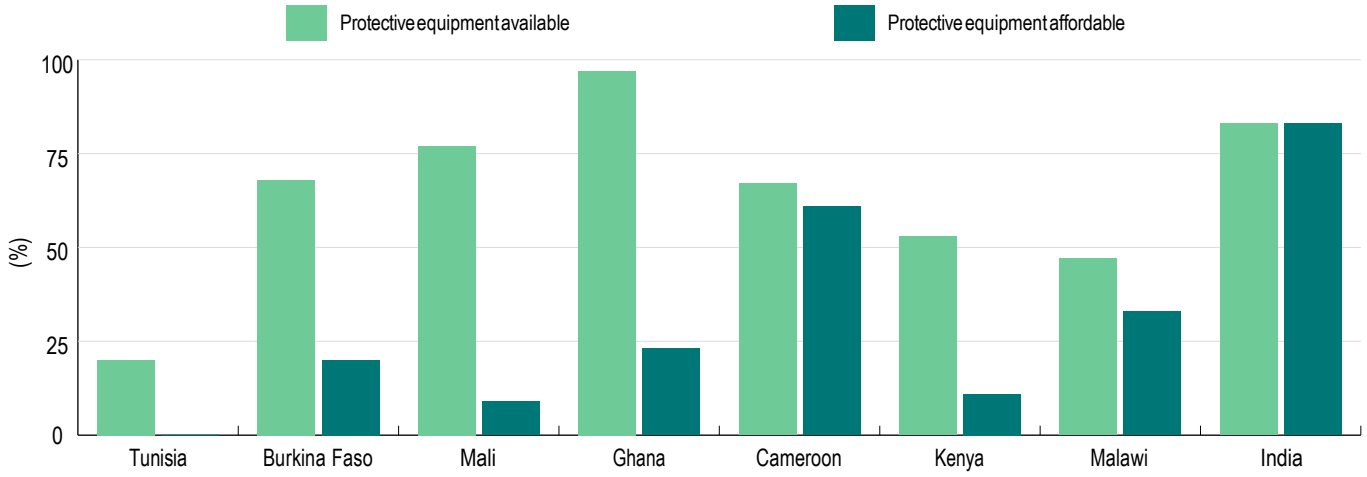
Legislation covering technical requirements for packaging and re-packaging (e.g. robust, impermeable material, safety features, etc.) is in place in only six out of the 14 study countries (Table B.3.-1). Such regulations ensure that pesticide manufacturers use containers that have appropriate technical requirements, so as to avoid environmental contamination or hazard to humans. All countries except Cameroon require the official approval of the pesticide label, and this ensures that the information given to the user is correct and conforms to requirements. However, having a readable label on the pesticide package at the time of sale is mandatory in only eight out of the 14 countries (Figure 5). Moreover, the label language and system of weights and measures to be used is not always mentioned (in place in 10 out of 14 countries), and this may mean that farmers are not able to understand the information given in a foreign language or an unfamiliar system of weights and measures. This creates a risk of pesticide misuse by farmers.

**Table B.3.-1 Overview of key provisions covering pesticide packaging and labelling**

| Indicator | Country | | | | | | | | | | | | | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TN | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | |
| **Technical requirements for packaging** and re-packaging are specified | ✓ | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✓ | 6 |
| The label must be **officially approved** at the time of pesticide | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 13 |
| **How the information on the label should be communicated** is described | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | 10 |
| Pesticides may only be **sold with a readable label** | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | 8 |

## Pesticide use and safety



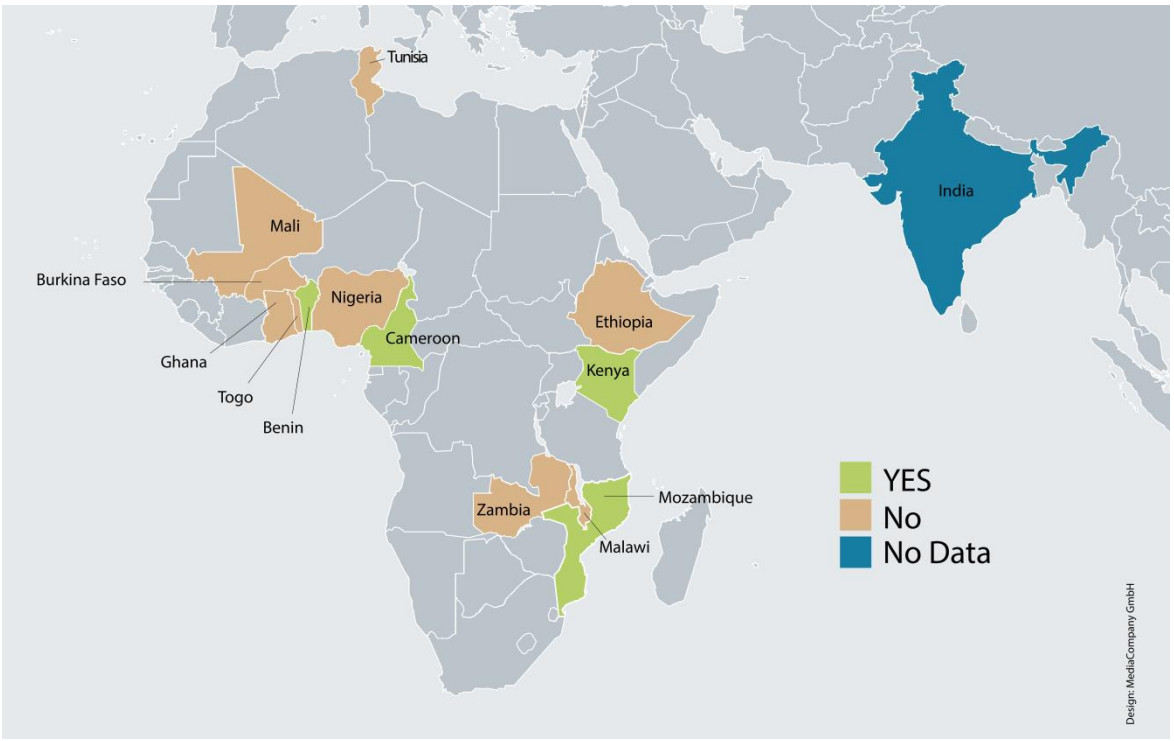



**Figure 4 Legislation contains provision to prevent the use of and sale of pesticides to children or pregnant and nursing women**

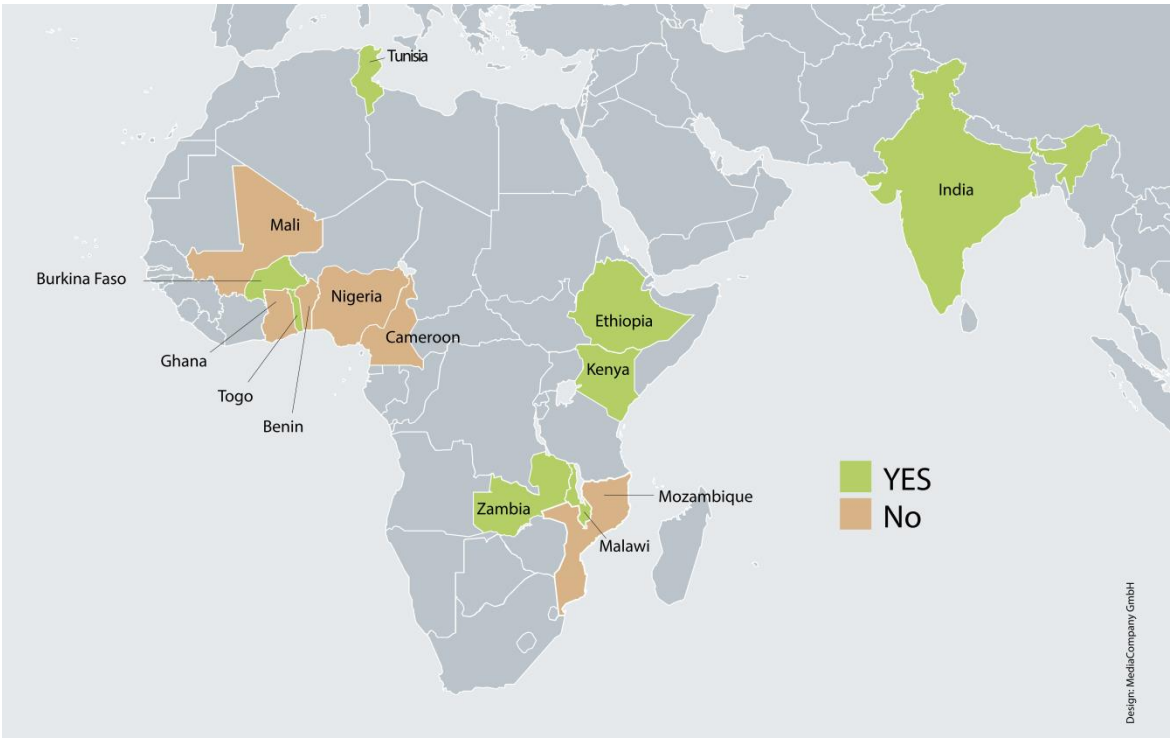



**Figure 5 Legislation requires that pesticides offered for sale have a readable label**

### Recommendations

1. The technical requirements for (re-) packaging of pesticides and the need for the pesticide to have an approved label at the time of sale should be added to the national law where this is not already the case. Relevant government authorities should take responsibility for this.
2. Relevant governmental authorities should ensure that all relevant stakeholders (advisory services, regulators, input suppliers and retailers) are made aware of packaging and labelling requirements.

**Extension level**

Extension agents' understanding of the safety information present on pesticide labels varies among the study countries, from good to limited. Most of the extension agents in all countries have heard of hazard colour bands on pesticide labels (Table B.3.-2) but only in three countries do extension agents indicate that they have a good understanding. Similarly, the correct identification of hazard symbols and advice pictograms by extension agents varies among the countries. Extension agents are more likely to recognize the more obvious advice pictograms (wear boots, wear gloves). Extension agents in the majority of countries also indicated that they have a limited understanding of re-entry interval.

**Table B.3.-2 Extension agents' understanding of safety information present on pesticide labels**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=7 | BF n=16 | ML n=23 | GH n=13 | CM n=19 | KE n=20 | MW n=19 | IN n=8 | |
| **Understanding of hazard colour bands on pesticide labels. Percentage of extension agents who:** | | | | | | | | | |
| Have never heard about it | 29 | 13 | NA | 9 | 22 | 10 | 32 | 13 | **18** |
| Have a good understanding | 42 | 38 | NA | 73 | 28 | 85 | 32 | 75 | **53** |
| **Understanding of re-entry interval. Percentage of extension agents who:** | | | | | | | | | |
| Have never heard about it | 14 | 6 | NA | 18 | 22 | 45 | 32 | 25 | **23** |
| Have a good understanding | 43 | 75 | NA | 82 | 61 | 45 | 0 | 0 | **44** |
| Hazard symbols and advice pictograms correctly identified (%) | 70 | 51 | 51 | 68 | 48 | 67 | 34 | 90 | **60** |

NA: Data not available

### Recommendation

1. Extension agents' knowledge of colour codes and warning signs should be enhanced through training. Such trainings may be conducted through a PPP with input supply stakeholders to ensure that the information is being transferred to farmers.

**Agro-input level**

Information gathered through interviews with agro-input suppliers and other stakeholders indicates that pesticides are sometimes re-packaged and sold in inappropriate containers (e.g. soda bottle) and without approved labels.

**Recommendations**

1. Agro-input retailers should be informed of the regulations regarding pesticide packaging, labelling and sale, where these are in place. Relevant stakeholders who should be involved include the agro-input sector and governmental authorities in charge of agriculture, environment and health.

2. Agro-input retailers should accept from their suppliers only pesticide lots sold in the original, undamaged packaging, and with readable labels in a national language.

**Farmer level**

Most of the farmers interviewed read pesticide labels (Table B.3.-3). Most of them are able to identify the most obvious advice pictograms (rubber gloves and boots), but only a few are able to identify hazard symbols (toxic, harmful/irritant, harmful to the environment). Moreover, only a minority of farmers have a good understanding of hazard colour bands on pesticide labels or of key label information, such as re-entry interval.

**Table B.3.-3 Farmers' understanding of safety information present on pesticide labels**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | **TN** n=20 | **BF** n=30 | **ML** n=44 | **GH** n=30 | **CM** n=18 | **KE** n=20 | **MW** n=20 | **IN** n=12 | |
| **Farmers (%) who read pesticide labels** | 85 | 52 | 50 | 60 | 78 | 75 | 58 | 58 | **64** |
| **Farmers' level of understanding of hazard colour bands on pesticide labels. Farmers (%) who:** | | | | | | | | | |
| Have never heard about it | NA | 56 | NA | 43 | 50 | 53 | 67 | 25 | **49** |
| Have a good understanding | NA | 33 | NA | 37 | 39 | 29 | 17 | 17 | **29** |
| **Farmers' level of understanding of re-entry interval. Farmers (%) who:** | | | | | | | | | |
| Have never heard about it | NA | 43 | NA | 43 | 63 | 41 | 61 | 100 | **59** |
| Have a good understanding | NA | 48 | NA | 33 | 22 | 12 | 6 | 0 | **20** |
| Hazard symbols and advice pictograms correctly identify (%) by farmers | 49 | 48 | 51 | 44 | 43 | 78 | 20 | 65 | **50** |

NA: data not available

## Recommendation

1. In order to reduce the risk of harm to human health and the environment, farmers should be given information on the hazard colour bands and warning symbols on pesticide labels. This could be achieved through direct training or through mass media.

## B. 4. Pesticide supply, sale, sources and choices

**Why is it important?**

The full implementation of IPM and the phasing out of HHPs requires the availability of selective, lower-toxicity pesticides. This means that these products must not only be registered, but they must also be available at agro-input shops and then recommended by extension agents or agro-input retailers so that they are eventually used by farmers.

**Legislative level**

The majority of the countries require that licences be granted only to retailers who are competent and have received training (Table B.4.-1). Fewer than half of the countries grant licences only where further specific criteria are satisfied, e.g. storage conditions, record-keeping, safety equipment and emergency plans. A subsidy scheme is in place in only two countries, Zambia an India, although in India subsidies schemes are not in place in all states. All inputs are covered by the subsidy scheme in Zambia and this may promote the indiscriminate use of pesticides. On the other hand, the subsidy scheme in India is in most cases restricted to biological control products and this contributes to their uptake.

**Table B.4.-1 Overview of key provisions covering pesticide supply and sale in the study countries**

| Indicator | Country | | | | | | | | | | | | | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TN | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | |
| **Only those with competency and training may be licensed to sell pesticides** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✓ | 11 |
| The **decision-making criteria for the grant of a licence** include further specific criteria | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | 6 |
| A **subsidy scheme for pesticides** is in place. | ✓ | ✓ | ✗ | ✓ | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ✓ | ✓ | 6 |

### Recommendations

1. Governments should be advised against a broad subsidy scheme that may result in excessive or unnecessary pesticides use. However, they should be encouraged to develop a subsidy scheme that is restricted to lower-risk alternatives (for example, biological control products), to foster their uptake. Relevant governmental authorities should take responsibility for this.

2. Governments should be encouraged to require those who sell pesticides to hold a valid licence. Relevant governmental authorities (trade and industry, standards authorities) should coordinate to ensure that licensing is covered in the legislation and enforced.

3. A system of coordinated training and certification for pesticide retailers should be established and monitored. The establishment should involve all relevant stakeholders, including governmental authorities, trade/retail associations and the agro-input sector. Certification should be renewed regularly to ensure retailers stay up to date on new products and changes to the legislation.

4. Relevant governmental authorities should enforce national regulations (for example, through deterrent fines), to ensure that day-to-day sales are made by trained staff.

**Agro-input level**

In some countries (e.g. Burkina Faso and Mali) non-registered, HHPs are easily available: they are cheap, farmers have experience of using them, many farmers specifically ask for them, and this pushes agro-input retailers to store them. Moreover, counterfeit products are sometimes offered for sale. On the other hand, biological control products and other lower-risk alternatives are often not readily available. These products are often more expensive, and some products cannot be stored over a long time or require specific storage conditions.

**Recommendations**

1. Governments should ensure that agro-input retailers are made aware of the regulations on pesticide sales. Relevant governmental authorities should provide retailers with a new list of registered pesticides each time it is updated, and should inform them about the major recent changes in the legislation and in the list of registered pesticides.

2. Agro-input retailers should be provided with training on the identification of counterfeit products, so that they can then refuse dubious pesticide batches. Relevant stakeholders who should be involved include input supply stakeholders and regulators.

3. Agro-input retailers should be encouraged and supported to store lower-risk alternatives: for example, through the provision of technical backstopping and storage facilities. Relevant stakeholders who should be engaged include agro-input suppliers, government and NGOs/ IGOs.

**Farmer level**

Most farmers mention having access to pesticides, although pesticide affordability is often considered a problem (Table B.4.-2). Availability of biological control products is very limited across all countries, although more farmers indicate that they are available in India (50%) or Malawi (39%). Where they are available, the affordability of biological control products is often a barrier, although in India two-thirds of the farmers who mentioned that they are available also mentioned that they are affordable. The high cost of commercial pesticides is one of the reasons that push smallholder

farmers in most countries to prepare homemade pesticides based on botanicals. Such preparations may represent a viable alternative for smallholder farmers. However, the safety and efficacy of homemade botanical pesticides will depend on the type and quantity of plant material used and on the preparation method. Thus, results are unpredictable and risks to human health cannot be excluded. In all countries, agro-input shops are the major source of pesticides, although 45% of the farmers in Tunisia mentioned that they also obtain pesticides through a bulk purchase system organized by extension agents. The main reasons for choosing a pesticide are recommendation and effectiveness, although price or availability was mentioned in some countries.

**Table B.4.-2 Farmers' access to and sources of pesticides and pesticide choices**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=20 | BF n=30 | ML n=44 | GH n=30 | CM n=18 | KE n=20 | MW n=20 | IN n=12 | |
| | % of farmers | | | | | | | | |
| **Farmers' access to inputs** | | | | | | | | | |
| Pesticides are available | 90 | 81 | 66 | 77 | 89 | 47 | 61 | 92 | **75** |
| Pesticides are affordable | 20 | 54 | 55 | 30 | 44 | 21 | 44 | 92 | **45** |
| Biological control products are available | 0 | 27 | 2 | 23 | 6 | 21 | 39 | 50 | **21** |
| Biological control products are affordable | 0 | 18 | 2 | 13 | 6 | 11 | 17 | 33 | **12** |
| Use homemade botanical pesticides at field stage | 5 | 46 | 52 | 43 | 33 | 68 | 42 | 75 | **46** |
| **Sources of pesticides** | | | | | | | | | |
| Extension agents | 45 | 14 | 3 | 17 | 11 | 15 | 16 | 0 | **15** |
| Agro-input retailer | 85 | 76 | 100 | 93 | 94 | 85 | 74 | 100 | **88** |
| **Farmers' main reason for choosing a pesticide** | | | | | | | | | |
| Price | 5 | 21 | 10 | 3 | 28 | 45 | 37 | 8 | **20** |
| Availability | 15 | 43 | 16 | 27 | 44 | 40 | 58 | 25 | **34** |
| Recommendation | 80 | 54 | 74 | 73 | 44 | 45 | 26 | 58 | **57** |
| Effectiveness | 60 | 82 | 37 | 67 | 94 | 40 | 47 | 50 | **60** |

### Recommendations

1. Farmers' access to appropriate pesticides and lower-risk products, such as biological control agents, could be facilitated by extension agents through bulk purchase systems. For example: Tunisian farmers in the area where the GIAE is active benefit from a bulk purchase system facilitated by extension agents.

2. The trade sector should work on a subsidy scheme for biological control products (and other lower-risk alternatives) in order to make them more affordable. This should be

reinforced by campaigns to raise awareness of those products and to inform user on how they should be used.

3. Extension agents and agro-input dealers should receive trainings on pesticide products / AI and their appropriate targets to ensure that they recommend products that are appropriate for the pests. Relevant stakeholders who should be involved include input supply stakeholders, research institutes, regulators and NGOs/IGOs.

4. Awareness-raising of farmers on the use of an ecosystem approach should be conducted where this is applicable. Conservation biological control can contribute to reducing pest pressure and eliminating the need for pesticides.

5. The local production of biological control agents should be supported. This approach should involve extension agents and agro-input suppliers, to ensure that biological control agents are made available to farmers and that these receive the information needed regarding the correct application of the biological control agents.

6. In countries were homemade botanical pesticides are popular, national researchers should investigate their effectiveness and safety, and also identify appropriate production methods.

## B.5. Pesticide handling

**Why is it important?**

Inappropriate use of pesticides poses a health and safety risk for farmers, farm workers and consumers, as well as having an impact on the environment. Precautions need to be put in place to reduce this risk. This means establishing legislation and systems to ensure that pesticides are handled in a safe manner. Risk reduction factors can include the wearing of PPE and other safety instructions relating to correct application: for example, the safety intervals to observe before re-entering an area following pesticide application.

**Legislative level**

In none of the study countries are regulations and policies covering pesticide handling comprehensive (Table B.5.-1). Most of the countries have legislation in place that requires employees to take necessary measures to protect the health of workers and the environment. These measures include, for example, the provision of PPE, training and safety information. However, only six out of the 14 countries have a policy to promote the use of PPE that is suitable, and none has a subsidy scheme for PPE. Only two countries (Burkina Faso and India) have a policy in place to produce and disseminate relevant and clear educational materials on pesticide use and safety. Moreover, only four out of the 14 countries have legislation in place to prevent the use of pesticides by, and sale of pesticides to, children or pregnant women and nursing mothers (Figure 4). The lack of this basic legislation means that pesticide users and retailers will use their own judgement regarding the use and sale of pesticides relating to vulnerable groups.

**Table B.5.-1 Overview of key provisions covering pesticide handling in the study countries**

| Indicator | Country | | | | | | | | | | | | | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TN | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | |
| **Employers must take the necessary measures** to protect the **health** of workers and the **environment**. | ✓ | ✗ | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | 10 |
| There are provisions to **protect vulnerable groups** | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | 4 |
| A policy is in place to **promote the use of PPE** that is suitable. | ✗ | ✓ | ✗ | ✓ | ✓ | ✗ | ✗ | ✗ | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | 7 |
| A policy is in place to produce **and disseminate educational materials on pesticide use and management** | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✓ | 2 |
| A **subsidy** scheme for PPE is in place | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | 0 |

## Recommendations

1. Legislation relating to safe pesticide handling should be added into national laws in a coordinated manner by relevant government departments responsible for health and safety, labour and employment.

2. In addition, a comprehensive campaign to raise awareness of pesticides and safe handling should be facilitated. This should be a coordinated approach involving all relevant stakeholders, such as manufacturers, retailers and advisory services, etc. Media, such as radio, market place talks and existing communication channels within farmers' associations and wider civil society groups (e.g. youth and women and mothers' groups), should be used.

3. Relevant governmental authorities (e.g. agriculture, health and safety) should be encouraged to develop policies to promote the use of PPE, including subsidy schemes for PPE.

**Extension agent level**

Extension agents suggest that farmers rarely follow pre-harvest and re-entry intervals and mention a range of problems related to pesticide use (Table B.5.-2). According to extension agents, the most common problems faced by farmers across all countries are the use of the wrong dosage, followed by pesticides being applied at the wrong time. Other problems noted include: using the wrong product for the pest, low PPE use and risk of environmental contamination

**Table B.5.-2 Extension agents' perceptions of problems related to pesticide use**

| | Country | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **TN** n=7 | **BF** n=16 | **ML** n=23 | **GH** n=13 | **CM** n=19 | **KE** n=20 | **MW** n=19 | **IN** n=8 | **Avg.** |
| **According to extension agents, farmers (%) who:** | | | | | | | | | |
| Follow the pre-harvest interval | 24 | 35 | 18 | 25 | 37 | 36 | 18 | 21 | **27** |
| Follow the re-entry interval | 20 | 28 | 9 | 21 | 28 | 20 | 15 | 3 | **18** |
| **Major problems related to pesticide use according to extension agents (%)** | | | | | | | | | |
| Agree that use of the wrong dosage is a major problem | 100 | 81 | 91 | 85 | 83 | 95 | 84 | 75 | **87** |
| Agree that use of the wrong product for the pest is a major problem | 86 | 69 | 70 | 54 | 61 | 63 | 53 | 63 | **65** |
| Agree that application of pesticides applied at the wrong time is a major | 86 | 69 | 74 | 77 | 67 | 95 | 74 | 38 | **72** |
| Agree that non-use of PPE is a major problem | 100 | 94 | 83 | 77 | 61 | 44 | 16 | 25 | **63** |
| Agree that environmental contamination is a major problem | 86 | 94 | 83 | 46 | 61 | 68 | 32 | 38 | **63** |

### Recommendations

1. Extension agents should be given appropriate training and extension materials that cover the use of appropriate pesticides and their safe handling so that they can in turn inform farmers. Relevant stakeholders who should be involved include agro-input stakeholders, governmental authorities (health, environment, agriculture) and NGOs/IGOs.

2. Extension agents should have PPE available and demonstrate how it should be used each and every time they advise on the use of pesticides.

3. Extension agents should be provided with information on the PPE requirements of pesticides according to the risk they represent.

4. Advisory services should make sure that farmers have sufficient knowledge to correctly handle pesticides and have PPE that is appropriate for the pesticides they recommend.

**Agro-input level**

Day-to-day business at agro-input shops is often undertaken by untrained staff, even where a licence scheme requires a shop-owner and/or staff member to have followed formal trainings. As a result, the advice given to farmers may be limited or incorrect.

### Recommendations

1. Agro-input retailers' knowledge of safe pesticide handling should be enhanced through interactive training or capacity-building activities leading up to the delivery of a certificate. Relevant stakeholders who should be involved include government, agro-input suppliers and manufacturers.

2. Agro-input retailers should be provided with flyers describing the safe handling of pesticides. Such flyers should be provided in sufficient numbers that they can be distributed to farmers. Such materials should be richly illustrated in order to reach illiterate farmers.

3. Agro-input retailers should be advised to read aloud or explain the information on handling listed on pesticides labels.

4. Agro-input retailers should offer for sale PPE that is appropriate for the pesticides they sell.

**Farmer level**

About half of the farmers across the study countries indicated that they (or the person in charge of the application) have received training on pesticide handling (Table B.5.-3). Although the majority indicated that they wear some type of PPE, only a minority of farmers wear full PPE when applying pesticides. The fact that most farmers in all countries except Mali and India have also experienced some negative health effects after applying pesticides raises questions about the quality of the training and the quality of PPE. For example, face masks as defined by farmers are pieces of cloth tied around the face or face masks procured from local health clinics, which do not meet safety

standards for the application of pesticides. Many farmers in Tunisia and India – and to a lesser extent Kenya – apply pesticides with their bare arms and legs, and these farmers are particularly at risk of pesticide poisoning. The reasons indicated by farmers for the non-use of PPE include the expense of PPE, non-availability or PPE being too cumbersome.

**Table B.5.-3 PPE: farmers' practices and attitudes**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=20 | BF n=30 | ML n=44 | GH n=30 | CM n=18 | KE n=20 | MW n=20 | IN n=12 | |
| | % of farmers | | | | | | | | |
| Have received training on pesticide handling | 5 | 72 | 45 | 83 | 44 | 70 | 53 | 33 | **51** |
| Wear PPE | 55 | 76 | 59 | 63 | 89 | 75 | 47 | 75 | **67** |
| Have felt negative health effects | 65 | 72 | 32 | 77 | 89 | 80 | 58 | 42 | **64** |
| **PPE worn for applying pesticides** | | | | | | | | | |
| Goggles | 10 | 28 | 53 | 40 | 44 | 6 | 18 | 16 | **27** |
| Mask | 45 | 64 | 73 | 47 | 67 | 65 | 35 | 32 | **53** |
| Rubber gloves | 20 | 46 | 57 | 47 | 56 | 76 | 47 | 42 | **49** |
| Coverall | 10 | 7 | 37 | 40 | 83 | 47 | 12 | 16 | **32** |
| Long-sleeve shirt | 20 | 71 | 50 | 50 | 78 | 29 | 24 | 26 | **43** |
| Long trousers | 10 | 60 | 57 | 37 | 89 | 24 | 24 | 21 | **40** |
| Rubber boots | 45 | 39 | 57 | 63 | 11 | 76 | 29 | 32 | **44** |
| **Reasons for not wearing PPE** | | | | | | | | | |
| PPE is too cumbersome / too hot | 30 | 15 | 23 | 3 | 6 | 0 | 6 | 64 | **18** |
| PPE is not available | 25 | 30 | 17 | 0 | 28 | 33 | 41 | 18 | **24** |
| PPE is too expensive | 10 | 70 | 23 | 43 | 11 | 67 | 26 | 9 | **32** |

## Recommendations

1. Farmers' awareness of hazards linked to pesticides use, appropriate pesticide handling and the need to wear PPE should be raised in order to reduce the numbers of farmers experiencing health problems. Farmers need to be aware that risks increase with exposure: for example, when pesticides are applied with bare arms and legs. Relevant stakeholders who should be involved include agro-input stakeholders, governmental authorities (health, environment and agriculture), extension agents, farmer cooperatives and NGOs/IGOs.

2. In addition, appropriate PPE should be subsidized in order to make it more affordable for farmers who would choose to wear it. Current subsidy schemes for agricultural inputs, where they exist, should be widened to allow farmers to purchase PPE.

3. Retailers should be incentivized/have the legal obligation to stock PPE that is appropriate for the pesticide products that they are selling.

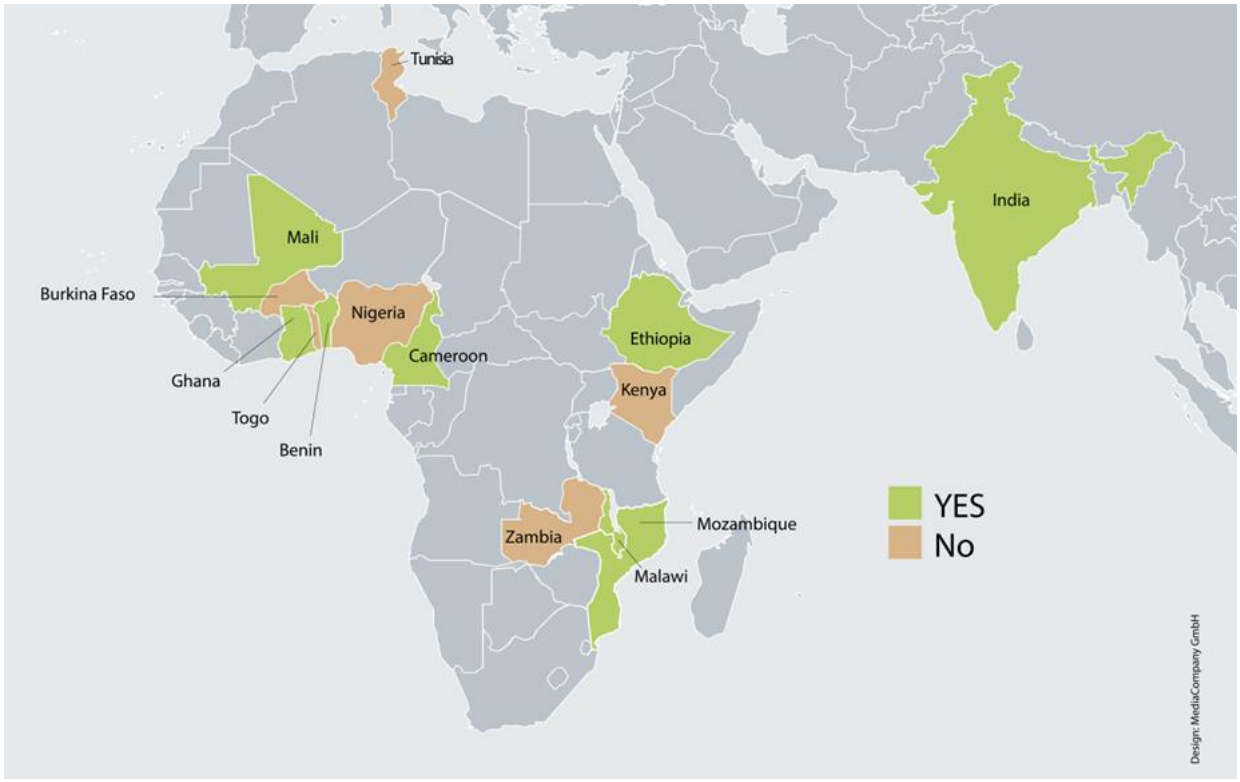
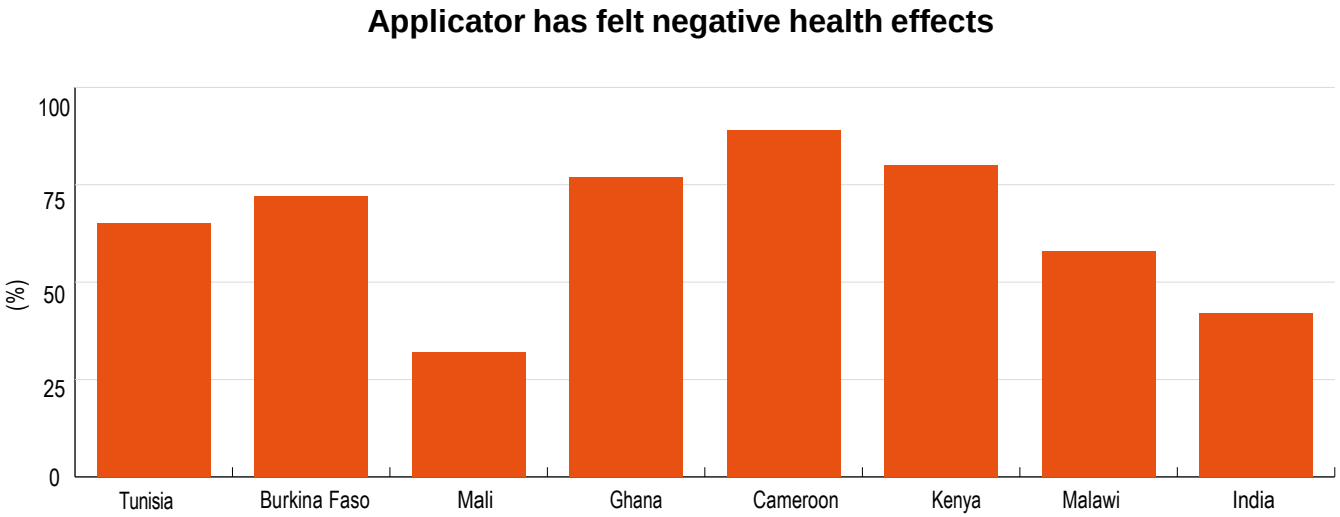



Figure 6 Legislation contains provisions to regulate and/or monitor pesticide residue in food



## B.6. Maximum Residue Levels (MRLs)

**Why is it important?**

MRLs for pesticides are the established maximum acceptable concentration of pesticides allowed in a food product. MRLs are covered by the Codex Alimentarius (inter-governmental standards for food), and provide a reference for governments and the global food trade to assess food safety. The correct use of pesticides by farmers helps to ensure that MRLs are not exceeded and that the food consumed by farmers or sold by farmers is safe. The pre-harvest interval is the minimum time allowed between spraying a crop and harvest. Information on the pre-harvest interval is provided on pesticide labels and is product-specific.

**Legislative level**

Nine of the countries have legislation in place to regulate and monitor pesticide residues in food (Table B.6.-1). In six of the countries the MRLs followed are those set by the Codex Alimentarius.

**Table B.6.-1 Overview of key provisions covering MRLs in the study countries**

| Indicator | Country | | | | | | | | | | | | | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TN* | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | |
| Provisions to regulate and/or **monitor pesticide residues in food** | ✗ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | 9 |
| It prescribes following the MRLs set by the ***Codex Alimentarius*** | ✗ | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | ✓ | ✗ | ✗ | ✓ | 6 |

* The regulations in Tunisia do not define the authority responsible for setting MRLs. The regulations do not prescribe to follow the MRLs established by the *Codex Alimentarius* but do follow MRL established by the importers.

**Recommendation**

1. Governments should enhance MRL testing in order to ensure potentially harmful produce are taken out of the value chain. MRL testing will allow governments to assess risks relating to certain chemicals or products, and to put in place mitigation measures.

**Extension level**

Only slightly more than the half of the extension agents has a good understanding of pesticide residues and pre-harvest intervals (Table B.6.-2).

**Table B.6.-2 Extension agents' understanding of pesticide residue issues**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=7 | BF n=30 | ML n=23 | GH n=13 | CM n=19 | KE n=20 | MW n=19 | IN n=8 | |
| | % of extension agents | | | | | | | | |
| **Extension agents' understanding of pesticide residues** | | | | | | | | | |
| Have never heard about it | 14 | 19 | NA | 9 | 6 | 10 | 16 | 13 | **12** |
| Have a good understanding | 86 | 56 | NA | 64 | 76 | 90 | 58 | 13 | **63** |
| **Extension agents' understanding of pre-harvest intervals** | | | | | | | | | |
| Have never heard about it | 14 | 31 | NA | 9 | 6 | 10 | 53 | 13 | **19** |
| Have a good understanding | 72 | 69 | NA | 82 | 66 | 80 | 11 | 13 | **56** |

NA = data not available

## Recommendation

1. Refresher training should be conducted for extension agents. This should include information on MRLs, pesticide residues and their risks, as well as pre-harvest intervals. Relevant stakeholders who should be involved include trade sector actors, researchers and relevant government authorities.

**Agro-input level**

Staff working at agro-input shops have often not received any formal training. As a result, they have limited knowledge of pesticide residues and pre-harvest intervals, and do not possess the knowledge required to advise farmers.

### Recommendations

1. Agro-input retailer's awareness of pesticide residues and their hazards, and of pre-harvest intervals, should be raised. Likewise, awareness of farmer cooperative members and consumers should be raised. This could be done through direct contacts, distribution of flyers or use of other media (e.g. radio). Relevant stakeholders who should be involved include the agro-input sector, the trade sector and government authorities.

2. Agro-input retailers should mention the pre-harvest intervals of each pesticide sold and should underline to famers the importance or respecting pre-harvest intervals.

**Farmer level**

Farmers are often familiar with pesticide residues and related hazards. About half of the farmers have never heard of pesticide residues (Table B.6.-3) and do not have a good understanding of pre-harvest

intervals. This may result in high residue levels in produce, harming consumer health and potentially leading to the rejection of export produce by buyers.

**Table B.6.-3 Farmers' awareness of pesticide residues**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=7 | BF n=16 | ML n=23 | GH n=13 | CM n=19 | KE n=20 | MW n=19 | IN n=8 | |
| | % of farmers | | | | | | | | |
| **Farmers' understanding of pesticide residues** | | | | | | | | | |
| Have never heard about it | NA | 86 | NA | 33 | 39 | 53 | 61 | 42 | **52** |
| Have a good understanding | NA | 7 | NA | 40 | 39 | 12 | 17 | 8 | **20** |
| **Farmers' level of understanding of pre-harvest intervals** | | | | | | | | | |
| Have never heard about it | NA | 30 | NA | 23 | 28 | 29 | 61 | 33 | **34** |
| Have a good understanding | NA | 59 | NA | 40 | 72 | 29 | 17 | 33 | **42** |

NA: data not available

## Recommendation

1. Farmers should be trained on the risks of pesticide residues and the importance of respecting pre-harvest intervals and MRLs. Relevant stakeholders who should be involved include extension services, trade sector actors, and the ministry of health.

## B.7. Pesticide storage

**Why is it important?**

In order to avoid harm to people and the environment, it is important that pesticides and spray equipment are safely and securely stored. At a minimum, pesticides should be stored in a locked location. This location should be inaccessible to children and never used for food storage.

**Legislative level**

Most of the study countries have enacted provisions covering the storage of pesticides (Table B.7.- 1). As the enforcement of the legislation is not realistic at the smallholder farmer level efforts should concentrate on informing extension agents and farmers.

**Table B.7.-1 Existence of provisions covering pesticide storage in the study countries**

| Indicator | Country | | | | | | | | | | | | | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TN | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | |
| There are provisions for the **safe storage of pesticides** | ✓ | ✓ | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✗ | ✓ | ✓ | **10** |

**Recommendations**

1. Gaps in legislation relating to pesticide storage should be addressed by the responsible government authorities (regulators, ministry in charge of agriculture and ministry of health).
2. Relevant governmental authorities should ensure that all stakeholders (the agro-input sector, enforcement authorities, extension agents, farmers) are aware of the national regulations regarding the storage of pesticides.

**Extension level**

Most extension agents recommend that farmers store pesticides in a place that is inaccessible to children or in a locked location (Table B.7.-2). All extension agents in Tunisia, Cameroon, Kenya and Malawi recommend one of these practices.

**Table B.7.-2 Extension agents' recommendations for pesticide storage**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=7 | BF n=16 | ML n=23 | GH n=13 | CM n=19 | KE n=20 | MW n=19 | IN n=8 | |
| | % of extension agents | | | | | | | | |
| **Extension agents' recommendations for pesticide storage** | | | | | | | | | |
| Not accessible to children | 100 | 94 | 96 | 77 | 100 | 95 | 100 | 78 | **92** |
| In a locked location | 100 | 81 | 78 | 92 | 79 | 100 | 58 | 33 | **78** |
| Storage area labelled with a warning sign | 100 | 69 | 48 | 77 | 74 | 65 | 32 | 0 | **58** |

### Recommendation

1. Awareness-raising is required to ensure that 100% of extension agents understand the necessity to recommend that pesticides be kept away from children and in a locked location that is labelled with a warning sign. In order to avoid ambiguity, all extension agent training relating to pesticides should specifically cover best storage practices.

**Agro-input level**

Day-to-day business at agro-input shops is often undertaken by untrained staff, who have little knowledge of safe pesticide storage. As a result, the advice given to farmers may be limited or incorrect.

### Recommendations

1. Agro-input retailers' knowledge of appropriate pesticide storage should be enhanced through interactive training or capacity-building activities leading up to the delivery of a certificate. Relevant stakeholders who should be involved include government, agro-input suppliers and manufacturers.
2. Agro-input retailers should be provided with flyers describing the safe storage of pesticides. Such flyers should be provided in sufficient numbers so that they can be distributed to farmers. Such materials should be richly illustrated in order to reach illiterate farmers.

**Farmer level**

The study findings show that farmers do not always store pesticide in a safe manner (Table B.7.-3). Across all of the study countries, only about half of the farmers store pesticides away from children, and just under half store them in a locked location. However, there is a large variation between countries.

The ideal scenario would be that 100% of farmers store pesticides in locations that are locked and that are labelled with a warning sign – or at a minimum in locations that are inaccessible to children.

**Table B.7.-3 Storage of pesticides by farmers**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=20 | BF n=30 | ML n=44 | GH n=30 | CM n=18 | KE n=20 | MW n=20 | IN n=12 | |
| | % of farmers | | | | | | | | |
| **Farmers' practices on pesticide storage** | | | | | | | | | |
| Not accessible to children | 40 | 45 | 20 | 43 | 89 | 94 | 38 | 8 | **47** |
| In a locked location | 85 | 28 | 3 | 27 | 72 | 55 | 31 | 42 | **43** |
| Storage area labelled with warning sign | 0 | 3 | 0 | 7 | 22 | 5 | 0 | 0 | **5** |

### Recommendation

1. Farmers should receive awareness-raising on pesticide safety – and specifically on safe pesticide storage. These awareness-raising messages can be provided through many different avenues: for example, in extension materials provided by service providers and from retailers at the time of purchase.

## B.8. Pesticide container disposal

**Why is it important?**

Empty pesticide containers and packaging can be hazardous due to the pesticide left inside them and users are often unaware of the risks posed by improper disposal of containers. In some cases, pesticide containers are seen as valuable recyclable commodities and are sold or reused for food and water, which is contrary to health and safety advice. Governments should discourage inappropriate practices through legislation and ensure that safe container disposal options are available to users.

**Legislative level**

Legislation covering empty container disposal is present in half of the countries Examples of such legislation in India, as an example, include: labelling has to provide Instructions on the decontamination or safe disposal of used containers; Insecticide regulations state that the washing and disposal of empty packages must be done in a safe manner so as to prevent environmental and water pollution; It also emphasizes that packages shall not be left outside to avoid reuse. It is also mandatory for operators to dispose of packaging e.g. packages shall be broken up and buried away from dwellings.

However, even where legislation is present it sometimes lacks key provisions recommended in FAO and WHO international guidelines (Table B.8.- 1). If containers are not decontaminated they represent a greater risk; however, only two countries legislate for triple-rinsing. Only three countries require empty containers to be made unusable (e.g. by puncturing or crushing) and only five countries ban the re-use of pesticide containers. No country has a mandatory container disposal system, although Tunisia is developing one (pilot phase). At present, only voluntary collection systems are in place (e.g. in Burkina and Cameroon).

**Table B.8.-1 Overview of key provisions covering container disposal in the study countries**

| Indicator | Country | | | | | | | | | | | | | | Sum |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TN | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | |
| **Pesticide container disposal is addressed** in the legislation | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ | 7 |
| When a pesticide container is empty, it should be **triple-rinsed**[1] | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | 2 |
| After rinsing, the **container should be rendered unusable** (e.g. by puncturing) | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | 3 |
| The regulation **bans the re-use** of empty pesticide containers | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | 5 |
| **Burying** empty pesticide containers is | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | 4 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Burning** empty pesticide containers is | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | **5** |
| There are provisions to establish a **container collection system** | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | **0** |

[1] With the resulting residue being added to the spray tank for application

### Recommendations

1. The appropriate disposal of pesticide containers should be added to the national law, where this is not already covered. The relevant government authorities should be encouraged to take responsibility to address this.

2. Government should ensure that a number of different stakeholders (advisory services, regulators, input suppliers, farmers' organizations) are made aware of the regulations and other factors (such as hazards) so that they can in turn inform farmers.

3. The establishment of a mandatory container collection system by the governments should be encouraged. In the absence of a national system required by law, GIAEs could partner with other stakeholders – the agro-input sector, farmer coops, local government, etc. – to establish a voluntary container scheme. Regardless of whether they are mandatory or voluntary, relevant stakeholders, notably input supply stakeholders, should sustainably finance collection systems.

**Extension level**

The recommendations for container disposal made by extension agents are, with the exception of Tunisia, often not in accordance with recognized best practice (Table B.8.-2). The two final steps of container disposal – (triple-) rinsing and puncturing – are recommended to varying degrees across the countries. Tunisia, Kenya and Ghana are ahead in recommending best practices, while India, Malawi and Cameroon are behind. Many extension agents recommend burning or burying empty pesticide containers; this may be explained by the absence of a collection system at the local level.

In countries where no official container collection system exists, the study findings showed that extension agents still recommend that farmers use a container collection system. This could be due to several reasons: 1) They may be providing answers that are 'wishful/aspirational', e.g. If a container system existed, then they would recommend it; 2) Extension agents may be unfamiliar with their country's legislation on this matter and unfamiliar with what is available locally (they falsely believe a collection system exists).

## Application of recommended practice for the disposal of empty pesticide containers

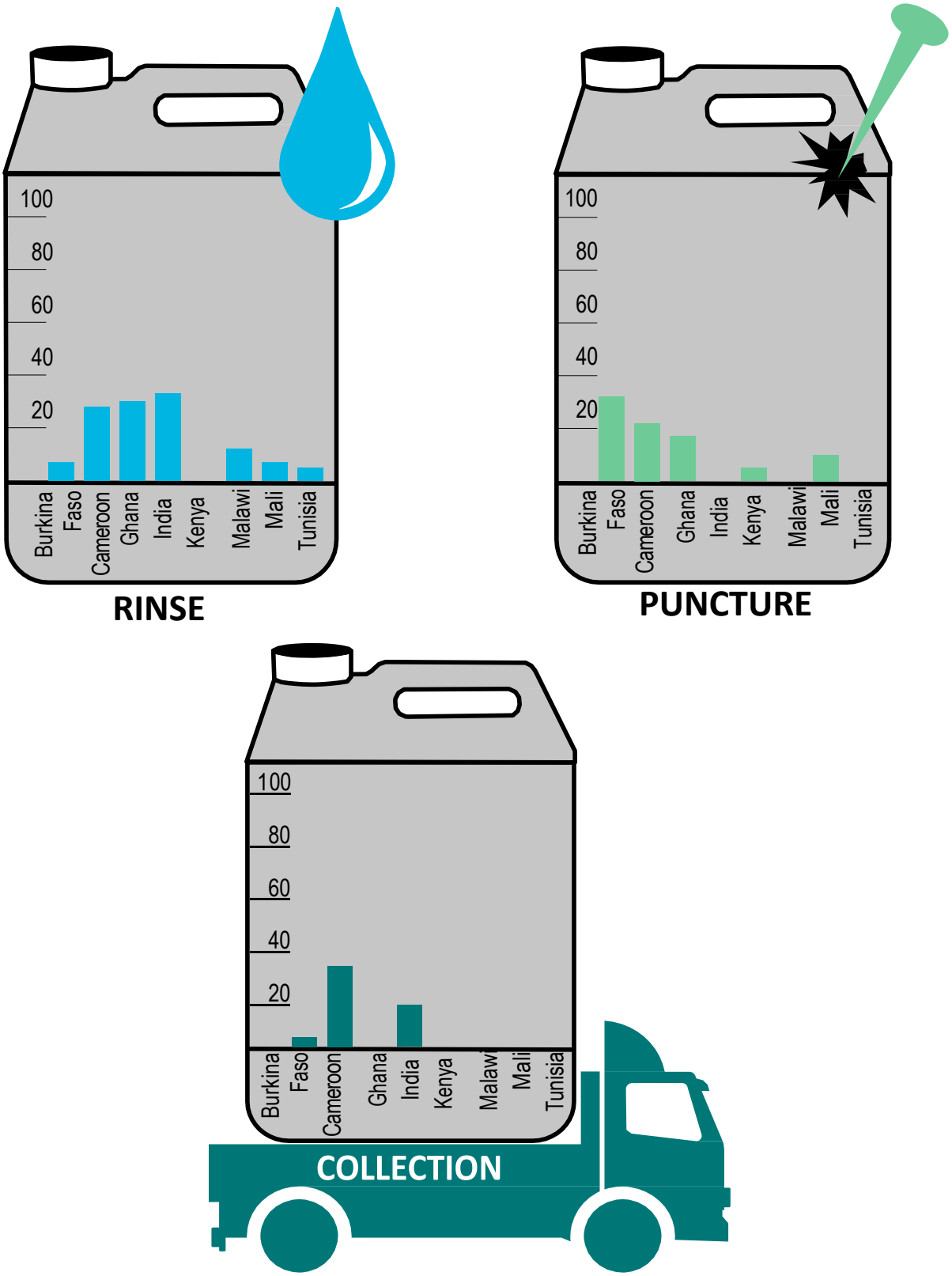


**Table B.8.-2 Extension agents' recommendations for container disposal**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=7 | BF n=16 | ML n=23 | GH n=13 | CM n=19 | KE n=20 | MW n=19 | IN n=8 | |
| | % of extension agents | | | | | | | | |
| **Extension agents' recommendations for container disposal** | | | | | | | | | |
| Rinse | 71 | 19 | 22 | 46 | 5 | 55 | 0 | 0 | **27** |
| Puncture | 71 | 44 | 57 | 54 | 26 | 70 | 11 | 0 | **42** |
| Container collection system | 57 | 31 | 48 | 23 | 47 | 70 | 11 | 43 | **41** |
| Return to sale point | 14 | 0 | 13 | 8 | 11 | 15 | 5 | 0 | **8** |
| Burn | 57 | 63 | 57 | 77 | 79 | 50 | 89 | 43 | **64** |
| Bury | 29 | 69 | 87 | 62 | 42 | 75 | 95 | 67 | **66** |
| Use to store other items | 0 | 6 | 0 | 8 | 0 | 5 | 5 | 0 | **3** |
| Leave in field | 0 | 6 | 4 | 0 | 0 | 0 | 0 | 0 | **1** |

### Recommendations

1. Extension agents' knowledge of appropriate container disposal should be enhanced through training. As a minimum requirement, extension agents should always recommend triple-rinsing and puncturing of empty pesticide container in order to avoid poisoning incidents, environmental contamination and re-use. Trainings may be conducted through a PPP with input supply stakeholders: e.g. Bayer's BayG.A.P.
2. Where a container collection system is in place, extension agents should promote its use and advise against burning or burying containers.
3. It should be ensured that extension agents are aware of national legislation regarding empty pesticide container disposal, and have the capacity to transfer this information to farmers in a practical way.

**Agro-input level**

Day-to-day business at agro-input shops is often undertaken by untrained staff, even where a licence scheme requires the shop-owner and/or staff to have followed formal trainings. As a result, the advice given to farmers may be limited or incorrect.

### Recommendations

1. Agro-input retailers' knowledge of appropriate container disposal should be enhanced through interactive training or capacity-building activities leading up to the delivery of a certificate. Relevant stakeholders who should be involved include government, agro-input suppliers and manufacturers.

2. Agro-input retailers should be provided with fliers describing the safe disposal of containers. Such fliers should be provided in sufficient numbers so that they can be distributed to farmers. Such materials should be richly illustrated in order to reach illiterate farmers.

3. Agro-input retailers should be involved, together with other relevant stakeholders (government, agro-input suppliers and manufacturers), in mandatory or voluntary container collection systems.

**Farmer level**

In all countries, many farmers dispose of pesticide containers in a manner that poses a risk to human health or the environment (Table B.8.-3). The two first steps of container disposal – (triple-) rinsing and puncturing – are rarely followed by farmers. Many farmers burn or bury their empty pesticide containers; this can be explained by the absence of a container collection system. On the positive side, farmers rarely report that they re-use containers or leave empty containers in their fields.

In countries where no official container collection system exists, the study findings showed that some farmers still respond that they use a container collection system. This could be due to several reasons: 1) They may be providing answers that are 'wishful/aspirational', e.g. If a container system existed then they would use it, 2) Farmers may be unfamiliar with what is available locally (they falsely believe an official collection system exists).

**Table B.8.-3 Empty pesticide container disposal by farmers**

| Indicator | Country | | | | | | | | Avg. |
|---|---|---|---|---|---|---|---|---|---|
| | TN n=20 | BF n=30 | ML n=44 | GH n=30 | CM n=18 | KE n=20 | MW n=20 | IN n=12 | |
| | % of farmers | | | | | | | | |
| **Farmers' practices on container disposal** | | | | | | | | | |
| Rinse | 5 | 7 | 7 | 30 | 28 | 0 | 12 | 33 | **15** |
| Puncture | 0 | 32 | 10 | 17 | 22 | 5 | 0 | 0 | **11** |
| Container collection system | 0 | 4 | 0 | 0 | 33 | 0 | 0 | 17 | **7** |
| Return to sale point | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Burn | 50 | 50 | 33 | 77 | 33 | 33 | 53 | 58 | **48** |
| Bury | 10 | 60 | 43 | 23 | 56 | 5 | 12 | 25 | **29** |
| Use to store other items | 0 | 4 | 0 | 0 | 11 | 0 | 0 | 0 | **2** |
| Leave in field | 25 | 0 | 7 | 10 | 0 | 0 | 0 | 0 | **5** |
| Give away or sell to others | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | **6** |

**Recommendation**

1. In order to avoid incidents of poisoning, environmental contamination and re-use, farmers should be made aware of how to safely dispose of empty containers. This includes providing information on disposal options when a container collection system is in place. Advisory service providers can play a key role in undertaking this knowledge transfer to farmers.

## B. 9. Registered pesticides and related hazards

When pesticides are not used appropriately they can become a cause for concern due to the risks that they pose to the health and safety of farmers, farm workers and consumers, as well as their potential impact on the environment. The analysis of the list of registered pesticides conducted as part of this study provides information on the full range of pesticides that are registered and used to control pests in the 14 GIAE countries' focal crops and for crop protection as a whole. It identifies which of those pesticides are HHPs, i.e. those that are "acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems", or that "appear to cause severe or irreversible harm to health or the environment under the conditions of use in a country" (FAO 2014). It also provides an assessment of the risks posed by the registered AIs and the availability of alternative lower-toxicity pesticides, such as biological control products, which could potentially be used to support the phase-out of the HHPs. Proposals for next steps are provided, along with recommendations regarding mitigation measures that can be put in place where immediate phase-out of HHPs is not possible.

The analysis of the national lists of registered pesticides for the 14 countries identifies a total of 569 AIs that are registered in at least one country. In total, 7,600 products based on these AIs are registered in 13 of the 14 countries. Only the list of AIs registered for India was unavailable, so the number of products registered in India is not included in this total. The number of AIs registered varies considerably by country (Table B.9.-1). Kenya, with 319 AIs registered, has the highest number of AIs, and Benin, with 41 AIs registered, has the lowest number of AIs.

**Table B.9.-1 Number of products and AI registered in the study countries**

| | TN | BF | BJ | TG | ML | GH | CM | NG | KE | ET | MZ | MW | ZM | IN | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total number of AIs registered | 225 | 130 | 41 | 61 | 130 | 159 | 156 | 85 | 319 | 150 | 224 | 158 | 171 | 272 | **570** |
| Total number of products registered | 767 | 453 | 73 | 170 | 654 | 536 | 573 | 481 | 1,197 | 440 | 969 | 453 | 440 | – | **7,621** |

The 569 AIs registered across the 14 countries differ in terms of their overall hazard level: 112 (19.7%) of the AIs meet one or more of the HHP criteria; 150 (26.4%) AIs are categorized as "danger" (one or more of the associated human health hazard statements indicate that the AIs is "toxic" or "fatal" if inhaled or swallowed); 207 (36.4%) AIs are categorized as "warning" (one or more of the associated human health hazard statements indicate that the AI is "harmful" or "may be harmful" if inhaled or swallowed); 46 (8.1%) AIs are categorized as "low hazard" (there are no known human health hazard statements associated with the AI); and data is not available for one or more of the criteria used for identifying HHPs for 54 (9.4%) of the AIs.

The 14 countries differ in the numbers and proportions of AIs registered per hazard category (Figure B.9.-1). The highest proportion of registered AIs which are HHPs are in Malawi (31%) and Nigeria and Zambia (29% each), while only 17% of the AIs registered in Burkina Faso and Mali are

HHPs. In the range of about a third (36% in Zambia and Malawi) to about half of the registered AIs (47% in Burkina Faso and Mali) fall into the category “warning”. However, for all countries, only a low percentage of the AIs are in the “low hazard” category (10% in Kenya to 0% in Benin and Togo).

Together, the combined data on registrations, recommendations and reports on usage from the findings provide a comprehensive picture of the potential use of HHPs. There is a concern that HHPs are registered and continue to be used. One of the issues identified is that less toxic pesticides are often not registered in the GIAE countries, or are too expensive for smallholder farmers. Long and costly registration procedures, combined with the small market size of individual countries, can explain the limited number of registered pesticides that are less toxic. GIZ continues to address this challenge in the 14 countries by promoting pesticide risk reduction through implementation of its pesticide procurement guidelines. These guidelines state that the use of pesticides in GIZ projects should be limited to exceptional situations where alternative treatments would not be effective. This helps to reduce unnecessary applications of pesticides. The following recommendations relating to the reduction in HHP in GIZ programme countries and programmes are made:

### Recommendations

1. At the national level generally, a gradual phasing-out of HHPs from the country’s supply chain is recommended. This should follow the guidance set out in the International Code of Conduct on Pesticide Management (FAO 2013) and the related Guidelines on Highly Hazardous Pesticides (FAO 2016). Registration considerations should also include the HHP criteria.

2. Where phasing-out HHPs is not immediately practical, risk reduction measures should be implemented. Governments should ensure that key stakeholders (advisory services, regulators, input suppliers, farmers’ organizations) have a good understanding of pesticide hazards and risk, and of the ways and means of protecting human health and the environment so that they can in turn inform farmers.

3. GIAEs should ensure that adequate advice is provided in each case where pesticide use is being recommended. The GIZ policy related to excluding any recommendation, procurement or use of HHPs should also be clearly communicated to all partners to ensure that it is consistently applied.

4. GIAEs should work with relevant stakeholders to raise awareness about HHPs among pesticide regulatory authorities and to strengthen the capacity of pesticide regulatory authorities on pesticide risk assessment.

5. Mechanisms should be put in place to ensure that the information on pesticides and HHPs are kept up to date and that channels for information exchange on efficacy and risks are established.

6. Researchers, regulators and other relevant stakeholders should work together to identify alternatives to HHPs in order to manage the pests for which HHPs are currently registered. Effective, non-chemical control methods and non-HHP pesticides with the lowest risk should be prioritized.

7. Governments should be encouraged to facilitate the registration of lower-risk products, e.g. reducing registration fees for lower-risk products or by setting in place a specific registration pathway for biological control products. This should be coupled with policies to increase the availability and affordability of safer, low-toxicity alternatives and putting in place subsidy programmes for pesticides of known low-toxicity, such as biological control products.

8. Governments should be encouraged to work with neighbouring countries to develop a harmonized registration procedure at the regional level in order to prompt manufacturers to register lower-risk pesticides for minor uses by increasing the size of the market for which the registration is valid.

9. National policies to promote awareness and use of low toxicity products should also be supported. This could include, for example, the development of extension material and/or ICT tools highlighting registered and available biological control products and other low toxicity products that can be used in place of more toxic chemical pesticides. For example, development of a free and easy to access national biopesticides database and portal could be considered.

10. To promote the availability of less toxic AI, GIAEs should explore the possibility of local production of biological control products. This could be particularly beneficial in countries where there are significant obstacles to the registration of HHP alternatives: for example, where pesticide registration processes are slow or few manufacturers pursue registration.

11. When pesticide recommendations are made, the type and requirements of the PPE to be used and the level of training of the pesticide operators should be taken into account.

12. Availability and use of appropriate PPE can be encouraged through subsidy programmes. Options for engagement with the private sector exist around the production and supply of protective clothing and implementation of pesticide container collection and disposal schemes.

## B. 10. Farmers' practices on pest management in rice and potato

In all study countries control methods that can be integrated into an IPM strategy for the focal crops were identified through a review of scientific literature. This covered the major pests of 16 focal crops and allowed the identification of a set of proven IPM methods, including non-chemical preventive and direct control methods and low-toxicity chemicals. The review primarily focused on methods that have been tested in the national or regional context, but also included information from other regions of the globe when literature documenting trials conducted at a national or regional level was limited. Detailed information is available in the individual country reports.

Out of the 16 focal crops across the 14 GIAEs, some, such as soybean, groundnut, rice and potato, are the focal crop for more than one GIAE (Figure 1). Due to limitations of space, the description of IPM practices given in this report is confined to two crops only: rice and potato.

Potato is represented in four of the eight countries where an in-country data collection took place and rice is represented in three. The in-country data collection included a documentation of farmers' pest management practices and allowed the identification of knowledge gaps. The section below lists the major pests and describes farmers' practices for their control. Key control methods and successful examples from GIAEs are highlighted.

### Potato field pest management in Tunisia, Mali, Cameroon and India[2]

**Diseases**

Late blight (*Phytophtora infestans*) is considered to be a major pest by nearly all farmers in Tunisia, Cameroon and India but not in Mali, where potatoes are exclusively grown during the dry season. Early blight (Alternaria spp.) is also common in Tunisia and India, but not in Mali and Cameroon. Bacterial blight (*Ralstonia solanacearum*) was mentioned by all farmers in Mali and Cameroon, but not in Tunisia and India.

Over two-thirds of the farmers in Tunisia and all farmers in Mali, Cameroon and India practice crop rotation, which is effective against soil-borne diseases, such as bacterial blight, and against early blight. The vast majority of farmers rotate with appropriate, non-solanaceous crops, but rotation duration in Mali and Cameroon is of one year and this is insufficient to keep bacterial blight under control. Recommendations for extending crop rotation duration include field exchange between farmers and the facilitation of the adoption of alternative cash crops by farmers.

About half of the farmers in Mali, Cameroon and India use disease-free or certified planting material3. All Tunisian farmers use disease-free planting material as its access is being facilitated

2 Countries where data on potato pests and their management was collected through interviews with farmers and extension agents. This section does not include field data from Nigeria. Information on potato pests in Nigeria was instead gathered from a literature review as part of a country desk study. Please see the Nigeria country report for further information.

by the Tunisian GIAE through a private producer at subsidized prices. Similar partnerships could be considered in other countries.

Biological control products (e.g. *Bacillus subtilis* against diseases in Tunisia) are rarely used and this is due to their limited availability and relatively higher cost. Field trials conducted in coordination with extension agents, as take place in Tunisia, can also contribute to the adoption of biological control products.

Nearly all farmers use pesticides to control early and late blight where these diseases are present Information on spraying schedules was however not collected as part of this study. HHPs are frequently used for control of early and late blight: nearly all farmers in Tunisia, India, and Cameroon use Mancozeb and nearly all farmers in Cameroon also use Chlorothalonil. Both AI are effective against both pests, and are cheap and relatively easy to source. These two old AI are multi-site and thus no resistance against these AI has built up in the pathogen population, and this explains why they are popular. Reducing the use of HHPs will require that alternatives to these products are both available and affordable.

**Insects and mites**

Interviewed farmers also mentioned a variety of insect pests, as well as mites, although these appear to be less problematic than fungal and bacterial diseases. In all countries, many of the interviewed farmers (from 50% in Mali to 90% in Cameroon) use insecticides for their control, although some subsistence farmers in Mali use a local repellent plant, trap crops (*Hibiscus sabdariffa*) and neem-based homemade pesticides. Homemade botanical pesticides represent an alternative for farmers who have no access to, or simply cannot afford, to buy synthetic pesticides. However, the safety of these homemade pesticides has not been well investigated and their efficacy may vary. Where the use of such products is recommended by extension services (e.g. in Mali), national research should be conducted to identify botanicals and preparation methods that are effective and reliable, and that pose little risk to farmers.

## Potato post-harvest pest management in Mali and Cameroon

Farmers covered by this study in Tunisia do not currently store their crop, preferring instead to benefit from high markets prices to sell the crop soon after harvest. Responses from farmers interviewed in India also showed that they prefer to sell their potatoes just after harvest. Farmers in Mali reported having problems with termites and potato tuber moth, while farmers in Cameroon mentioned tuber rot and potato tuber moth, but not termites. Post harvest management of potatoes stored by retailers was not captured in this study.

[3] Certification ensures that seeds meet certain quality standards, one of which is that material is disease free. Farmers should therefore always be advised to purchase seed from recognized, certified suppliers in order to ensure that the material is disease free.

**Insects**

Half of the farmers in Mali cover the soil with ash and sand to prevent termite infestations. Insecticides are used by half of the farmers in Cameroon and Mali for control of potato tuber moth (*Phthorimaea operculella*). In Cameroon, an HHP (Cypermethrin) is used by a fifth of the interviewed farmers. The literature review indicated that storing potatoes in sand can reduce potato tuber moth infestations and that covering the soil in ashes is reported to prevent termite infestations. These traditional methods are already used by some farmers and can contribute to reducing yield losses. At present, a biological control product (Spinosad, GIZ procurement class B) is registered for the control of potato tuber moth in Mali but none is registered in Cameroon and Mali. The biological control product Bacillus thuringiensis (GIZ procurement class D) is registered in both countries, but not for use on potatoes.

**Diseases**

Most farmers in Cameroon sort the tubers at harvest to prevent tuber rot from spreading to healthy tubers and only a single farmer reported using an unidentified product against this pest. Tuber rot is caused by infestation in the field by soil-borne bacterial or fungal pathogens (likely by *Ralstonia solanacearum*, possibly also Erwinia sp.). Best practices for the control of soil-borne diseases include cultural practices – in particular, long crop rotations (three or more years) and the use of disease-free or certified planting material.

## Rice field pest management in Burkina Faso, Mali and Ghana

**Insects**

Insect pests are problematic in all countries. All farmers in Mali mentioned various vaguely identified insects (e.g. “worms” and “insects”) as major pests. Information collected from extension agents suggest that farmers are referring to rice stem borers (possibly *Sesamia calamistis*), rice caseworm (*Nymphula depunctalis*) and African rice gall midge (*Orseolia orzyvora*). Most farmers in Burkina Faso also mentioned various insects, with “caterpillars” (including stem borers) mentioned by over a third of the interviewed farmers. On the other hand, only termites seem to be problematic in Ghana (cited by about two-thirds of the farmers).

Only a few farmers in Burkina Faso reported using non-chemical methods, such as field sanitation or draining the field, to control what they named “caterpillars”. About a quarter of the farmers in Mali reported using homemade botanical insecticides – mainly based on neem but also on a local plant called “diaralamba”.

Most other farmers rely only on synthetic pesticides for insect pest control: over three-quarters of the farmers in Burkina Faso, about two-thirds of the farmers in Mali and about a third of the farmers in Ghana use insecticides for insect pest control. Biological control products are registered for the control of insect pests on cotton or tomato only in Burkina Faso and Mali, and none is registered for use on rice. Both countries share a harmonized registration system and the relevant regional authorities should be encouraged to develop simple label extension mechanisms (e.g. facilitate the registration of the pesticide product for the same pest but on other crops) in order to increase the availability of lower-risk options.

**Rodents**

Rodents (grasscutters and rats) were mentioned by nearly all farmers in Ghana but only by a third and a fifth of the farmers in Mali and Burkina Faso, respectively. Rodents are mainly controlled with non-chemical methods in Burkina Faso (a few farmers reported using traps) and Ghana (over half of the farmers use hand weeding for grasscutter control and a few reported using traps or placing coconut branches around the field). However, over a third of the farmers in Ghana said

they used "any agro-chemical" against rodents and almost half of farmers in Mali use rodenticides, including the HHP Difenacoum. Cultural control methods, such as weeding to expose rats to predators, or the use of traps, can contribute to reducing their populations. Such methods should be popularized through participatory approaches, such as farmer field schools.

**Birds**

Birds (likely to be weaver birds, *Quelea quelea*) are a major pest for all farmers in Ghana and two-thirds of the farmers in Mali, but are less frequently mentioned by farmers in Burkina Faso. Birds are mainly kept at bay by scaring them (about three-quarters of the farmers in Ghana and about a third in Burkina Faso and Mali) or hunted with slingshots or rifles (about a fifth of the farmers in

Burkina and Ghana); alternatively, about a quarter of the farmers in Mali destroy birds' nests. A few farmers in Mali and Ghana reported using unidentified poisons or insecticides, including the HHP Carbofuran. Where poisons are being used to control birds, farmers should be warned not to eat them as they will poison themselves. At present, no pesticide is actually registered for use against birds in Burkina Faso, Mali and Ghana, but a repellent (Methyl Anthranilate, not listed in the GIZ procurement classification) is registered for use against weaver birds in Ghana.

**Weeds**

Over two-third of the farmers in Mali and about half of the farmers in Burkina Faso and Ghana consider weeds to be a major problem. Weeds are controlled mechanically or by hand by about two-thirds of the farmers in Mali and by about one-third of the farmers in Burkina Faso and Ghana. Herbicides are used by about half of the farmers in Burkina Faso and Mali and by about a quarter of the farmers in Ghana. Simple machinery, such as weeders, is already being used by farmers in Burkina Faso. Mechanical control represents a safe, non-chemical alternative to pesticides, but its implementation requires the development of simple machinery that can be produced at the national level. PPP with German or local manufacturers could be considered for the development of such machinery. Support of farm mechanization can help boost farm productivity while promoting sustainable practices.

**Diseases**

Diseases were less frequently mentioned: rice blast was mentioned by about half of the farmers interviewed in Ghana and by a quarter of the farmers in Mali (unidentified fungal diseases were mentioned by the farmers, which, according to the extension agents, is rice blast). In Mali, a virus (rice yellow mottle virus according to extension agents) was mentioned by about a third of the farmers.

Diseases were hardly mentioned by the interviewed farmers in Burkina Faso. Disease control is very limited in all countries. Only one farmer (out of 11) in Mali indicated that he burned crop residues to control the rice yellow mottle virus and only two farmers (out of 15) in Ghana mentioned using fungicides. Based on the literature review, cultural practices such as the destruction of crop residues can reduce incidence of rice blast and rice yellow mottle virus. Such practices do not require investments and popularizing them among farmers can contribute to food security.

## Rice post-harvest pest management in Burkina Faso, Mali and Ghana

**Rodents**

In all countries, the most frequent pest is rodents (mice and rats), mentioned by half of the farmers in Burkina Faso and Mali, and by a third of the farmers in Ghana. Non-chemical control is hardly practised, with the exception of traps or clearing the storage room – methods which are used by about a fifth of the interviewed farmers in Ghana. Other farmers mostly rely on rodenticides (about a third of the farmers in each country), including the HHP Difenacoum. There is currently no non-HHP rodenticide registered in the three countries. A potent narcotic human drug (oxycodone + paracetamol) is used by about a quarter of the farmers in Ghana to control rodents, but this product is not registered as a rodenticide and it is not clear how safe and effective this method is. Facilitation of farmers' access to simple and effective rodent traps could be considered to promote a safer alternative for the control of rodents in the field and during storage.

**Insect pests**

Termites were mentioned by up to a third of the farmers in all countries. The only mentioned non- chemical control method was putting the rice bags on pallets to protect them from termites, and only two farmers reported doing this. Most farmers rely on pesticides to control insect pests. This includes HHPs Aluminium phosphide, Carbofuran and Dichlorodiphenyltrichloroethane (DDT).

Pesticides that are not HHPs are registered for control of termites in all countries. Nationally registered alternatives are listed in the country reports. Farmers should be warned about the danger of using HHPs and should be informed about the alternatives that are available.

### Recommendations

Recommendations for the implementation of priority, innovative pest management measures for the key pests of the focal crops are detailed in the country reports.

The country reports also include a list of registered, less toxic, alternative AI to the HHPs that are registered for use on the focal crops, used by farmers or recommended by extension agents.

## B. 11. Voluntary standards applied to focal crops

Voluntary standards guidelines aim at certifying production processes that are sustainable from an environmental or social point of view, and/or aim at complying with buyers' requirements in terms of quality and food safety. Farmers who adhere to these guidelines obtain in exchange price premiums and/or access to new markets. Certification is conducted by independent certification bodies and the cost of this process is usually covered by farmers. This section focuses on the major international voluntary standards covering organic production, GAP or social responsibility at the farm level and that are applied in the focal crops value chains in countries where the GIAEs are being implemented. Their scope is described and their implementation in value chains targeted by the GIAEs is briefly discussed.

**Customer-oriented standards**

Customer-oriented standards aim to meet customers' demand for certified, sustainable production processes. They are visibly placed on the certified produce and customers accept to pay a premium for the produce. The two main types of standards are organic agriculture standards, such as the European Union standard (EU-BIO), which bans the use of non-natural inputs, and fair-trade standards, such as FLOCert's standard, which stands for fairer prices for smallholder farmers but also contains further requirements related to IPM as well as restrictions regarding pesticide use. Both fair-trade and organic agriculture standards are well known but remain a niche market.

**Business-to-business standards**

Business-to-business standards are much more widespread, yet the general public is less familiar with them. With the exception of UTZ-Rainforest Alliance[4], these standards are not displayed on produce. These standards are preferred by multinational corporate groups which want to ensure the quality of the produce they source but which are also keen to demonstrate that their sourcing is sustainable. Five major standards have been identified in the focal crops. Rainforest Alliance primarily stands for biodiversity protection and sustainable resources management but also addresses social responsibility. The UTZ standard mainly covers the economic sustainability of certified farms, GAP implementation and social responsibility. Global G.A.P. focuses on GAP implementation and ensuring food safety, but also contains minimal social responsibility standards. Business Social Compliance Initiative (BSCI) focuses only on social responsibility and African Cashew Alliance (ACA) Quality and Sustainability Seal focuses on social responsibility and food safety.

**Implementation in focal crops**

The most widely implemented international standard in the focal crop value chains is organic agriculture (in seven of the study countries / nine value chains), followed by fair-trade (five

[4] Both standards have merged as at 1 January 2018, but the separate guidelines and certifications processes are still in

countries / five value chains). UTZ-Rainforest Alliance and Global G.A.P. are both implemented in two countries / value chains. Finally, BSCI is only applied to mangoes in Mali and the ACA

Quality and Sustainability Seal is only applied to cashew in Togo. In half of the countries, voluntary standards are not applied to the focal crops (Ghana, Nigeria, Ethiopia, Mozambique, Malawi, Zambia and India). This can be explained by the fact that international voluntary standards are usually not valued in the local markets, and they are thus only applicable to export crops and not to staple crops, such as maize or rice. The relevance of pursuing such certifications is directly linked to the presence of a market for the produce. When this is the case, certifications can ensure market access and often also grant a better price for the produce. However, when, due to an unstable market, the demand disappears, certified producers have no other option but to sell their produce as conventional produce. Without the gain of a price premium, certification can become a burden since farmers do not recover the money they invested in obtaining it. This is best illustrated by the example given by mango farmers interviewed in Mali. The National Federation of Organic and Fairtrade Producers (FENABE) cooperative follows a double certification (organic agriculture and fair-trade). They used to sell their produce at a premium price to a Burkinabe processor who was paying the price premium, but due to issues with customs he had to stop importing mangoes from Mali. Over the last eight years, the mango farmers were unsuccessful in recovering the price premium for their certified mangoes in the national market. The cooperative's farmers are now discouraged regarding seeing any return on their investment and some of them are abandoning the certification. The local GIAEs are now identifying exporters in Europe to solve the problem.

Nevertheless, this examples illustrate that voluntary certifications should be promoted only where a price premium and access to the market are guaranteed. Nationally recognized voluntary standards are also being implemented, such as the Malawi Organic Grower Association or the Kenya G.A.P. standards. These standards can ensure that sustainable production guidelines are followed but they do not grant access to international markets.

**Certification bodies**

Certification to international standards is only possible when a certification body has operations in the country. One of the leading certification bodies is Ecocert, which has operations in more than 130 countries, including west and southern African countries and India. Ecocert offers organic agriculture and fair-trade certification and was mentioned by stakeholders in Burkina Faso (sesame value chain), Togo (cashew, groundnut and soybean value chains), Mali (mango value chain) and Cameroon (cocoa value chain). The certification body Gebana also offers organic agriculture and fair-trade certification and is active in the soybean value chains in Togo and Benin. Certification of Environmental Standards (CERES) is specialized in organic agriculture certification and has been reported to be active in the Togolese soybean value chain. A large number of other minor certification bodies exist; the lists of accredited certification bodies can be obtained through the targeted voluntary standard.

**Online support for voluntary standard compliance**

The IPM-Coalition platform (www.ipm-coalition.org) offers access to information on pesticide hazards. It allows users to quickly see which pesticides are allowed, restricted or banned by a variety of different voluntary standards. The system contains a filter function which allows farmers following multiple certifications (e.g. Rainforest Alliance and Fairtrade) to rapidly identify the pesticides which are allowed by both voluntary standards. The goal of this platform is to support the phasing out of HHP. In the future, the platform should also include crop-specific information on non-chemical pest management.

### Recommendations

1. Compliance with national voluntary standards that rely on self-inspection or production guidelines should be facilitated to support the uptake of sustainable production guidelines, e.g. GAP or IPM in all crops.

2. Certification to international voluntary standards should be considered only for export crops. This should be facilitated only where there is a sustained market demand for certified produce.

3. A coordinated systems approach involving other key actors (e.g., advisory services, agro-input dealers) could be considered. This would harmonise and reinforce the messaging transmitted to farmers. A training and 'certification' system for advisors or agro-input dealers, including a periodic evaluation process, would be one way to create consistency while also promoting those who comply.

## B.12. PPPs: Examples and opportunities

### PPPs in the countries where the GIAE initiative is being implemented

This section describes some of the PPPs that are in place in the countries where the GIAE initiative is being implemented. Some areas where there is a potential for a PPP are underlined.

**Facilitating agricultural mechanization**

A PPP between regional authorities, a blacksmith cooperative (SOCAFON) and the World Bank is facilitating famer access to rice seeders in Mali. This contribution to agricultural mechanization helps boost farm productivity. Such partnerships could be considered elsewhere – in particular, to facilitate access to weeders, thus offering an alternative to herbicides.

**Voluntary pesticide container collection schemes**

Working with the agro-input sector can help solve problems linked to pesticide use. Where the state does not have the capacity to put a mandatory container collection system in place, a PPP can be considered to put a mandatory container collection system in place. For instance, the Burkinabe pesticide manufacturer Saphyto already possesses an incinerator and discussion with this company could be considered. Pesticide manufacturers and suppliers in Tunisia (Bayer) and Mali (Louis Dreyfus Commodities) mentioned that they are willing to take responsibility for container disposal but that their attempts to fi a solution with national authorities were unsuccessful.

**Safe pesticide handling and application**

The Burkina Faso GIAE is working with the pesticide supplier Saphyto to offer farmers training on safe pesticide handling and application called “Applique Bien”. The goal of the training is to minimize pesticide risks to human health and the environment and to maximize the effectiveness of pesticides through appropriate use. The training is given by a mobile team. The training method includes videos, interactive support and practical trainings. Another example is India’s GIAE partnerships with Bayer to provide PPE to farmers.

#### Recommendations

1. Where relevant, consider exploring opportunities with the private sector to improve the sustainability of development programmes. As long as a private sector entity has the opportunity to achieve an adequate profit or return on investment, it will be more likely to support and invest in an initiative beyond GIZ’s involvement.

2. Consider engaging with the private sector to achieve greater scale. That scale can be geographic or it can be manifested as a scope expansion into complementary products or services.

3. Consider engaging with the private sector to improve the impact of the programme, through the provision of more tailored and frequent support, or connections across the value chain (e.g. agro-input dealers)

## B. 13. Review of extension materials developed by GIAEs and partner organizations

CABI reviewed extension and training materials provided by GIAEs for quality of the pest management sections (see Annex I for the list of extension materials reviewed). Some countries had no extension materials to share at the time of the desk study: Burkina Faso, Malawi, Mozambique and Zambia. Benin and Togo provided extension materials that did not cover pest management or that only made a brief mention of it. The India extension materials provided were in the local languages Marathi and Kannada and because of this only the recommended pesticides could be reviewed. Finally, seven countries provided extension materials on pest management or with a section dedicated to pest management: Cameroon, Ethiopia, Ghana, Nigeria, Kenya, Mali and Tunisia. We highlight below some selected examples of good guidance and also underline some of the shortcomings of the reviewed extension material.

Technical training manual for trainers on good agricultural practices on sweet potato production in western Kenya constitutes a good example of training material. It is well structured and well-illustrated, and the language used is appropriate to the target audience. Chapter 4 focuses on pests and their management. Major pests and the symptoms they cause are well described and are illustrated with pictures. The material includes advice for pest monitoring. The non- chemical preventive and direct control methods that are relevant for each pest are listed but their implementation is not (or is only briefly) described and this could be improved upon. Only one recommendation for pesticide use was identified. There is no mention of AI that are appropriate for the pests and this could potentially lead to the use of the wrong products. Some major precautions to be followed when handling pesticides are listed but they are not well explained and this text is hidden in the IPM section. Developing the information on pesticide handling and dedicating a whole section to it would contribute to further improving this material.

Together with the International Potato Center, Cameroon's GIAE has developed a guide for the training of trainers, titled Potato learning farms. Potato pests and their monitoring are very well described and the guide is illustrated with pictures of the symptoms. Preventive and non-chemical direct control methods and their implementation are very well described. Moreover, the training guide contains instructions for the production of healthy seed potato by farmers. However, the major downside is that pesticide applications (insecticides or fungicides) are recommended without mentioning the AI that are appropriate for the pest. The precautions to be followed when using pesticides are also not described. Providing that a section on the safe handling of pesticides is added, this good quality extension material could be adapted to other potato-growing countries.

Another relatively good example is Ghana's training material for rice farmers, Disease and Pest Management / Safety use of Pesticides - Good Agricultural Practices. It contains a section specifically about the safe use of pesticides. The major precautions to be followed when using chemicals are well explained, although some gaps were identified and this could be improved. For instance, re-entry intervals are not mentioned or only a few hazard symbols and advice

pictograms are shown. The material contains some mistakes: for instance, it indicates that Sevin (Carbaryl) is a relatively safe pesticide, while our analysis shows that it is an HHP. Another shortcoming of this document is that it does not indicate which pesticide AIs are appropriate for the major pests. Finally, the technical level of this document is well adapted to extension agents, but may be too complicated for the farmers which are the training's target audience.

Some of the other extension materials reviewed contain little information on IPM. For instance, the information on non-chemical preventive and direct control methods is very limited in Ethiopia's Identification and management Faba bean Disease: Training Manual, and it is generic and not specific to the major pests of the focal crops in the extension materials from Mali. In the extension materials from Nigeria, only the reference guides for potato include preventive control methods.

The other reference guides' advice for pest management are limited to pest monitoring and pesticide use. Ethiopia's Wheat production guide for farmers, development agents and experts contains good descriptions and illustrations of plant health problems, but the recommendations for the non-chemical management wheat pest are limited and their implementation is not well explained. On the other hand, extension material from Tunisia contains detailed information about IPM – but the language used is very technical and the material lacks illustrations.

The safe handling of pesticides, their storage and the safe disposal of empty pesticide containers is overlooked in the training material developed by partners of the Benin and Mali GIAEs. These documents contain recommendations for the use of insecticides but contain no information regarding the safe handling of pesticides. By contrast, the extension materials from Ethiopia, Tunisia and Nigeria contain information about pesticide hazards and risks, as well as the correct handling of pesticides. In the extension material from Ethiopia (Agricultural Pesticides and safety measures for chemical application), pesticides hazards and risks are extensively described, although some mistakes are identified: for example, the information about the WHO classification of pesticides by hazard is incorrect. The section covering the handling and application of pesticides covers the key steps and often contains important information, but some inappropriate recommendations were also spotted: for example, to pour unused pesticides away from homes and streams. The extension material from Tunisia contains key information on the safe handling and application of pesticides, but the information is spread between different presentations by different authors and the information is not sufficiently structured. In the extension material from Nigeria, the information on safe pesticide handling is limited and mistakes were spotted.

### Recommendations

1. All non-chemical methods that are appropriate against the targets pests should be mentioned. They should be described with all the details needed for a correct and successful implementation.

2. The material should include detailed information on pest monitoring and locally relevant economic thresholds where these are available

3. Where pesticides are recommended, the least toxic options that are appropriate for the pest should be preferred.

4. Where pesticides are recommended, comprehensive information on the correct application of the pesticides and on measures to protect human health and the environment should be included.

5. Extension materials should be available to extension agents in a variety of formats (including downloadable content), to help them make appropriate IPM decisions.

6. A consultative approach should be used for the development of extension materials. This should include working with researchers, extension agents and farmer cooperatives.

7. The language used should be appropriate for the target audience.

8. The materials should be appropriately illustrated to facilitate the understanding.

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# Annexes

## I. List of reviewed extension materials

**Benin**

- Bones techniques de production du soja. Fortuné Amonsou Biaou
- Renforcement de capacités des techniciens sur les bonnes pratiques de production du riz selon le SRI. C. Akakpo

**Burkina Faso**

- No extension materials available

**Cameroon**

- Potato learning farms: technical guide for trainers. Cameroon GIAE, International Potato Centre, Ministère de l'Agriculture et du Développement Rural.

**Ethiopia**

- Super Grain Bags: Chemical free Wheat and Faba bean Storage Structure. Ethiopia GIAE, Ministry of Agriculture and Natural Resources.
- Agricultural Pesticides and safety measures for chemical application. Daniel Kasa - IP Consult. Identification and management Faba bean Disease: Training Manual. Daniel Kasa - IP Consult. Wheat production guide for farmers, development agents and experts. IP Consult, Ethiopia GIAE.

**Ghana**

- Rice: Weed Management and Nutrient/Fertilizer Management – Good Agricultural Practices.Agriculture & Finance Consultants, Ghana GIAE and Ministry of Food and Agriculture
- Rice: Disease and Pest Management / Safety use of Pesticides – Good Agricultural Practices.Agriculture & Finance Consultants, Ghana GIAE and Ministry of Food and Agriculture
- Maize: Weed Management and Nutrient/Fertilizer Management - Good Agricultural Practices.Agriculture & Finance Consultants, Ghana GIAE and Ministry of Food and Agriculture
- Maize: Disease-Pest Management and Safe Use of Pesticides. Agriculture & Finance Consultants, Ghana GIAE and Ministry of Food and Agriculture

**India**

- 21 brochures were provided but all were in the Marathi or Kannada language and could not be reviewed except for the pesticides that were recommended.

**Kenya**

- Technical training manual for trainers on good agricultural practices on sweetpotato production in western Kenya. Philip Ndolo – Kenya GIAE

**Malawi**

- No extension materials were available at the time of the study

**Mali**

- Module 13 : Maladies des cultures maraichères : connaissance, prévention et traitement. Centre Communautaire de Formation Agro-Pastorale de Zamblara (CCFAP-Z) – Commission Technique Régionale de Conception des modules de formation en Irrigation de Proximité
- Module 14 : Ennemis des cultures maraichères : connaissance, prévention et lutte. Centre Communautaire de Formation Agro-Pastorale de Zamblara (CCFAP-Z) - Commission Technique Régionale de Conception des modules de formation en Irrigation de Proximité
- Module 17 : Production maraîchère biologique. Centre Communautaire de Formation Agro- Pastorale de Zamblara (CCFAP-Z) – Commission Technique Régionale de Conception des modules de formation en Irrigation de Proximité

**Mozambique**

- No extension materials were available at the time of the study

**Nigeria**

- Doing good business with rain-fed maize: Producer's Reference for Northern Nigeria. GIZ and AFC
- Doing good business with quality cassava: Producer's Reference Southern Nigeria. GIZ and AFC
- Doing good business with quality potato: Producer's Reference for irrigated potato production. GIZ and AFC
- Doing good business with quality potato: Producer's Reference for rainfed potato production. GIZ and AFC
- Doing good business with quality irrigated dry season lowland rice: Producer's reference Nigeria. GIZ
- Doing good business with quality rainfed lowland rice Producer's reference Nigeria. GIZ

**Togo**

- Bonnes pratiques agricoles de production de l'arachide : Support de formation et d'appui conseil. GIZ Bonnes pratiques agricoles de production de l'arachide : Avoir plus d'arachides à la récolte. GIZ Critères de conformité pour la production de soja biologique. GIZ
- Boîte à image soja conventionnel: récolte et post récolte du soja. GIZ

- Boîte à image soja conventionnel: Des astuces pour gagner plus avec la culture de soja. GIZ
- Culture de la noix de cajou : Informations relatives aux aspects phytosanitaires. GIZ

**Tunisia**

- Application des Pesticides Adaptée et Efficace. Dr. Samir Chebil
- Bonnes Pratiques Agricoles et Lutte Intégrée contre les Maladies des Plantes. Prof. Dr. Bouzid Nasraoui

**Zambia**

- No extension materials were available at the time of the study

## II. CABI toolkits

This section presents some of the tools developed by CABI to contribute to the uptake of IPM and GAP.

**Plantwise plant clinics**

Plantwise is a global programme, led by CABI, to increase food security and improve rural livelihoods by reducing crop losses. This is achieved by establishing sustainable networks of local plant clinics, run by trained plant doctors, where farmers can find practical plant health advice.

Plant clinics are reinforced by the Plantwise Knowledge Bank, a gateway to actionable online and offline plant health information. Working in close partnership with relevant actors, Plantwise strengthens national plant health systems from within, enabling countries to provide farmers with the knowledge they need to lose less and feed more.

**Data collection app**

A data collection app was developed for use by Plantwise plant doctors to allow them to SMS high-quality advice to farmers. At the same time, the plant doctors quickly and easily collect plant health data during their regular clinics and farm visits. This data is collated for, and analysed by, country stakeholders to inform their plant health decision-making. The app takes plant doctors through an interview with farmers, using the principles of IPM, to diagnose plant health problems and send a suitable and safe recommendation to the farmer via SMS. The form can be filled in on- or offline, depending on where the plant doctor is. The simple design of the app allows interviews to be completed very rapidly – saving time for busy plant doctors and farmers.

**Online and downloadable extension resources**

The Plantwise Knowledge Bank (www.plantwise.org/KnowledgeBank) includes diagnostic resources, pest management advice and front-line pest data for effective global vigilance. Easy to use, with free online and downloadable resources, the Plantwise Knowledge Bank links all actors in the plant health system – plant clinics, researchers, extension workers, farmers and government bodies – to the information they need for timely action against crop pests and diseases. The Plantwise Knowledge Bank collects, analyses and disseminates pest data in order to enable identification and management of plant pests, protection against pest threats, and secure storage and analysis of national plant pest data. The cyclical flow of information means that everyone benefits from improved knowledge.

CABI also has experience in developing a crop-specific IPM toolbox in collaboration with the private sector, with users in about 60 countries. A lot of these users are field technicians

(agricultural advisers) who have the app on their tablets, but it is also being used by farmers in some countries. Some of our most active users are in Asia (India, Philippines, Pakistan) but users also exist in Africa, more particularly in Tanzania.

**Green and yellow lists**

Plantwise's Pest Management Decision Guides follow the concept of green and yellow lists, first developed and introduced by the International Organization for Biological Control. Based on a traffic light system, they contain a selection of the most appropriate preventive and direct control methods, and are quick and easy-to-use reference guides for use by extension agents in the field.

**Training of trainers**

Where it is necessary to reach a large number of extension agents and farmers, training will usually follow a cascade approach in which successive groups are trained to train others. CABI has experience in conducting trainings of master trainers. These master trainers then lead the training of extension agents, who will in turn carry out the farmer trainings in the communities where they are based.

**Training on rational and safe use of pesticides**

CABI has experience in developing training guides for extension agents and farmer manuals, and conducting trainings with the goal of promoting a more judicious use of pesticides so as to reduce risks to the health and safety of farmers and farm workers, and to minimize the impact of chemical products on the environment. The training also includes a tool that allows the identification of the kind of PPE that is appropriate for the pesticide to be used.

**University-level education**

CABI has developed IPM curricula for university lecturers in the Democratic People's Republic of Korea (DPRK) and Albania.

**Development of technical guidelines**

CABI has developed crop-specific technical guidelines for a range of crops, such as apples, cabbage, maize and tomato. The guidelines follow the recommendations developed by the Commission on Guidelines for Integrated Production of the International Organisation for Biological and Integrated Control. CABI facilitated the implementation of voluntary inspection systems to ensure compliance with these guidelines in Kosovo, Albania, Turkey, Argentina, Tanzania and DPRK.

**Development of farmer manuals**

CABI has extensive experience in the development of farmer manuals that follow IPM principles. Some examples include farmer manuals for cabbage and maize IPM, a manual for spray operators in DPRK, a farmer manual for tobacco IPM in Argentina, and a farmer manual for tomato IPM in Kosovo.

**Local production of biological control agents**

A joint collaboration involving agricultural research, development and extension institutions, as well as a commercial biological control manufacturer, was initiated in three Asian countries (China, Lao People's Democratic Republic and Myanmar) to set in place local production facilities for the production of Trichogramma parasitoids of the Asian corn borer, *Ostrinia furnacalis*. A grassroots approach was used to ensure the active participation of all relevant stakeholders, including smallholder farmers, in the decision-making process. Local grassroots organizations were established for: i) training of facility personnel to produce Trichogramma and farmers to apply the Trichogramma; ii) management of the Trichogramma production facility, according to a business plan; and iii) marketing of the Trichogramma and improved access to market opportunities. Such an innovative community-based approach is instrumental for the long-term sustainability of the established Trichogramma production facilities, ensuring that the profits stay within the community. CABI has also developed manuals for the rearing of Trichogramma, an antagonistic fungi used to prevent fungal diseases and boost plant growth, as well as for the rearing of nematodes used for the control of insect pests in DPRK and Rwanda.

**AgPortal**

AgPortal is a mobile app and website that facilitates the identification of pests and records observations in the field. The service links seamlessly to the kinds of products that can be used to control the pest. The service aids compliance with market certification standards, by incorporating tools to help identify the appropriate dosage levels and traceability reports that show what pesticide was applied when. The service is designed to increase the professional capability of extension agents that interface with farmers.

**CABI's Compendia**

CABI's Compendia bring together a vast selection of information into one place. The Compendia combine indexed information of all scientific research, detailed datasheets, images and much more. CABI's Compendia on animal health and production, aquaculture, crop protection, forestry and horticulture are available to subscribed users while the Invasive Species Compendium is freely available.

**Biopesticides Portal**

The portal is a mobile app and website that facilitates the identification, sourcing and application of biological control products for particular crop pest problems in a given country. It can be accessed on smartphones, tablets and desktop computers in order to put this information at the fingertips of those who need it.

**E-learning tools**

The PestSmart Diagnostic Simulator serious game was developed to train extension agents in plant health problem diagnosis. The simulator contains realistic 3D models and scenarios that help them develop their diagnostic skills. These scenarios include all major pests and diseases of maize, cassava, tomato and cabbage. The app is available on tablets via the Google Play

store, and data is captured and analysed in a web portal. The results of our testing indicate that the Plant Doctor Simulator is an effective training tool.

**Mobile messaging**

Direct2Farm, an initiative of CABI, makes use of mobile phones (SMS) to help farmers develop their skills and solve farming problems, but also to facilitate linkages and access to trade and services. The goal of Direct2Farm is to help farmers make a better profit from farming operations and to improve their food and livelihood security. This is done by bringing dispersed agricultural extension information under a single digital repository, by enabling farmers to access information on-demand by using their mobile phones, and by fostering linkages between research, agri- business, policy makers and development organizations.

**Social media as a means of communication among extension agents**

Some extension agents working under the Plantwise programme spontaneously started to use social media (e.g. Whatsapp or Facebook groups) to obtain information on plant health diagnosis and management from their peers. Whenever they are unsure about the diagnosis or the management of a plant health problem, they post pictures of the problem (or a description), which are then commented by other group members. Such groups could be encouraged as they can contribute to knowledge transfer among extension agents.

**MAS-ICM**

In collaboration with the University of Neuchâtel, Switzerland, CABI has launched a Masters of Advanced Studies in integrated crop management (MAS-ICM). Scientists, teachers, extension officers and policy makers have the opportunity to come to Switzerland to enrich their knowledge about the importance of ICM, supporting its adoption as a long-term strategy to address global challenges. The course gives students everywhere the opportunity to learn about sound crop management principles and to explore solutions that can be incorporated into practice and policy back home. Scholarship funding is available for high calibre individuals from around the world.

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