



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

### ETHIOPIA

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## Executive Summary

Ethiopia is considered one of the most important biodiversity hotspots of the world. The country faces many environmental challenges, however, including pests and pesticide use, decline in soil fertility and water quality, loss of biodiversity, deforestation and soil erosion. A study was carried out to evaluate the legal framework for pesticide management as well as pest management practices for the major pests of the Green Innovation Centres' focal crops in Ethiopia, which are wheat and faba bean. A desk study and a validation workshop with stakeholders in the major value chains were conducted. This study examined and analysed the legal framework by comparing Ethiopia's regulations and policies against the best practices. It documented the analysis of registered pesticides and hazards linked to their use, non-chemical and chemical pest management practices and pesticide management, as well as knowledge of integrated pest management (IPM). The study also identified areas where further training of farmers and extension agents would be required as well as gaps in the national regulations and policies. From the findings, provisions lacking in the legislation that need to be addressed include risk reduction methods on pesticide use, clear specifications on appropriate protective gear when handling pesticides, and pesticide container disposal methods to be used by farmers and those responsible for disposing. The training manuals on disposal and other risk management methods when handling pesticides need to be updated and simplified for farmers. One hundred and fifty Active Ingredients (AI) are registered in Ethiopia, of which 47 AI were categorized as "danger" of high toxicity and likely to cause a human health hazard. Farmers need to have options of less toxic pesticides and be trained on other IPM options. The training and extension materials need to be revised to include such options with more emphasis on prevention measures, scouting and use of less toxic pesticides only when necessary and based on action thresholds.

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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.

## List of abbreviations

AI	Active ingredient
APHRD	Animal and Plant Health Regulatory
ATA	Ethiopian Agricultural Transformation Agency
ATC	Agricultural Training Centre
ATVET	Agricultural Technical and Vocational Education and Training
CABI	Centre for Agriculture and Bioscience International Centre
CPPTRD	Crop Production and Protection Technology and Regulatory Department
CSA	Central Statistical Agency
DA	Development Agent
EGTE	Ethiopian Grain Trade Enterprise
EPC	Environment Protection Council
FAO	Food and Agriculture Organization of the United Nations
FTC	Farmer Training Centre
GAP	Good Agricultural Practice
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
GIAE	Grüne Innovationszentren in der Agrar-und Ernährungswirtschaft (in English: “Green innovation centres for the agriculture and food sector”)
GIZ	Gesellschaft für Internationale Zusammenarbeit (in English: “Corporation for International Cooperation”)
HHP	Highly hazardous pesticide
ILO	International Labour Organization
IPM	Integrated Pest Management
M&E	Monitoring and evaluation
MoA	Ministry of Agriculture
MOLSA	Ministry of Labour and Social Affairs
MRL	Maximum residue levels
ISO	International Organization for Standardization
NGO	Non-Governmental Organization
ODS	Ozone depleting substance
PAN	Pesticide Action Network
PHI	Pre-harvest interval
PIC	Prior informed consent
POP	Persistent organic pollutant
PPE	Personal protective equipment
QMPTL	Quality Monitoring and Pesticide Testing Laboratory
REI	Re-entry Interval
SNNP	Southern Nations, Nationalities and Peoples
WHO	World Health Organization

## Introduction

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

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

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



## Methodology

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

### Desk study

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

Utilizing a tool developed by CABI, the most up-to-date version of the national list of registered pesticides (and biopesticides, where available) was analysed to identify the full list of AI and products that are registered for use in Ethiopia. For each AI registered, a profile was developed that includes the chemical class, use type, and associated hazards to human health and the environment. The profiles also included information on the crops and pests for which the pesticide was registered. The *Guidelines on Highly Hazardous Pesticides* (FAO, 2016) define highly hazardous pesticides (HHPs) as “pesticides that are acknowledged to present particularly high levels of acute or chronic hazards to health or environment according to internationally accepted classification systems”. These guidelines also list the criteria for determining whether or not an AI is an HHP. HHPs that are registered for use in the country were identified using these criteria. The toxicological profiles and information on target pests was also used to assess the availability of lower toxicity alternatives to the HHPs for specific crop pests. With the support of national partners, the national pesticide act, subsidiary legislation and other policies relating to pests and pesticides management were identified, and an analysis of the existing legal framework for pest and pesticides management was carried out. A cross comparison was made with international guidelines (eg from the FAO and the International Labour Organization (ILO)) and other regulatory best practices (eg the Organisation for Economic Co-operation and Development).

The desk study information was used to compile a preliminary description of the policy setting process in Ethiopia. The status of implementation and the adequacy of enforcement of the regulations were then confirmed and complemented by data gathered through a desk study and stakeholder workshop.



**Participants filling gaps in the desk study at the stakeholder workshop**

## Data collection

A standardized approach was devised by CABI for the in-country data collection in order to enable cross-country comparison. The activities included desk studies and stakeholder workshops. The planning was then discussed and agreed with the national GIAE staff. In country, all organizational aspects were taken over by the national GIAE staff.







## Results and findings

### Overview of agriculture sector performance and contribution to the economy

Agriculture is a source of livelihood for more than 80% of the population and represents more than three quarters of national exports (Table 1).

**Table 1: Contribution of the agricultural sector to the economy**

Selected indicators – agriculture sector generally	2007	2010	2013	Most recent date	Source
Total area of land under agriculture (sq. km)	350,770	356,830	362,590	362,590 (2015)	FAOstat World Bank
Arable land per person (ha)	0.173	0.166	0.159	0.151 (2015)	FAOstat/ World Bank
GDP per capita (current US\$)	243.303	341.310	502.153	706.757 (2016)	World Bank
Agricultural value added (% of GDP)	45.462	44.741	44.897	37.230 (2016)	World Bank
Agricultural value added (annual % growth)	9.448	5.130	7.098	2.325 (2016)	World Bank
Agricultural labour force (% of total labour force)	55.80	68.80	72.70	70.5 (2017)	FAOstat
Rural population (% of total)	83.88	82.68	81.41	80.078 (2016)	World Bank
Value of total agriculture production (Gross Production Index Number) current million US\$	107.87	137.18	152.57	158.09 (2014)	FAOstat

Source: FAOstat and World Bank (2007–2017)

**Table 2: Key crops, both domestic and for export**

Key commodities (general)	Year	Area harvested (Ha)	Yield Kg/Ha	Production (tonnes)	Source
Maize	2007	1,694,522	1969.2	3,336,795	FAOstat
	2010	1,963,180	2539.8	4,986,125	FAOstat
	2013	1,994,813	3254.2	6,491,540	FAOstat
	2014	2,114,876	3421.0	7,234,955	FAOstat
	2015	2,111,518	3733.1	7,882,444	FAOstat
	2016	2,135,572	3674.5	7,847,175	FAOstat
Sorghum	2007	1,464,318	1581.7	2,316,041	FAOstat
	2010	1,897,734	2086.6	3,959,897	FAOstat
	2013	1,677,486	2282.5	3,828,870	FAOstat
	2014	1,834,650	2365.1	4,339,134	FAOstat
	2015	1,854,711	2569.5	4,765,621	FAOstat
	2016	1,881,971	2525.1	4,752,096	FAOstat
Teff	2007	2,565,155	1014	2,992,923	Central Statistical Agency (CSA) data archive
	2010	2,761,190	1262	3,483,482	CSA data archive
	2013	3,016,520	1465	4,418,642	CSA data archive
	2014	3,016,060	1575	4,750,657	CSA data archive
Wheat	2007	1,473,917	1671.1	2,463,064	FAOstat
	2010	1,553,240	1838.5	2,855,682	FAOstat
	2013	1,605,654	2444.6	3,925,174	FAOstat

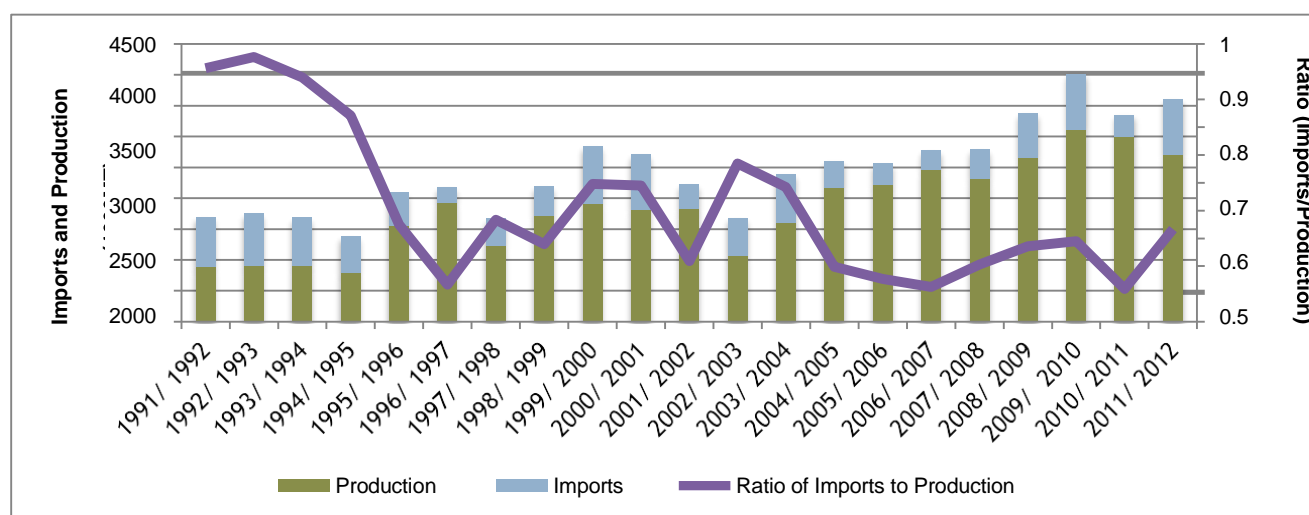
	2014	1,663,845	2543.3	4,231,589	FAOstat
	2015	1,664,565	2794.1	4,650,934	FAOstat
	2016	1,696,083	2675.5	4,537,852	FAOstat
Faba bean	2007	-	-	-	-
	2010	459,183	1520	697,798	CSA data archive

Source: FAOstat and CSA data archives (2007–2016)

### Key crops, both domestic and for export

There are three major types of wheat: bread (*Triticum aestivum*), durum (*Triticum turgidum durum*), and emmer (*Triticum turgidum dicoccoides*). Bread wheat accounts for about half of the area planted, and is generally grown in the highland and semi-highland areas of the Oromia, Tigray and Amhara regions. Durum wheat covers about 40% of the national wheat area. Wheat production in Ethiopia has significantly increased over the past 20 years. All commercial imports come through the state owned Ethiopian Grain Trade Enterprise (EGTE). The EGTE limits imports to ensure that domestic production is consumed first, and the ratio of wheat that is imported to wheat that is produced domestically has declined since the early 1990s (Figure 1).

Figure 1: Wheat imports relative to production



Source: USDAF; AS (PSD Online, 1991–2012)

### Major markets

Ethiopia's faba bean export has moved northward since the year 2000 and the major destinations are Sudan, South Africa, Djibouti, Yemen, Russia and the USA. Wheat in Ethiopia is primarily grown in the Amhara, Oromia, Tigray and Southern Nations, Nationalities and Peoples (SNNP) regions. These regions account for more than 90% of national wheat production. With respect to increasing productivity, the Government of Ethiopia and its international partners have made a number of interventions to support the development of the country's agriculture sector. In an effort to accelerate the country's agricultural development, the government established the Agricultural Transformation Agency (ATA) to address systemic bottlenecks in the agriculture sector by supporting and enhancing the capability of the Ministry of Agriculture and Natural Resources (MoANR) and other public, private and non-governmental implementing partners.

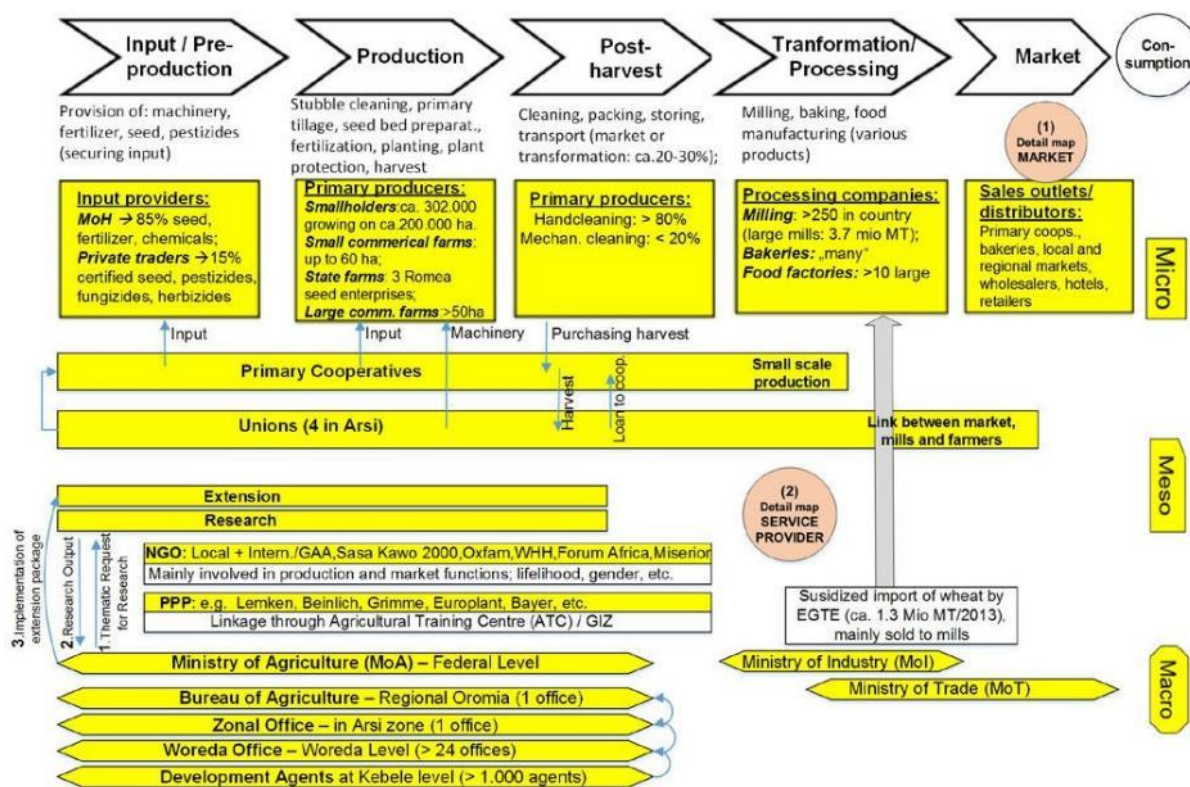
### General information about the in-country focal crop value chain

With a total area of 1,127,127 sq. km, Ethiopia is the second most populated country in Africa, with a population of 94m (2013), and has an annual growth rate of 2.5% (Moller, 2016). Ethiopia has about 51.3m hectares of arable land but only about 20% is currently cultivated, mainly by small scale farmers who own less than 1 ha each. Agriculture accounts for 46.3% of the nation's Gross domestic Product (GDP), 83.9% of exports, and 80% of the labour force. Exports are almost entirely agricultural commodities, and coffee is the largest foreign exchange earner.

Ethiopia has dedicated an annual investment of about 14.7% of all government spending to the agriculture sector since 2003. The Agricultural Development Led Industrialization strategy, the Sustainable Development and Poverty Reduction Plan and the Plan for Accelerated and Sustained development to End Poverty all highlight the importance of cereals and pulses in Ethiopia's overall economic development. Wheat plays a major role in the economy and diet of Ethiopia. The figure below summarizes the different stages of the wheat production value chain in Ethiopia.

Value chains actors include actors such as input suppliers, producers, processors, traders and consumers. The value chain also includes technical support, financial services, communication and information sharing. Value chain actors and service providers interact in different ways, from the local to national and international levels.

Figure 2: Basic wheat value chain map in Arsi zone, Ethiopia



Source: GIZ (2014)

In Ethiopia, wheat seed distribution is done by public, private and seed based cooperative unions and seed producer cooperatives. The private sector plays a smaller role (15%) in seed distribution and production but it is developing to a better level mainly for hybrid crops. Ethiopia has a strong seed research system, although there is low usage of improved seed varieties. Extension support services have increased the use of inputs, especially fertilizer application and use of improved seed varieties.

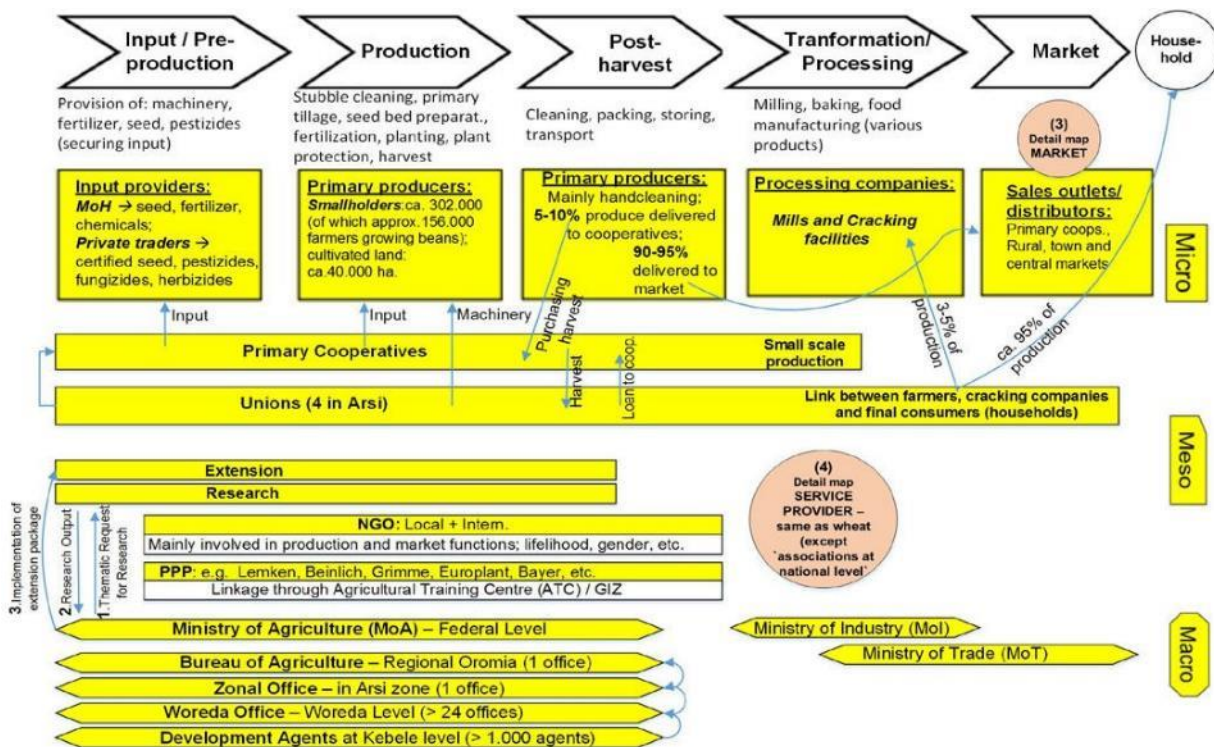
The primary producers of wheat in Ethiopia are smallholder farmers, which account for 89% of the market share. There are more than 4 million smallholder farmers. There are also state owned farms and small and large commercial grain farms.

The government is investing in transport infrastructure and has earmarked over \$4bn to build, upgrade and repair roads in the next 10 years under the Road Sector Development Program (Mengesha, 2017). The traders collect grains from the farmers in rural areas and transport the grains from inaccessible areas. They transport over 70,000 metric tons of wheat annually and sell directly to consumers and wholesalers. Sixty percent of the grain is held by the Ethiopian Food Security Administration for use during emergencies.



There are about 250 flourmills in Ethiopia, with a total production capacity of 3.7m tons of flour annually. The milling factories are predominantly based in Addis Ababa and procure domestically from the local market. Most of the imported wheat is milled in private sector mills. The sale outlets and distributors of wheat in Ethiopia include 51% sold to wholesalers, 43% to retailers and 6% goes directly to consumers. Most farmers sell wheat within their districts.

Figure 3: Basic faba bean value chain map in Arsi zone, Ethiopia



Source: GIZ (2014)

**Wheat:** Approximately 70–80% of the wheat is consumed at farm level and 20–30% of the harvested grains is sold to other farmers, intermediate traders, mills and the food processing industry. Farmer cooperatives are key in linking farmers to markets

**Faba bean:** Collectors buy from farmers, who then sell to retailers located in urban areas; retailers sell to wholesalers, who deliver the produce to processors. Brokers link different actors.

**Table 3: Pesticides imports into Ethiopia between 2000 and 2012 (metric tons)**

Year	Insecticides	Herbicides	Fungicides	Others	Total
2000	160.7	805.9	46.8	2.5	1,015.9
2001	462.6	760.7	36.0	177.5	1,436.8
2002	706.0	1,136.0	71.0	171.0	2,084.0
2003	359.0	868.5	77.0	323.0	1,627.5
2004	407.0	915.7	114.0	322.8	1,759.5
2005	455.6	1,197.6	146.6	423.8	2,223.7
2006	569.3	1,821.1	135.7	801.6	3,327.7
2007	595.7	1,687.9	153.7	594.4	3,031.7
2008	453.1	1,634.9	141.7	212.7	2,442.4
2009	376.8	3,105.8	223.1	12.6	3,718.3
2010	651.9	3,146.8	387.3	25.4	4,211.4
2011	431.0	973.0	337.0	-	1,741.0
2012	2,012.0	1,992.0	355.0	52.0	3,611.0
<b>Total</b>	<b>6,840.6</b>	<b>20,046.0</b>	<b>2,224.3</b>	<b>3,120.0</b>	<b>32,230.9</b>
<b>Share in %</b>	<b>21.2%</b>	<b>62.2%</b>	<b>6.9%</b>	<b>9.7%</b>	<b>100%</b>

Source: Animal and Plant Health Regulatory (APHRD), Ministry of Agriculture, 2013

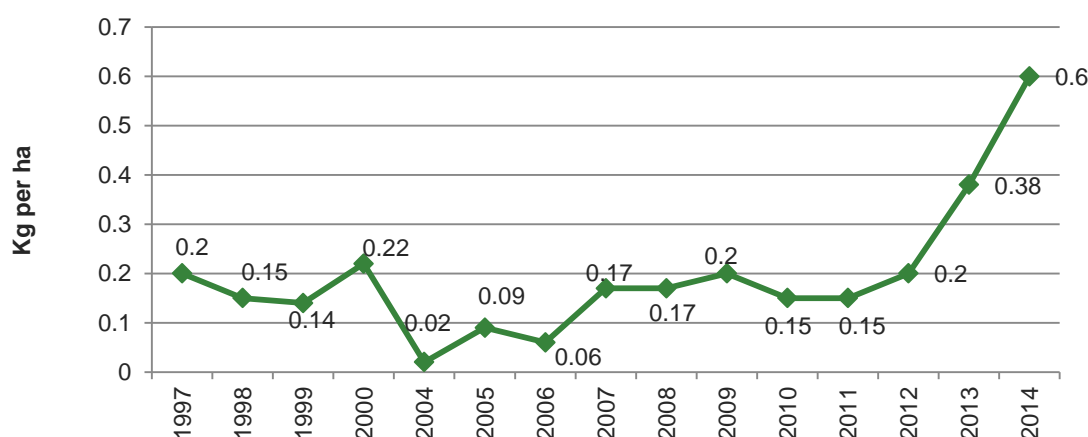
**Table 4: Pesticide production for agriculture and public health by Adami Tulu Pesticide Processing Share Company during 2000 to 2012 (metric tons)**

Year	Insecticides for		Acaricides	Fungicide	Total (metric tons)
	Agriculture	Public health			
2000	106.46	-	2.50	-	108.96
2001	293.75	93.65	3.03	-	390.43
2002	319.71	60.34	2.00	-	382.05
2003	545.50	157.78	7.42	-	710.70
2004	397.17	475.25	12.42	-	884.84
2005	327.54	565.41	70.31	-	963.26
2006	792.07	764.46	22.42	-	1,578.95
2007	767.92	616.47	50.59	-	1,434.98
2008	560.93	785.23	34.79	1.84	1,382.79
2009	773.18	1,561.58	28.52	0.07	2,363.35
2010	1,110.50	1,959.84	65.28	21.50	3,157.12
2011	1,093.02	862.18	67.70	36.57	2,059.47
2012	1,209.51	956.07	71.71	8.44	2,245.73
<b>Sub-total</b>	<b>8,297.31</b>	<b>8,858.30</b>	<b>438.68</b>	<b>68.43</b>	<b>17,662.63</b>
<b>Total</b>	<b>17,662.63</b>		<b>438.68</b>	<b>68.43</b>	<b>17,662.63</b>

Source: Adami Tulu Pesticide Processing Share Company, 2013

During recent decades, Ethiopia has experienced an approximate four-fold increase in pesticide use (see Figure 4).

**Figure 4: Pesticide usage in Ethiopia**



**Table 5: Sources of agricultural inputs, including synthetic pesticides and bio- pesticides**

Inputs	Company	Activity type
Pesticides (insecticides, herbicides, etc.)	Croplife Ethiopia; various private companies and public institutions	Pesticide management through training and disposal of obsolete pesticides and empty pesticide containers
Seed	Ethiopian Seed Association (ESA) Kirkos Sub City, Woreda 2, Meskal Flower Street, H.No. 400	Operates a central seed testing laboratory and has six smaller seed laboratories. The company also operates six seed production sites in different regions of the country, with a total area of 6,543 ha of land under rainfed conditions
Inoculum	Menagesha Biotechnology and the state owned National Laboratory	Distributors of inoculum; biofertilizer
Agro-inputs (general)	Agricultural Inputs Supply Enterprise and other cooperative unions and federations	Supply of general inputs
Fertilizers	Ethiopia Agri-business Corporation	

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

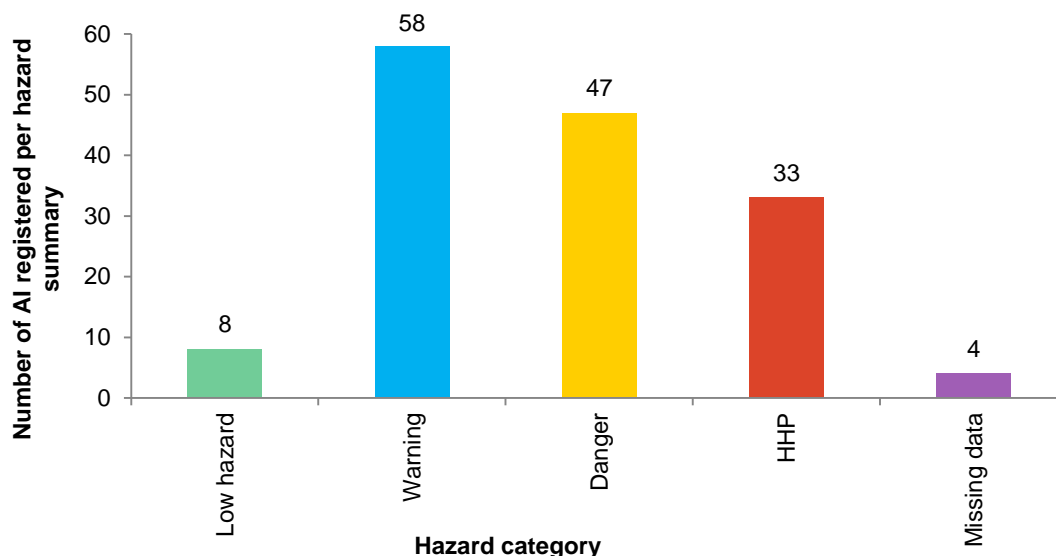
### Analysis of registered pesticide list for HHPs and alternatives

The list of registered pesticides released by the Ethiopia Pesticides Control Board (December 2017) contains 150 AI registered products.

The 150 AI registered in Ethiopia differed in terms of their overall hazard level (see Figure 5): 33 of the AI that are allowed for use met one or more of the HHP criteria; 47 AI were categorized as a “danger” (i.e. one or more of the associated human health hazard statements indicated that the AI is “toxic” or “fatal if inhaled”); 58 AI were categorized as “Warning” (i.e. moderately toxic if eaten, absorbed; through the skin, inhaled, or it causes moderate eye or skin irritation) eight AI were categorized as “Low hazard” (i.e. there were no known human health hazard statements associated with the AI); and key human health hazard data was missing for four AI. The AI that were identified to be HHPs are listed in Appendix Table 3.

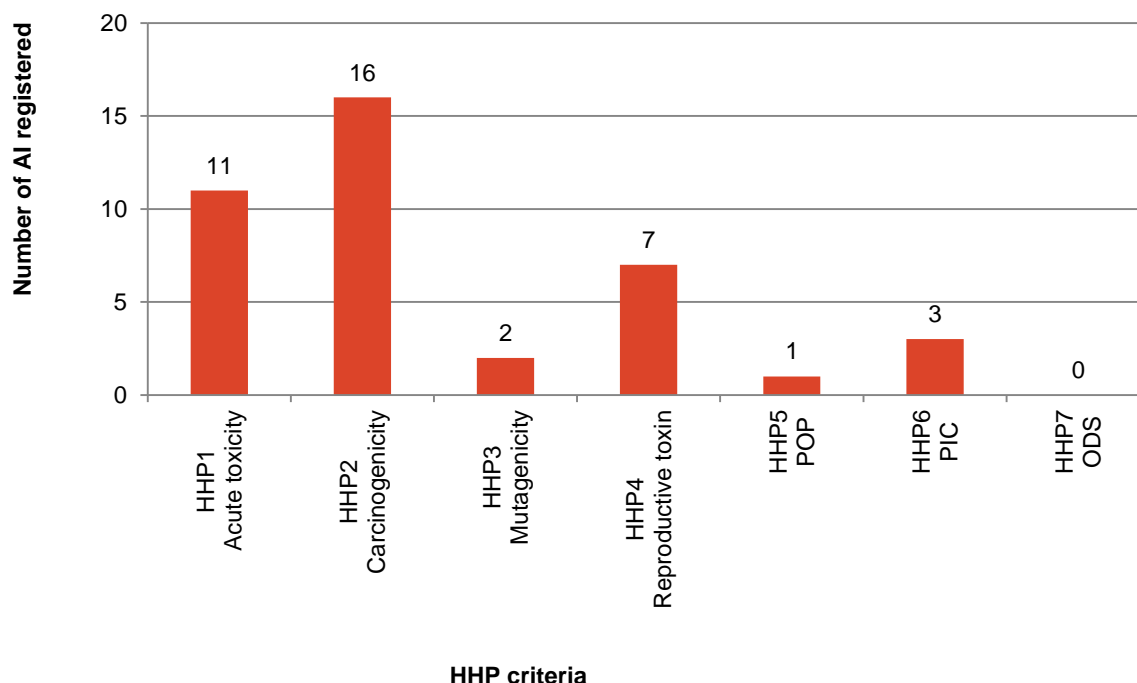


Figure 5: Number of AI in each hazard category



Of the HHPs identified, 48% were carcinogens, 33% were either extremely or highly acutely toxic, 21% were reproductive toxins and 6% were mutagens (see Figure 6). Alachlor, Carbofuran and Endosulfan all require prior informed consent under the Rotterdam Convention, while Endosulfan is also a Persistent Organic Pollutant (POP) listed in the Stockholm Convention. For several AI, more than one of the HHP criteria was met: Benomyl, Carbendazim, Diclofop-methyl, Endosulfan, Epoxiconazole and Ethoprop.

Figure 6: Number of HHP AI allowed for use per HHP criteria



In addition to the information on the HHP criteria, the compiled Globally Harmonized System of Classification and Labelling of Chemicals (GHS) hazard statements identified other human health and environmental hazards. Irritation to the skin, eyes or respiratory tract were frequently listed as potential health effects (54 AI). Other human health effects that were identified included endocrine disruption (19 AI), allergic reactions (51 AI), the potential for serious eye damage (47 AI) and the potential for organ damage (both specific and general: 52 AI). The human health hazard statements covering health effects were included in the determination of hazard category. With

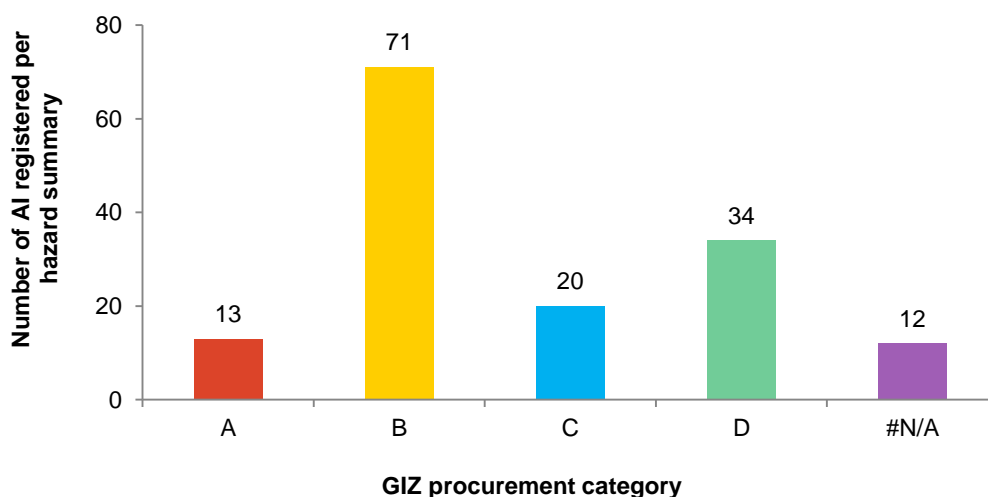
respect to environmental hazards, 112 AI were found to be very toxic to aquatic organisms, often with the potential for long lasting effects. Data on pollinator hazards was available for 51 AI, and, of those that were assessed, 11 AI were found to be very toxic or very highly toxic to bees.

None of the AI are listed as candidate POP. Twenty-seven of the identified AI are currently listed in the Rotterdam database of notifications of final regulatory action. Sixty-nine of the AI are included in the Pesticide Action Network (PAN) HHP list (2016). On an AI basis, almost 64% of the AI are allowed for use in the EU (Approved = 95 AI) or pending approval for use in the EU (pending = 1 AI), whereas the other 36% are not allowed for use in the EU (Not approved = 42 AI) or otherwise not listed (12 AI). Annex 5 gives information on specific AI.

Five of the identified AI are allowed for use in organic agriculture in that they are listed in Annex II of Commission Regulation (EC) 889/2008. Thirty-one of the AI are classified as U (unlikely to cause acute hazard under conditions of normal use) in the *WHO Recommended Classification of Pesticides by Hazard* (2009). Several (32) of the AI identified through this study are not listed in the 2009 classification.

Our analysis shows that, per the GIZ procurement policy (GIZ, pers. comm., 2017), 13 AI fall into procurement category A (not allowed), 71 AI fall into procurement category B (only as exception, elaborate verification needed), 20 AI fall into procurement category C (only by authorized staff with strict protection; not for small farmers) and 34 AI fall into procurement category D (appropriate precaution). Twelve of the AI have not been classified by GIZ.

**Figure 7: Number of AI by GIZ procurement category**



The current study identified 23 non-HHP AI that are also registered to manage the pests for which HHPs are currently registered, used by farmers or recommended by extension agents. For eight of the 11 key pests of wheat, at least one non-HHP AI was identified. However, a few products are registered for use on faba beans and non-HHP AI were identified for only two of eight key pests. The full list of pests and the lower toxicity alternative pesticides that are registered to manage them is given in Appendix Table 11.

## Analysis of existing legal framework for pest and pesticide management

Details of the findings are below, with a summary in Appendix 3

- a) Title and objectives: The document may be cited as the “Pesticide Registration and Control Proclamation No.674/2010”. The Proclamation is in force but undergoing revision. The objectives of the legislation are not fully outlined as in the FAO Code of Conduct.
- b) Definitions: The legislation gives definitions of the key words used in the document in line with the FAO Code of Conduct Article 2 but Article 3 (sections 1 to 17) of the FAO code of conduct is not adequately covered (e.g. government’s role in allocation of adequate

resources, keeping track of the uses of the pesticides, promotion of research by governments on other management options (3.10), and proper maintenance and use of spraying equipment).

### **Regulations on pesticide use in Ethiopia**

Pesticide proclamation No.674/2010, called the Pesticide Registration and Control Proclamation, was enacted in August 2010 by the Ethiopian government and mandated the Plant Health Regulatory Directorate of the MoA to: (i) regulate pesticide management, relating to importation, distribution, transportation, storage, retailing and use; (ii) adopt regulations; (iii) promote the correct use of pesticides and search for alternatives to chemical pesticides; (iv) raise awareness and provide technical support when the need arises during project implementation time; (v) participate in monitoring and evaluation (M&E) of stakeholders; and (vi) evaluate the competence of companies that are engaged in imports. The Pesticide Act states that “No person shall import, manufacture or sell a pesticide, which has not been registered under this Act”.

Policies to promote reductions in unnecessary pesticide use include policies such as IPM, Good Agricultural Practice (GAP), organic production and sustainable agriculture. Under its environmental policy, Ethiopia “Promotes integrated management and control of pests and diseases and environmentally sustainable agricultural development by ensuring sustainable crop and livestock production using Organic farming (Organic Agriculture System Proclamation No. 488/2006). In a baseline funded by the Swedish Society of Nature Conservation, 137,822 ha of land and 110,861 farmers were found to be under organic certification in Oromia, SNNP, Amhara and Tigray regions, mainly for coffee (80%), sesame and honey. The organic standards used are in line with EU regulation 2092/9 and also the US National Organic Program or the Organic Standards in the Japan Agricultural Standards (Ethiopia Organic Forum, 2009)

There are supporting national policies, strategies, regulations and directives on pest management that have been considered in different regulations and decrees. For example, the National Agricultural research Policy and Strategy in October For example, the National Agricultural Research Policy and Strategy issued in October 1994 states that the plant protection research to be conducted in the country should aim to achieve a sustainable increase in agriculture; The Environment Policy of Ethiopia (April 1997) promotes environmentally sustainable agricultural development by ensuring sustainable crop and livestock production through ecologically appropriate production and management systems, as well as an appropriate legal and institutional framework for sustainable environmental management; Environmental Impact Assessment Proclamation 299/2002 provides measures and procedures for environmental impact assessments and Occupational Safety Health and Welfare Act 1997 that regulates conditions of employment in workplaces with regard to the safety, health and welfare of employees.

### **Adherence to and implementation of international agreements relating to pesticides**

The country has been a party to the Montreal Protocol since July 2002 (proclamation No.278/2002) and a party to the Rotterdam Convention signed in September 1998. The country is a party to the Stockholm Convention signed on May 2001, and enacted provision relating to the implementation of the Stockholm Convention on 22 May 2002 (proclamation No.279/2002). The country is a party to the Basel Convention March 1989 and enacted provision in April 2000 (proclamation No.278/2002, Ratified. No.356/2002). The country is a party to the ILO Safety and Health in Agriculture Convention (C184) and has been a member since 28 September 1923.

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

A policy is in place to develop and promote the use of IPM. A policy is also in place to promote the adoption of GAP, organic production and/or sustainable agriculture standards (Ethiopian Organic Agriculture System Proclamation No. 488/2006). The Ethiopian Organic Association was established in 2007. There is no policy in place to facilitate access to information on matters including pesticide hazards and risks, residues in food, IPM/Integrated Vector Management (IVM), alternatives to HHPs, and related regulatory and policy actions.



The country's policies to achieve the sustainable use of pesticides include quantitative objectives, targets, measures, timetables or indicators to reduce risks and impacts in parallel with the requirements of EU Directive 2009/128/EC (National Action Plan for the Sustainable Use of Plant Protection Products/Biocides (NAPS)).

### **Research**

A policy is in place to encourage and promote research on alternatives to existing pesticides that pose fewer risks, such as non-chemical preventive and direct control measures.

### **Regulations related to the manufacture of pesticides and requirements for sale**

A regulation addressing the manufacture and packaging of pesticides exists, which states that no person shall make any import order of any pesticide without obtaining an import permit issued by the Ministry (Part 2, Article 14 .1) and no pesticide shall be registered unless the efficacy, safety and quality is tested under field or laboratory conditions and approved by the Ministry. No person may formulate, manufacture, import, pack, repack, label, sell, distribute, store or use a pesticide not registered by the Ministry or contrary to the conditions of its registration (Part 2, Article 3.1). It also ensures that packaging or repackaging is carried out only on licensed premises that comply with safety by issuing certificates of competence to only those that are competent in the manufacturing and formulation of pesticides and the import and export of pesticides. Furthermore, pesticide application services involving fumigation by Ministry of Agriculture and business licences required by holders of certificates of competence are issued under Article 15(2) by regional state organs in the Ministry of Trade and Industry in accordance with the relevant laws. The legislation does not define the proper siting of plants and stores, monitoring and control of waste, emissions and effluents and quality assurance procedures and appropriate engineering standards as well as operating practices.

### **Legal framework for non-chemical preventive and direct control measures**

There is no legal framework for non-chemical preventive and direct control measures and no subsidy scheme for non-chemical preventative and curative control methods is in place.

### **Price and trade policy, including subsidies**

There are no subsidies by government in the legislation for purchase of pesticides, application and protective clothing. Distribution is a market-driven supply process; there is no government purchasing.

### **Registration (synthetic pesticides and biopesticides)**

The legislation establishes a mandatory registration system for pesticides, tailored to national needs. The registration process involves the risk-based evaluation of comprehensive scientific data demonstrating that the product is effective for its intended purposes and does not pose an unacceptable risk to human or animal health or the environment. There is a mechanism in place for regional coordination / harmonization for the registration of pesticides.

The legislation identifies the different bodies and persons responsible for regulations, registration and implementation of regulations in Part 7, Sections 13 to 30. The Council of Ministers is responsible for issuing the regulations necessary for the implementation of this Proclamation. The members of the Pesticide Advisory Board include representatives from the Environmental Protection Authority, the Quality and Standards Authority, the Ethiopian Institute for Agricultural Research, the Institute of Biodiversity, the Ministry of Labour and Social Affairs (MOLSA), and the Authority of Revenue and Customs.

The functions of the board, operations of the board, pesticide inspectors, and record keeping procedures for reporting accidents are clearly outlined. The legislation gives inspectors responsibility to report to the appropriate body evidence gathered in the course of carrying out inspections that enables the prosecution of persons violating the provisions of the Proclamation. The legislation requires pesticide dealers to keep records of all quantities of pesticides imported, exported, manufactured, packed, repacked, stored, labelled, transported, distributed or sold.

In section 2 articles 3 to 14 on registration of pesticides, the legislation indicates how the registration body will make its registration decisions, lists the types of final decisions the registration body can take, how the decision must be communicated to the applicant, within a certain time period, and how it must include a justification based on the decision criteria. The legislation clearly defines the activities and types of pesticides requiring registration and states that new pesticides can only be registered if they are to replace more toxic pesticide products used for the same purpose

The validity period for registration is covered in Section 21 of the Pesticides Act: “The registration of a pesticide shall be valid for a period of five years, and renewal of the registration for a further period of five years if the Pesticide Advisory Board continues to be satisfied”. It, however, does not have different conditions for the registration of less toxic products. The legislation provides for distinct registration pathways for biopesticides or biological control agents and chemical pesticides. The Pesticide Advisory Board is also involved in the identification of HHPs and other hazards associated with pesticides that are registered in the country.

### **Availability**

The legislation does not contain provisions to regulate the availability and use of pesticides in accordance with the hazards involved and the existing levels of user training. It does not take into account the type of formulation, method of application and its uses when determining the risk and degree of restriction appropriate to the product. It does not contain restrictions specifically targeting products used on seed/planting material or products used for post-harvest applications.

### **Handling and use, including regulations on application equipment**

The responsibilities of pesticide operators (farmers and farmer workers) are identified in national regulations. The legislation contains provisions to prohibit the use of pesticides for a purpose, or in a manner, other than that prescribed. The legislation contains provision for employers to take the necessary measures to protect the health of workers and the environment. Part Five, Section 22 of the legislation states the following on occupational safety: “No person shall use or require an employee to use or recommend that another person use a pesticide in any manner other than that prescribed by this Proclamation or contrary to any condition attached to the registration of the pesticide. Any employer who requires or permits an employee to use or handle pesticides shall provide facilities and protective clothing required for safe handling of the pesticide and require the employee to use the same. Any employer who requires or permits an employee to work with pesticides shall provide the employee with: such instructions as are necessary to enable him to achieve the required standard of competence; such periodic medical check-ups as may be prescribed by the Ministry of Agriculture or the Ministry of Health; and such expenses of medical and compensation for damages sustained by the worker due to the absence of sufficient direction and appropriate protective equipment on the part of the employer”. The legislation does not contain provisions to promote the use of pesticide application methods and/or equipment that minimize risk.

The legislation does not contain provisions to permit pesticide application equipment and personal protective equipment (PPE) to be marketed only if they comply with established standards. It also does not prescribe the use of proper application equipment or appropriate calibration of the spraying equipment for the pesticides to be applied, or prescriptions of the responsible cleaning of application equipment (eg rinsing the content of the tank with fresh water and applying the remaining liquid to the treated field).

### **Requirement for training**

There is no policy in place on the training and production and dissemination of relevant and clear educational materials on pesticide use, or content required for mandatory training. The legislation does not include provision for pest control operators to hold a licence or permit and does not specify application methods to be used for different pesticide products.

## **Restrictions related to vulnerable groups**

The legislation contains provisions to prevent the use of pesticides by and sale of pesticides to children. The legislation requires employers take the necessary measures to prevent use by children and other vulnerable people (Part Five, article 22). Occupational safety, health, and workplace regulations are available in two proclamations. The Food, Medicine and Health Care Administration and Control Proclamation No. 661/2009 (article 23/1) states that any employer shall ensure the availability of occupational health services to his/her employees. In Article 23 sub-article 2 of the same proclamation, it is stated that the executive organ shall issue appropriate directives on occupational health and use of machinery. Labour Proclamation No. 377/2003, under Sub-Articles 1–8 of Article 92, describes the provisions for occupational safety, health, and working conditions.

## **Requirements for PPE**

The legislation includes a requirement for all to use protective clothing. The following are, however, missing from the legislation: assessments on operator risk at the time of registration to determine the PPE performance; application of international standards (e.g. ISO 27065) or national standards for the classification of PPE by performance requirements (level of chemical resistance or some other measure to differentiate the level of protection provided by PPE); a requirement that only PPE that have met national standards may be marketed; and label requirements to list the elements of PPE (e.g. gloves, protective footwear, face protection, apron, etc.) and their performance requirements.

## **Storage**

Under miscellaneous provisions, Part 8 Article 32 states that any pesticide dealer shall keep records of all quantities of pesticides imported, exported, manufactured, packed, repacked, stored, labelled, transported, distributed or sold and any other information that may be prescribed by directives of the Ministry, and submit the same to the Ministry or the concerned appropriate organ when so requested. There is no other provision for storage. Indeed, a number of provisions are lacking. It does not differentiate between private, end-user or home storage and bulk or commercial storage, type of storage structures or facilities, containers required, specifications on how and where pesticide products may be stored (e.g. by referring to label storage requirements), or storage requirements for different formulations, and does not specify the suitable conditions of storage facilities such as ventilation, temperature, lighting and measures in case of spillage.

However, under the section on packaging and labelling there is a provision on containers for safe storage that states that no person shall pack or repack any pesticide unless it is in a container which is safe for storage, handling and use and that prominently displays a legible label in Amharic and in English, which has been approved and cannot easily be detached.

## **Disposal of unused pesticides**

A policy is in place to prevent the accumulation of obsolete pesticides and used containers. Part 4, Section 21 of the legislation states: “No person shall dispose of any pesticide or pesticide waste in a manner that may harm human or animal health or the environment. Any person who imports pesticides or sells pesticides shall be responsible for the disposal of any obsolete pesticide in his custody at his own expense. The Ministry shall issue directives on pesticide disposal in consultation with the appropriate organs and shall monitor and control its implementation”. The legislation does not state how they will be disposed of or the prohibited methods of disposal such as burying in unapproved sites and burning in unapproved incinerators. The legislation does not state affirmative actions on failure by industry to assist in proper disposal and ways to ensure proper disposal, such as seeking authorization from the competent authority. There is no provision in the legislation for a toxic waste collection scheme and facilities for the management of bulk quantities of toxic pesticides.

## **Disposal of empty pesticide containers**

There is no provision in the legislation that addresses the disposal of pesticide containers and the use of PPE when disposing of, rinsing and rendering the container unusable by puncturing, crushing, etc. The regulation does not contain specifications for the storage. Moreover, there are



no specifications on recommended safe disposal and prohibited methods of disposal and how to transport the containers for final disposal.

### **Post-registration monitoring**

Section 28 of Part 7 of the legislation states the functions of the Pesticide Advisory Board as carrying out or authorizing periodic review of pesticides in use. It assigns responsibility for mandatory monitoring and data collection with respect to pesticides to pesticide inspectors.

There is a policy in place to collect reliable data and maintain statistics on the health effects of pesticides and pesticide poisoning incidents / on environmental contamination and adverse effects, including monitoring pesticide residues in feed, drinking water and/or the environment. Under Section 30 of Part 7, the roles of the inspectors are clearly outlined to include the following: carry out periodic inspections of establishments that import, export, manufacture, pack, repack, label, store, sell, distribute, advertise or use pesticides to determine whether the provisions of this Proclamation and the regulations and directives issued pursuant to the Proclamation are being complied with; carry out post-registration surveillance to ensure that conditions of registration are complied with; and inspect certificates, permits, licences, trade licences, records or other documents relevant for compliance.

There is a provision in the legislation on reporting accidents. Part 5, Section 23 of the legislation states: "Any person who becomes aware of an accident occurring in the vicinity where pesticides are transported, stored, sold or used shall, without delay, report to the Ministry or the appropriate regional state organ. Any physician or other medical personnel who learn of a person being poisoned by a pesticide shall report to the Ministry without delay. The Ministry and the Ministry of Health as well as the appropriate regional state organs shall exchange information regarding any accidents reported"

### **Residue monitoring in food and maximum residue levels (MRLs)**

The legislation contains provisions to regulate and/or monitor pesticide residues in food. Part 6, sections 24 to 26 of the legislation state that the Ministry of Agriculture may designate any public or private laboratory fulfilling the necessary requirements as an official laboratory for conducting tests under the Proclamation. An official analyst shall, after conducting a pesticide analysis, issue a certificate of analysis stating the method used and other information that may be prescribed by directives of the Ministry. The Ministry shall carry out pesticide residue analysis for primary agricultural products. The Ministry shall collaborate with relevant authorities in establishing the maximum residue limits for agricultural products. Pesticide residue analysis and monitoring of processed agricultural products and human beings shall be conducted by the concerned appropriate organs. Effectiveness tests and supervision of pesticide treated nets shall be conducted by the Ministry of Health.

The legislation does not define which authority is in charge of the monitoring and of setting the MRLs. It does not state the MRLs set by the *Codex Alimentarius* and whether they are the same for national consumption as well as for imports / exports and does not specify the relevant crops.

### **Other relevant human health and environmental protection regulations**

A policy is in place to carry out health surveillance programmes of those who are occupationally exposed to pesticides. Article 15 of the Proclamation calls for each of the 11 regional states in Ethiopia to establish an independent regional environmental agency, or designate an existing agency to lead environmental management. The proclamation also stipulates that all government ministries or agencies establish an environmental unit to ensure that their activities comply with the environmental standards and laws of the country.

A policy is in place to raise awareness among users about the importance and ways of protecting health and the environment. Under Proclamation No. 4/1995, MOLSA is given the power to determine the standards and measures for the safety and health of workers and to follow up on their implementation. In addition, MOLSA is responsible for collecting, compiling and disseminating information on the safety and health of workers. There is, however, no national policy that outlines

how occupational safety and health should be handled nationally or at lower governing levels as required by the International Occupation Safety and Health and Working Environment Convention No. 155/1981. There is no provision in the legislation providing guidance and instructions to health workers on the diagnosis and treatment of suspected pesticide poisoning.

### **Compliance and enforcement**

Under Part 8, Section 31 (Miscellaneous provisions), the legislation states that no person shall import, store, transport or offer for sale any pesticide unless it is packed and labelled according to the legislation, no person shall formulate, manufacture, import, export, pack, repack, label, sell, distribute, store, or use a banned pesticide under any circumstances, and no person shall formulate, manufacture, import, export, pack, repack, label, sell, distribute, store, or use a severely restricted pesticide without written authorization from the Ministry. The legislation also states the penalties for those who do not comply (e.g. people selling an unregistered pesticide, an obsolete pesticide, or pesticides in containers that do not comply with prescribed standards).

The legislation contains provisions to prohibit the import, packaging, repackaging, transportation, distribution or sale of a pesticide unless it is packaged in accordance with criteria provided in the law. It also prohibits providing false information on documents. The legislation contains provisions to detect and control counterfeiting and illegal trade in pesticides.

The legislation contains provisions to facilitate the exchange of information (e.g. actions taken to ban or severely restrict a pesticide; scientific, technical, economic, regulatory and legal information; the availability of resources and expertise; cases of counterfeit and illegal pesticides being traded; and data on poisoning and environmental contamination) between regulatory and implementing authorities. The legislation designates the national authority responsible for inspection as the Ministry of Agriculture, clearly defines the powers of the inspectors, and provides procedures and criteria for inspections. The legislation does not provide procedures and requirements for sample taking, the designation of official laboratories for analysis of samples, or clear and effective procedures for intervention if irregularities are found during inspections. The legislation defines the actions that will be considered as offences and determines which offences will be criminal. Part 8, Section 33 defines the fine.

### **Analysis of GAP and other voluntary standards applied to focal crops**

The extension materials (flip-over and manuals for farmers and extension agents) developed by GIAE Ethiopia on faba bean and wheat, in collaboration with Hohenheim University of Germany, include most aspects of “Crop Rotation Based Good Agricultural Practices (GAP) for Wheat and faba Bean Production in Arsi Zone”. Appendix Table 12 of these materials includes the training topics for the two focus crops of faba bean and wheat and provides the contents of the recommended best production practices. The voluntary standards specify most recommended agronomic practices such as proper site selection, use of certified seed, timely planting, and fertilizer rates. There is a need to update the training and extension materials to include more sustainable preventive methods, particularly the cultural techniques, surveillance, monitoring and early detection (some examples are included in Appendix 6 of the current document).

### **State of science on crop protection**

A literature review and analysis of existing studies on field/post-harvest crop protection in focal crops in the study country can be found in Appendix 6 of the current document.

### **Advisory service characteristics and the advice they provide**

Deployment of extension approaches in Ethiopia started through the Land Grant College at Haramaya (then known as Alemaya College of Agriculture and Mechanical Arts), agricultural technical schools (Ambo and Jimma), development projects such as Arsi Rural Development Unit, Wolaita Agricultural Development Unit and Chilalo Agricultural Development Union.

There are currently regular extension activities under the Ministry of Agriculture and Livestock. The main alternative extension service delivery mechanisms in Ethiopia include:

- a. Public or private, government or non-government
- b. Profit, non-profit or cost-recovery based
- c. General, commodity based or Multipurpose or single purpose
- d. Technology driven or need oriented

The Government of Ethiopia established and operationalized 25 Agricultural Technical and Vocational Education and Training colleges (ATVETs) in different parts of the country to produce skilled development agents (DAs), as well as farmer training centres (FTCs) in each Kebele. There are over 83,000 trained DAs working in agricultural extension (MoA, 2017; CSA, 2017). The Ministry of Agriculture extension service supports implementation of voluntary standards/ certification schemes of target crops and organic farming (see the Ethiopian Association of Organic Agriculture (EAOA) website).

Under the GIZ project, a total of 352 DAs (15% female) were trained in rust identification, seed technology and crop management. Eight rust resistant varieties were demonstrated on 430 model farms in 16 districts in Oromia, Amhara and SNNP. Awareness was created through field days organized by the Kulumsa and Sinana research centres in Arsi and Bale, respectively. Technical and financial support was given to four federal (Kulumsa, Werer, Debre Zeit and Holetta) and three regional (Mekele, Sinana and Adet) research centres for early generation seed multiplication.

Some strengths and weaknesses of extension services in Ethiopia are outlined in the following table (ATA, 2015).

**Table 6: Strengths and weaknesses of extension services in Ethiopia**

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• There is a presence of decentralized and well-structured extension</li> <li>• Establishment of ATVET colleges to produce middle level skilled manpower,</li> <li>• Robust workforce of DAs (21 per 10,000 farmers, which is higher than any other country's ratio)</li> <li>• Establishment of FTCs at kebele level, allowing for greater access to extension, training and demonstration</li> <li>• Increased number of agricultural universities for skilled manpower development</li> <li>• Codified national extension approach</li> <li>• Strong social networks through farmer-group formation and peer-to-peer learning,</li> <li>• Increased demands by farmers for improved technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Limited consistency and quality of extension implementation</li> <li>• Weak coordination and linkages among actors in the research and extension system</li> <li>• Limited logistics and facilities for frontline extension workers</li> <li>• Short term focused campaigns divert attention from overall and long term extension system responsibilities</li> <li>• Focus on model farmers</li> <li>• Poor extension services for pastoral communities and urban and peri-urban areas</li> <li>• Poor functioning of FTCs to provide demand based extension services</li> <li>• Low motivation leading to high turnover of extension staff, particularly DAs</li> <li>• Limited use of communication media and use of ICTs</li> <li>• Limited technology multiplication centres such as for livestock</li> <li>• Minimum involvement of the private sector (limited capacity and inadequate support by government), including cooperatives in extension service delivery</li> <li>• Limited capacity in gender, nutrition, climate and environment mainstreaming and their application</li> <li>• Lack of clear line of command for the extension management, particularly at Woreda and Kebele levels</li> <li>• Limited communication and coordination between federal and regional bureaus of agriculture</li> <li>• Weak planning, monitoring, learning and evaluation and feedback systems</li> </ul>



There are certain bottlenecks, difficulties and challenges in plant protection and other constraints on production and these include:

- Lack of varieties suitable for different Agro-ecological zones and cropping systems (relay, double, intercropping, irrigation, etc.);
- Lack of resistant varieties for major diseases (Chocolate spot, viruses and wilt/root rots, ascochyta blight) and insect pests (aphids, pod borer, cutworm and bruchids); and
- Lack of varieties that combine high yield with market traits and pest resistance.
- Pesticide sources and availability, particularly low toxicity products and alternatives to synthetics pesticides.
- Limited training and sources of information (e.g Technical hand book for wheat and faba bean by GIAE).

### Wheat and faba bean value chains

The innovations and key constraints of the wheat and faba bean value chains are set out in Table 7 (ATA, 2014; 2015).

**Table 7: Key constraints along the wheat and faba bean value chains**

Key constraints			
Input	Production	Processing	Market
<ul style="list-style-type: none"> <li>- Access to finance for certified seed</li> <li>- Access to and finance of fertilizer</li> <li>- Plant protection</li> <li>- Insufficient agricultural finance</li> <li>- Knowhow and suitable advisory services</li> </ul>	<ul style="list-style-type: none"> <li>- Pests and diseases</li> <li>- Poor agricultural practices</li> <li>- Farmer organizations</li> <li>- Waterlogging</li> <li>- High labour costs</li> <li>- High post-harvest losses</li> </ul>	<ul style="list-style-type: none"> <li>- Transport and storage logistics</li> <li>- Finance</li> <li>- Quality and standards issues</li> <li>- Regulatory framework</li> <li>- Consistent availability of raw material</li> </ul>	<ul style="list-style-type: none"> <li>- Unpredictable market</li> </ul>
Key Innovations			
Input	Production	Processing	Market
<ul style="list-style-type: none"> <li>- Increase use of certified seed</li> <li>- Fertilizer use in extension package</li> <li>- Crop protection in extension package</li> <li>- Increased use of improved mechanization services</li> </ul>	<ul style="list-style-type: none"> <li>- Use of improved agricultural practices</li> <li>- Higher degree and effectiveness of aggregation</li> <li>- Organization of farmers</li> <li>- Warehouse receipt systems</li> </ul>	<ul style="list-style-type: none"> <li>- Development and use of standards</li> <li>- Strengthening of actors' voices</li> <li>- Good regulatory practices</li> </ul>	<ul style="list-style-type: none"> <li>-Strengthening of actors' voices to liberalize market forces</li> </ul>
<ul style="list-style-type: none"> <li>- Increase use of certified seed</li> <li>- Fertilizer use in extension package</li> <li>- Crop protection in extension package</li> <li>- Increased use of improved mechanization services</li> </ul>	<ul style="list-style-type: none"> <li>- Use of improved agricultural practices</li> <li>- Higher degree and effectiveness of aggregation</li> <li>- Organization of farmers</li> <li>- Warehouse receipt systems</li> </ul>	<ul style="list-style-type: none"> <li>- Development and use of standards</li> <li>- Strengthening of actors' voices</li> <li>- Good regulatory practices</li> </ul>	<ul style="list-style-type: none"> <li>-Strengthening of actors' voices to liberalize market forces</li> </ul>







## Conclusions

### Findings and recommendations

The low-yield potential of the wheat and faba bean indigenous cultivars used by most farmers is one of the most important production constraints. In addition, abiotic stresses such as waterlogging have been identified as important production constraints in the Vertisols of the Ethiopian highlands.

Our review of the Ethiopian legislation indicated that, although Ethiopia has made progress on ratifying the main international treaties on pesticide management, there remains several significant gaps. For example, legislation governing the disposal of used pesticide containers and safe pesticide storage are two areas of particular note. Where legislation exists, the implementation and enforcement appears to be weak, with two areas of concern being labelling and packaging. Some of the pesticides recommended for use on wheat and faba bean are HHPs. There are very few pesticide options recommended for faba bean pests. To address this, efficacy trials are required to facilitate the registration of pesticides of lower toxicity as well as biopesticides.

A review of the relevant literature on the Ethiopian agricultural advisory system reveals that the following constraints hamper effective delivery of agricultural advisory services:

- Frequent restructuring of the institutions and high turnover of staff.
- Inadequate budget for the implementation of activities.
- Weak system of agricultural inputs supply and distribution (seeds, fertilizer, credit, etc.) systems. Due to lack of efficient coordination among the actors involved in input delivery, inputs tends to reach farmers late – usually too late for planting. That said, fertilizer delivery has shown relative improvements over the past few years.
- Weak linkages between research bodies, extension services and farmers.
- Absence of public–private partnerships in extension service delivery.
- Limited availability of inputs (eg seeds, fertilizer, herbicides and fungicides).
- Insufficient supply of improved (certified) seed to farmers. About 66.4% of farmers preferred local landraces for their adaptability to the environment, tolerance to frost, early maturity, good food taste and straw yield, while improved varieties grown by 10% of the farmers were preferred for high grain yield and bigger grain size. Therefore, opportunities exist to improve the preferred landraces for yield and disease resistance through breeding (Asnahech Tekalign, 2014).
- The seed supply system is constrained by a lack of capacity on the part of many producers, who are unable to meet the standards. Private investors have been slow or unwilling to invest in the seed sector, particularly for self-pollinated or propagating crops.
- While storage conditions are generally good at the union level, both the quality and capacity of storage at the primary cooperative level are generally is poor (ATA, 2014; 2015). The storage facilities in most cooperatives are multipurpose. They serve as storage for various agricultural inputs and outputs, which results in fast deterioration of quality of inputs, which is more pronounced in regard to seeds.
- The key constraint for limited agricultural mechanization is lack of farm machineries and implements that are suitable to different agro-ecologies.

#### Private sector

- Limited private sector involvement in service delivery.
- Collaboration between the private sector and research institutes, public advisory services and other development actors is weak and this has led the private sector to operate in isolation.
- Limited interest and capacity to extend extension services into remote areas.
- Limited technical capacity and resources, which makes private sector actors less capable of delivering extension services at a larger scale.

#### Constraints related to crop production and protection

Pests and diseases are a major challenge in the field and stores and threaten wheat and faba bean production. Among the diseases rust is key. High yielding wheat varieties (Kubsa, Galema



and Simba), with yield potentials of between 65 to 70 Qt/ha, are all susceptible to rust. Volunteer 'weeds' like oats and *Trifolium* species are also difficult to manage. Most farmers do not use appropriate protective clothing when handling and spraying pesticides.

## Recommendations

### Short term

#### *Develop training materials and conduct trainings*

- Revise GIAE training curriculum on pest diagnosis and GAP for extension staff and farmers to include updated information such as new pest and disease tolerant varieties and pesticides of lower toxicity. Add new topics such as soil pests, how to recognize and conserve natural enemies, modes of action of pesticides, pest resistance management strategies, etc.
- Develop simple factsheets and pest management decision guides and training materials on pesticide risk reduction.
- Conduct short term training, awareness campaigns and demonstrations on pesticide use, safety and risk reduction to sensitize and demonstrate the proper and safe use of chemicals and PPE to farmers.
- Repackage 'improved' crop management practices in a more farmer friendly language that is easily understood by farmers with more emphasis on prevention measures and non-chemical options.
- Demonstrate and disseminate good agricultural practices with more focus on prevention measures and IPM at the FTCs and scale up at community level.
- Include more information on post-harvest handling.

#### *Farmers*

Farmer awareness raising is required in the following domains:

Safe use and handling of pesticides to include:

- Awareness of the need to buy pesticides from registered suppliers/dealers
- Understanding of labels and hazard warning
- Awareness creation on importance of using Personal Protective Equipment (PPE)
- Proper skills in pesticide application
- Appropriate storage, disposal of unused pesticides and their containers
- Awareness on Pre-harvest interval (PHI) and re-entry interval (REI)

#### *Extension service providers*

All actors involved in providing extension advice to farmers need an increased understanding of the following:

- Pesticides and the various pesticide categories including their modes of actions and potential hazards to enable them to provide advice on the use of the least harmful pesticides.
- Scouting methods and use of pest thresholds to support rational pesticide use.
- Correct identification and control of pests, diseases and nutrient deficiency
- Tolerant or resistant crop varieties.
- Beneficial insects and being able to distinguish between pests, natural enemies and other beneficial arthropods.
- IPM including cultural control and cropping patterns to reduce infestation.
- The impact of pesticides on the environment.
- The use of alternatives to pesticides, including botanical extracts (Tephrosia, solanum, neem, ash, etc.).
- Safe disposal of unused pesticides and pesticide containers.

#### *Value chain actors*

Value chain actors require capacity building to allow them to:

- Conduct demonstrations of PPE;
- Advise farmers which suppliers/retailers to use for PPE, pesticides and other farming implements;
- Provide farmers with information on alternative non-chemical pest management options;
- Provide advice to retailers on farmers' needs (eg appropriate seed varieties);
- Provide advice on pesticide application, dosage, rate, calibrations and correct choice and use of PPE;
- Engage with farmers via farmers groups or lead farmers; and
- Understand and support implementation of Ethiopian laws on pesticides, environmental protection and pollution control.

#### *Intermediaries such as retailers*

Retailers require understanding of the following:

- Pesticide legislation.
- Pesticides – labels and meaning of label information (colour codes and symbols), proper storage, expiry dates, handling including pesticide application and use of PPE, AI, effectiveness, PHI and REI).
- HHPs and the necessary safety precautions and advice to farmers (eg safe handling of fumigants such as aluminium phosphide).
- Knowledge of consumer protection

#### **Medium term**

- Examine the challenges and the gaps in legislation between policy and practice with respect to governing pesticides and in relation to registration, importation, distribution and use and review how different actors (state, market actors and farmers) can better govern pesticides to achieve environmental sustainability and safeguard workers' health and safety.
- Sensitize policymakers and crop protection researchers on the number of HHPs registered in the country and the need to conduct efficacy trials on pesticides against faba bean and wheat pests in order to increase the options in regard to pesticides with different modes of action.
- Introduce gender topics and encourage the participation of both genders and also youths in crop production and pest management.
- Introduce the Farmer Field School approach and agro-ecosystem analysis so that farmers better understand the relationship between the crop and pest life cycles and the role of natural enemies.
- Conduct a market survey and create structured linkages between input suppliers, seed producers and users in order to encourage the development of a sustainable seed and other input supply system by providing channels for communication and structured markets for seeds and other farm inputs.
- Enhance the adoption of improved seeds through training in seed selection.

#### **Long term**

- Develop multiple disease resistant varieties.
- Enhance the use of improved seeds by establishing stable seed systems, building capacities in technical skills, and markets.
- Create platforms that facilitate communication and structured linkages between seed producers, markets and users, and encourage the development of a sustainable seed supply system.





## References

- Addis Ababa Environmental Protection Authority, Ministry of Economic Development and Cooperation (1997) Environmental Policy of Ethiopia: Environmental Policy. Addis Ababa; Ethiopia.
- Agriculture Victoria (2016) [agriculture.vic.gov.au/agriculture/innovation-and-research](http://agriculture.vic.gov.au/agriculture/innovation-and-research)
- ATA (2014) Wheat sector development strategy (Working document 2013–2017)
- ATA (2015) National pulse value chain development strategy of Ethiopia (Working document 2016–2020)
- Asnakech Tekalign, B. (2014 ) Genetic analysis and characterization of faba bean (*Vicia faba*) for resistance to chocolate spot (*Botrytis fabae*) disease and yield in the Ethiopian highlands. PhD Thesis, Kwazulu Natal.
- Amede, T. and Belachew, T. (2001) Reversing the degradation of arable land in the Ethiopian Highlands (23).
- Araya, T., Cornelis, W. M., Nyssen, J., Govaerts, B., Bauer, H., Gebreegziabher, T., Oicha, T., et al. (2011) Effects of conservation agriculture on runoff, soil loss and crop yield under rainfed conditions in Tigray, Northern Ethiopia. *Soil Use and Management*, 27(3), 404–414.
- Aune, J. B., Asrat, R., Teklehaimanot, D. A. and Bune, B. T. (n.d.). Zero Tillage or Reduced Tillage: The Key to Intensification of Crop-Livestock Systems in Ethiopia. Retrieved July 13, 2012 from [www.ifpri.cgiar.org/sites/default/files/pubs/pubs/books/oc53/oc53ch12.pdf](http://www.ifpri.cgiar.org/sites/default/files/pubs/pubs/books/oc53/oc53ch12.pdf)
- Berhanu A., Tadowos E. and Dejene H.,(2015) Loose smut on wheat (*Ustilago nuda f.sp. tritici*). Pest Management Decision Guide: Green and Yellow List, Ethiopia.
- Byerlee, D., Spielman, D. J., Alemu, D. and Gautam, M. (2007). *Policies to promote cereal intensification in Ethiopia: A review of evidence and experience*. Retrieved from [www.ifpri.org/publication/policies-promote-cereal-intensification-ethiopia](http://www.ifpri.org/publication/policies-promote-cereal-intensification-ethiopia)
- CSA (2014) Data archive of the Central Statistical Agency. Central Statistical Agency, Federal Democratic Republic of Ethiopia; Addis Ababa: Area and Production of Major Crops. [http://harvestchoice.org/sites/default/files/downloads/publications/Ethiopia\\_2010-1\\_Vol\\_1.pdf](http://harvestchoice.org/sites/default/files/downloads/publications/Ethiopia_2010-1_Vol_1.pdf)  
<https://agriknowledge.org/downloads/pk02c9792>
- Dercon, S. and Hill, R. V. (2009). *Growth from agriculture in Ethiopia: Identifying key constraints*. Retrieved from [www.future-agricultures.org/pdf files/Ethiopia paper.pdf](http://www.future-agricultures.org/pdf_files/Ethiopia_paper.pdf)
- Di Falco, S., Chavas, J.-P. and Smale, M. (2007). Farmer management of production risk on degraded lands: the role of wheat variety diversity in the Tigray region, Ethiopia. *Agricultural Economics*, 36(2), 147–156. Retrieved from <http://doi.wiley.com/10.1111/j.1574-0862.2007.00194.x>
- Etagegnehu G., Tamado T., Desalegn G. and Negussie E. (2016a) Control of East African Couch Grass in Tef (*Digitaria abyssinica Ural*) Pest Management Decision Guide: Green and Yellow List, Ethiopia.
- Etagegnehu G., Tamado T., Desalegn G. and Negussie E. (2016b) Annual Grass Weeds in Wheat (*Phalaris paradoxa*, *Setaria pumila*, *Avena fatua*, *Bromus pectinatus*, *Snowdenia polystachia* *Asendabo*, *Yewesh Senededo*, *Sinar*, *Ginechina*, *Wovilo*,
- Environmental Protection Authority (2012) United Nations Conference on Sustainable Development (Rio+20) National Report of Ethiopia.
- Ethiopia Organic Forum (2009) Public Private Partnership United Nations Economic commission for Africa, Addis Ababa, Ethiopia July 18, 2009.
- FAOstat [www.fao.org/faostat/en/#da](http://www.fao.org/faostat/en/#da)
- FAOstat [www.fao.org/faostat/en/#data/QC](http://www.fao.org/faostat/en/#data/QC)



- Frehiwot S. (2015) Russian wheat aphid on wheat. Pest Management Decision Guide: Green and Yellow List, Ethiopia.
- Frehiwot S., Tadewos E., Ali S. and Dejene H. (2015) Yellow rust on wheat (Stripe rust) Pest Management Decision Guide: Green and Yellow List, Ethiopia
- Federal Democratic Republic of Ethiopia (1994) Constitution of Federal Democratic Republic of Ethiopia. Addis Ababa; Ethiopia.
- Federal Democratic Republic of Ethiopia (1995) Environmental Protection Authority Establishment Proclamation, Proclamation No. 9/1995. Federal Negarit Gazeta.
- Federal Democratic Republic of Ethiopia (2002a) Environmental Pollution Control Proclamation, Proclamation, No. 300/2002. Federal Negarit Gazeta.
- Federal Democratic Republic of Ethiopia (2002b) Environmental Protection Organs Establishment Proclamation, Proclamation No. 295/2002. Federal Negarit Gazeta.
- Federal Democratic Republic of Ethiopia (2003) Labour Proclamation, proclamation No. 377/2003. Federal Negarit Gazeta: Addis Ababa.
- Federal Democratic Republic of Ethiopia (2004) Ministry of Health. Infection Prevention Guidelines for Healthcare Facilities in Ethiopia.
- Federal Democratic Republic of Ethiopia (2009) Food Medicine and Health Care Administration and Control Proclamation, Proclamation No. 661/2009. Federal Negarit Gazeta: Addis Ababa.
- Federal Democratic Republic of Ethiopia (2011) Ethiopia's Climate-Resilient Green Economy, Green economy strategy. Addis Ababa.
- Günther H. (1992) Declaration of The United Nations Conference on the Human Environment (Stockholm Declaration), 1992 and The Rio Declaration on Environment and Development.
- Habtegebriel B, Boydom A (2016) Integrated Management of Faba Bean Black Root Rot (*Fusarium solani*) through Varietal Resistance, Drainage and Adjustment of Planting Time. J Plant Pathol Microbiol 7: 363. doi:10.4172/2157- 7471.1000363
- IFPRI (2010) Pulse Value Chain potential in Ethiopia: constraints and opportunities for enhancing exports.
- Mengesha, H. A. (2017). Ethiopia – Ethiopia-Road Sector Development Program APL4: P106872 - Implementation Status Results Report: Sequence 18 (English). Washington, DC, World Bank Group. <http://documents.worldbank.org/curated/en/301251498248636945/Ethiopia-Ethiopia-Road-Sector-Development-Program-APL4-P106872-Implementation-Status-Results-Report-Sequence-18>
- Ministry of Agriculture (2013) National Pesticide Management Strategies in Ethiopia, APHRD of the MoA, Unpublished Official Reports.
- MoA (2017) Annual Report.
- Solomon Y and Keil C. (2016) A report on the Ethiopian Occupational Health and Safety Regulatory Environment.
- Transitional Government of Ethiopia (1993) Health Policy of the Transitional Government of Ethiopia. Addis Ababa.
- Teshome B., Kassahun S. and Haile K. (2015) Stem rust (black rust) on wheat. Pest Management Decision Guide: Green and Yellow List, Ethiopia
- World Bank <https://data.worldbank.org/indicator/AG.LND.ARBL.HA.PC?view=map>
- World Bank <https://www.google.com/search?q=World+Bank+api.worldbank.org%2Fv2%2Fen%2Findicator%2FAG.LND.ARBL.HA.PC%3Fdownloadformat%3Dexcel&ie=utf-8&oe=utf-8&client=firefox-b>
- World Health Organization Regional Office for Africa (2009) The WHO strategic plan for health and environment in the African region, 2006–2009. Brazzaville, Republic of Congo.



## Appendices

**Appendix Table 1: Key stakeholders in the wheat and faba bean value chains and their roles**

Ministry of Agriculture (MoA)	
MoA	The directorate's goal is to increase productivity, employment, and technology transfer. The MoA is mandated to control all activities concerning pesticides by regulating imports and all related business. In addition, it is to promote safe handling and appropriate use of pesticides. It is required to issue subsidiary regulations to cover post-registration inspection and monitoring.
Federal Ministry of Agriculture	<ul style="list-style-type: none"> <li>• Development of national agricultural and rural services policies and strategies</li> </ul>
	<ul style="list-style-type: none"> <li>• Development of national agricultural packages</li> </ul>
	<ul style="list-style-type: none"> <li>• Technical backstopping to regional bureaus of agriculture</li> </ul>
	<ul style="list-style-type: none"> <li>• Administer National ATVETs (four ATVETs)</li> </ul>
Regional Bureaus of Agriculture	<ul style="list-style-type: none"> <li>• National agricultural M&amp;E</li> </ul>
	<ul style="list-style-type: none"> <li>• Adapt the national policies and strategies to respective regional circumstances</li> </ul>
	<ul style="list-style-type: none"> <li>• Adapt the national extension packages to respective regional conditions</li> </ul>
	<ul style="list-style-type: none"> <li>• Develop implementation strategies of the extension packages and set regional targets</li> </ul>
	<ul style="list-style-type: none"> <li>• Technical backstopping of regional and zonal agricultural offices</li> </ul>
Zonal Bureaus of Agriculture	<ul style="list-style-type: none"> <li>• Administer regional ATVETs</li> </ul>
	<ul style="list-style-type: none"> <li>• Regional M&amp;E</li> </ul>
	<ul style="list-style-type: none"> <li>• Develop implementation plans for the zonal agricultural extension service targets of the respective zones</li> </ul>
Woreda Office of Agriculture	<ul style="list-style-type: none"> <li>• Technical backstopping of woreda offices of agriculture</li> </ul>
	<ul style="list-style-type: none"> <li>• Zonal M&amp;E</li> </ul>
	<ul style="list-style-type: none"> <li>• Develop implementation plan for the woreda agricultural extension service targets</li> </ul>
	<ul style="list-style-type: none"> <li>• Support the administration of FTCs in the woreda</li> </ul>
Kebele Office of Agriculture/FTCs	<ul style="list-style-type: none"> <li>• Technical backstopping of kebele offices of agriculture</li> </ul>
	<ul style="list-style-type: none"> <li>• M&amp;E of the services at kebele levels</li> </ul>
Regional bureaus	<ul style="list-style-type: none"> <li>• Frontline provision of agricultural advisory services to the farmers</li> </ul>
	<ul style="list-style-type: none"> <li>• Training of farmers</li> </ul>
ATVETs	Farmer training
FTCs	Training farmers and provision of agricultural advisory services to the farmers



Agricultural Transformation Agency (ATA)	<ul style="list-style-type: none"> <li>• Supports and strengthens existing institutions and structures to catalyze the transformation of Ethiopia's agriculture sector</li> <li>• Create an enabling environment (e.g access to quality inputs including seed)</li> <li>• Strengthening federal and regional seed regulating capacity, implementing structural reforms and legal frameworks</li> </ul>
Bureau of Agriculture and Administration	Provide agricultural advisory services in the country
Debre Birhan Agricultural Research Centre (DBARC)	Disseminating technologies in Animal and Plant breeding including wheat, barley and faba bean
Ethiopian Agricultural Land and Investment Administration Agency	Dedicated to overseeing any new large-scale commercial farm deals
<b>Research</b>	
Federal and Regional Research Institute	16 research centres distributed in different agro-ecological zones
	Carry out pre-extension activities in the mandate areas, conducting demonstrations of new technologies and practices generated through the research process
Sasakawa Global 2000 (SG-2000)	Promote the use of productivity-enhancing technologies and access to inputs and credit, coupled with training using 1/4- to 1/2-hectare demonstration plots closely supervised by research and extension. Stimulate links between research and extension
Ethiopian Drug Administration Authority (EDACA)	Control of the distribution of drugs and public health pesticides for the prevention of malaria. However, according to an assessment by FAO, an amendment to the regulatory drug proclamation has extended its jurisdiction to include the registration and control of pesticides that are on the registered list of the MoA
Quality Monitoring and Pesticide Testing Laboratory (QMPTL) of the Ethiopian Standards Agency	The Ministry of Agriculture launched the Project for Strengthening of Agricultural Pesticide Residue Analysis System in cooperation with JICA in 2011
	Capacity building of the QMPTL to monitor pesticide levels on selected priority crops and to implement pesticide residue analytical methods
Environment Protection Council (EPC)	Oversees the Environmental Protection Authority, which includes Establishment of Environmental Protection Organs (Pro. No 295/2002), Environmental Impact Assessment (Pro. No. 299/2002) and Environmental Pollution Control (Pro. No. 300/2002)
	The EPC has representatives from both the Ministry of Health and MoA. It has been given the statutory mandate to make regulations, seek funds and generally oversee the full implementation of all conventions entered into by the government. Together with the Ministry of Trade and Industry, the Environmental Protection Authority (EPA) has also been given jurisdiction and control over the issuing of licences for investment projects
Crop Production and Protection Technology and Regulatory Department (CPPTRD)	Under the special decree, all pesticides are to be registered by a Pesticide Registration Team before importation. The Pesticide Registration Team is made up of five officers operating under the CPPTRD. The main duties of the team are to approve applications for registration of pesticides after evaluation by a Pesticide Technical Committee
	Give advice on policy matters and assist in the drawing up of regulations
	Conduct inspections and issue letters of support and of technical competence, which enables registered importers and retailers of pesticides to acquire licences issued by the Ministry of Trade and Industry
Ministry of Trade and Industry	Licensing
<b>Others</b>	
Ministry of Livestock and Fisheries	Provide extension services
Integrated Agro-Industrial Parks	Provide extension services
International organizations	Conduct research and advisory services



ICARDA	Seed research for drylands
USAID-supported malt barley and faba bean project implemented by ICARDA in partnership with DBARC	A faba bean variety <i>Walki</i> (high yielding, disease resistant and waterlogging tolerant) was introduced based on farmer preferences
<b>NGOs</b>	
Africa RISING	Advisory services
SG-2000	Introducing diversified and innovative agricultural technologies and approaches to the FTCs, builds DAs' capacity to enhance crop productivity, post-harvest handling and processing, public-private partnerships and market access
Oxfam International	Improving food and income security through better access to production technology and sustainable markets, especially for women, and by facilitating private and public sector engagement to enable access to markets
SelfHelp Africa	Scaling-up agricultural production and developing new enterprise and market opportunities for farmers and rural households
World Vision	Providing information and technologies to improve household food security status, resilience to shocks and recovery from disasters
Save the Children	Providing technologies and information to reduce chronically food-insecure households. So far Save the Children has been able to: support households to cope in times of hunger; increase incomes for vulnerable households; improve management of natural resources; strengthen early warning systems; and improve disaster risk management
CRS	Through providing information and capacity building, CRS works towards building individual and community assets through non-food aid in the form of agriculture, livestock, health, nutrition, and water and sanitation assistance. It also provides livelihoods support to farmers and entrepreneurs, promotes gender equality, mobilizes for immunization and mitigates the impact of HIV
REST	Providing information, technology and resources to improve household-level livelihoods and integrate this with improving the health and education status of the people of Tigray Region
Agri-Service Ethiopia	Providing information, technology and training to build and facilitate community learning and action, strengthening community based institutions, improving smallholder market access, improving food security and livelihood options
<b>Private sector</b>	
	The private sector is known to contribute to agricultural production through organized markets and channels for seed, fertilizers and other farm inputs to farmers.
Agro-industries	Providing technical advice and inputs (seeds and equipment) through contract farming
Universities	Generating agricultural technologies and conducting small scale technology popularization
Farmers' cooperatives/farmer organizations	<ul style="list-style-type: none"> <li>• Major distributors of both agricultural inputs and farm credits. They also provide grain marketing services and supply consumer goods to members.</li> <li>• Providing input supply services, such as seed fertilizer, financial services, storage and transport.</li> <li>• Facilitating delivery of services to members</li> <li>• Providing input supply services, such as seed fertilizer, financial services, storage and transport</li> </ul>

**Appendix Table 2: Key stakeholders in the wheat and faba bean value chains: locations, roles and websites**

Institution	Location	Roles / crop	Website / remarks
MoA (extension, mechanization, ATVETs, directorates, etc.)	Addis Ababa	<ul style="list-style-type: none"> <li>Overall policy support</li> <li>Signatory of GIZ/GIC projects agreement</li> <li>Wheat and faba bean development in general</li> </ul>	<ul style="list-style-type: none"> <li><a href="http://www.moa.gov.et/home">http://www.moa.gov.et/home</a></li> <li><a href="http://www.moa.gov.et/65">http://www.moa.gov.et/65</a> (contains frequently requested information/documents on pesticides)</li> <li>Animal and Plant health Regulatory Directorate</li> </ul>
Oromia Region Bureau of Agriculture and Natural Resources (rural extension, cooperatives, seed regulatory departments)	Addis Ababa	<ul style="list-style-type: none"> <li>Oromia Region is where the projects are active</li> <li>Extension services of innovations; cooperative development; Seed regulation</li> </ul>	
Oromia Region – Arsi Zonal Agriculture and Natural Resources	Assela, Arsi	<ul style="list-style-type: none"> <li>Extension/advice support</li> <li>Support in implementation of project activities in eight districts of the zone</li> <li>Hosting the main office for GIC/IP Consult (implementing consultant)</li> </ul>	
ATA (Federal and Oromia Region)	Addis Ababa	<ul style="list-style-type: none"> <li>Coordination of wheat value chain actors; host platform for wheat value chain development in Oromia Region and federal level</li> <li>Training on seed production, processing, and marketing; seed cooperatives development</li> </ul>	<a href="http://www.ata.gov.et/">http://www.ata.gov.et/</a>
Ethiopian Agricultural Research Institute and its centres	Addis Ababa	<ul style="list-style-type: none"> <li>Pre-basic seed provision</li> <li>Advice on wheat and faba bean innovations</li> <li>New innovations development for wheat and faba bean</li> </ul>	<a href="http://www.eiar.gov.et/">http://www.eiar.gov.et/</a>
Kulumsa Agricultural Research Centre	Assela, Arsi	<ul style="list-style-type: none"> <li>Seed supply of improved varieties</li> <li>Training on wheat/faba bean innovations</li> <li>Joint demonstration of new innovations at five project woredas</li> <li>Overall technical support</li> </ul>	<a href="http://www.eiar.gov.et/index.php/kulumsa-agricultural-research-center">http://www.eiar.gov.et/index.php/kulumsa-agricultural-research-center</a>  GIZ/GIC is also capacity building the centre in terms of seed processing facilities
Sinana Agricultural Research Centre; Bako Agricultural Research Centre		<ul style="list-style-type: none"> <li>Seed supply of improved varieties</li> </ul>	Under Oromia Institute of Agricultural Research
Public Seed Enterprises (Oromia SE; Ethiopian SE)	Addis Ababa and Assela	<ul style="list-style-type: none"> <li>Basic and certified seed supply</li> <li>Distribution of certified seed of preferred varieties</li> </ul>	<a href="http://www.oromiaseedenterprise.com/home.html">http://www.oromiaseedenterprise.com/home.html</a>

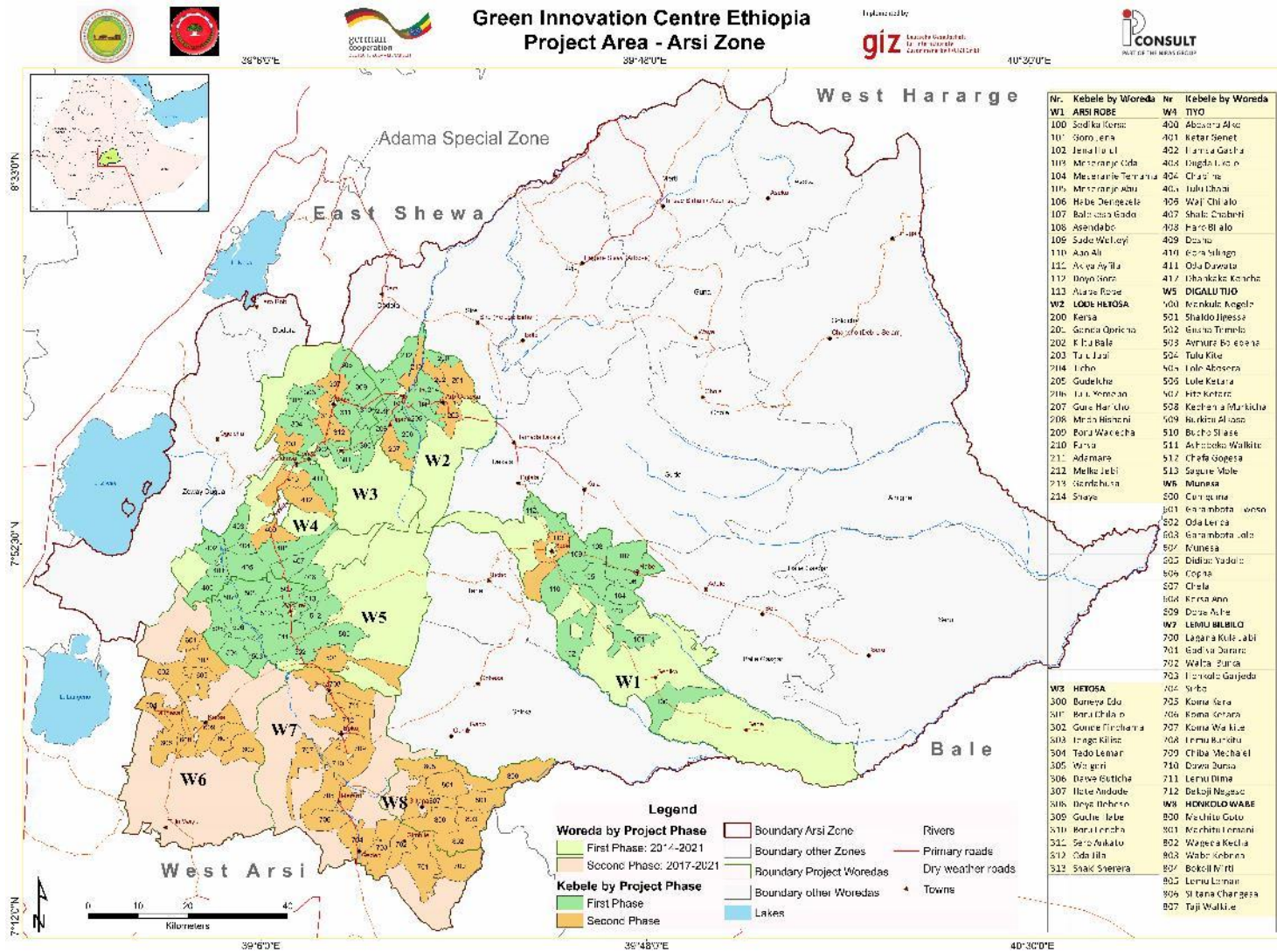
Institution	Location	Roles / crop	Website / remarks
Arsi University; College of Agriculture and Environmental Science	Assela, Arsi	<ul style="list-style-type: none"> <li>Teaching, research and community services in agriculture</li> <li>Need for joint studies at project districts</li> </ul>	<a href="http://www.arsiun.edu.et">http://www.arsiun.edu.et</a>
<b>NGOs</b>			
Agricultural Mechanisation and Technology for Smallholder Productivity (AMTP)	Addis Ababa; Assela	<ul style="list-style-type: none"> <li>Improved mechanization demonstration and promotion of wheat and faba bean</li> <li>Training on knowledge of calibration of farm machineries, maintenance/repair, safety and hazards</li> </ul>	GIZ/GIC project supported Project
CNFA Farm Service Centre Project – Green Innovation Centre Ethiopia	Addis Ababa; five farm service centres at project woredas	<ul style="list-style-type: none"> <li>Improved agricultural input supply services (pesticides, seeds, post-harvest technologies, etc.)</li> <li>One stop shop retail input supply and farm service with technical advisory</li> <li>Business that improves access to high quality agricultural inputs and services at affordable prices and in a timely manner</li> </ul>	<a href="https://www.cnfa.org/">https://www.cnfa.org/</a>  GIZ/GIC Project supported by CNFA; CNFA is international NGO
Enhancement of Quality Infrastructure Services for Innovations in the Agriculture and Food Sector Project (PTB TECHNISCHE ZUSAMMENARBEIT)	Addis Ababa	<ul style="list-style-type: none"> <li>Awareness on the importance of quality in general and benefits of quality infrastructure for the agriculture and food sectors</li> <li>Capacity building for relevant testing and calibration laboratories; inter-laboratory comparisons; standards development; proficiency testing; legal metrology of testing and calibration laboratories</li> </ul>	<a href="https://www.ptb.de/cms/en.html">https://www.ptb.de/cms/en.html</a>  GIZ/GIC project supported by PTB
Support to Sustainable Agricultural Productivity Programme – Agricultural Training Centre (ATC)	Addis Ababa; Assela	<ul style="list-style-type: none"> <li>Technical support and advice on modern and small scale mechanization</li> <li>Technical supervision and backstopping to selected mechanization service providers</li> <li>Utilization of ATC machinery and equipment for joint on-farm demonstrations</li> <li>Seed production and marketing promotion</li> </ul>	<a href="https://www.giz.de/en/worldwide/29670.html">https://www.giz.de/en/worldwide/29670.html</a>
German Agro-Action (Welthungerhilfe)		<ul style="list-style-type: none"> <li>Collaboration in seed production and marketing of wheat and faba bean</li> <li>Grain marketing</li> </ul>	<a href="https://www.welthungerhilfe.de/en/home-en.html">https://www.welthungerhilfe.de/en/home-en.html</a>

Institution	Location	Roles / crop	Website / remarks
Andreas-Hermes Akademie	Germany	<ul style="list-style-type: none"> <li>Seed cooperatives and seed unions' development</li> </ul>	
Menschen für Menschen	Addis Ababa	<ul style="list-style-type: none"> <li>Honey value chain development; hybrid maize seed production</li> <li>Job creation</li> </ul>	
Green Innovation Centre Ethiopia; IP Consult (implementing consultant)	Assela; Arsi	<ul style="list-style-type: none"> <li>Promote proven innovations in wheat and faba bean to increase productivity across project districts</li> <li>Community based seed production of preferred high yielding improved varieties</li> <li>Training of farmers, DAs and Subject Matter Specialists (SMSs)</li> <li>Seed and grain value chain enhancement</li> </ul>	<a href="http://www.ip-consult.de/">http://www.ip-consult.de/</a> GIZ/GIC Project supported by IP Consult
Digital Green – Ethiopia	Addis Ababa	<ul style="list-style-type: none"> <li>Training on GAP</li> <li>Training farmers using short videos where they record their problems, share solutions and highlight success stories</li> </ul>	<a href="https://www.digitalgreen.org/">https://www.digitalgreen.org/</a>
Integrated Seed Sector Development – Ethiopia	Addis Ababa	<ul style="list-style-type: none"> <li>Supports farmers' groups in the development of viable local seed businesses producing for a local market</li> <li>Informal seed systems</li> <li>Strengthens partnerships in the seed sector</li> <li>Supports private seed producers in seed production and marketing</li> </ul>	<a href="http://www.issdethiopia.org/">http://www.issdethiopia.org/</a>
EAOA	Addis Ababa	<ul style="list-style-type: none"> <li>Coordinates and promotes organic agricultural development, networking and marketing</li> <li>Aims to achieve sustainable agriculture, poverty reduction and environmental stability</li> </ul>	<a href="https://www.ifoam.bio/pt/ethiopia">https://www.ifoam.bio/pt/ethiopia</a>
<b>Farmer associations</b>			
<ul style="list-style-type: none"> <li>Hitosa Farmers Multipurpose Cooperatives union; Arsi Zone</li> <li>Didea Farmers Multipurpose Cooperatives Union; Arsi Zone</li> <li>Galama Farmers Multipurpose Cooperatives Union; Arsi Zone</li> <li>Galama Farmers Seed Cooperatives Union; Arsi Zone</li> </ul>	Arsi Zone	<ul style="list-style-type: none"> <li>Seed and grain production, processing (some involved in wheat milling) and marketing</li> </ul>	Note: multipurpose primary cooperatives are located at each kebele as union networks and are usually involved in input-output marketing (including pesticides)



Institution	Location	Roles / crop	Website / remarks
Federal Cooperative Agency	Addis Ababa	<ul style="list-style-type: none"> <li>Coordinates the cooperative movement across the country</li> </ul>	<a href="http://www.fca.gov.et/">http://www.fca.gov.et/</a>
<b>Trade sector actors</b>			
Private licensed pesticide registrants (fungicides, herbicides, insecticides, etc.)	Addis Ababa; Across other towns in Ethiopia	<ul style="list-style-type: none"> <li>Import and marketing of pesticides; training and advisory services</li> </ul>	See MoA website
Adami Tulu Pesticides Processing Factory S.C.	Addis Ababa	<ul style="list-style-type: none"> <li>Production and marketing of pesticides; training and advisory services</li> </ul>	
EGTE	Addis Ababa	<ul style="list-style-type: none"> <li>Purchasing grain, oilseeds and pulses both for local wholesale and export</li> </ul>	<a href="http://www.egte-ethiopia.com/en/">http://www.egte-ethiopia.com/en/</a>
Wholesalers and assemblers	Addis Ababa; Arsi Zone	<ul style="list-style-type: none"> <li>Buying and selling wheat and faba bean products (raw and processed products)</li> </ul>	
Ethiopian Millers Association	Addis Ababa	<ul style="list-style-type: none"> <li>Wheat grain milling (flour)</li> <li>Bread, Pasta, Biscuit, and related products</li> <li>Flour fortification</li> </ul>	<a href="http://www.ethiopianmillersass.com/">http://www.ethiopianmillersass.com/</a>
Ethiopian Pulses, Oil Seeds and Spices Processors and Exporters Association	Addis Ababa	<ul style="list-style-type: none"> <li>Facilitate export related services for its members e.g up to date online data access on local and International markets on pulses, oil seeds and spices</li> <li>Advocate for policy reforms</li> <li>Build capacity of exporters through trade fairs, exhibitions and workshops</li> </ul>	<a href="http://www.epospeaeth.org">www.epospeaeth.org</a>

Appendix Figure 1: Map of the study area (green and red coloured)



**Appendix Table 2: Adherence to and implementation of international agreements relating to pesticides**

Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
The country is a party to the Montreal Protocol	✓
The country enacted provision relating to the implementation of the Montreal Protocol	??
The country is a party to the Rotterdam Convention	✓
The country enacted provision relating to the implementation of the Rotterdam Convention	✓
The country is a party to the Stockholm Convention	✓
The country enacted provision relating to the implementation of the Stockholm Convention	✓
The country is a party to the Basel Convention	✓
The country enacted provision relating to the implementation of the Basel Convention	✓
The country is a party of the ILO Safety and Health in Agriculture Convention (C184)	✓
The country enacted provision relating to the implementation of the ILO Safety and Health in Agriculture Convention (C184)	✓
<b>Policies to promote reductions in unnecessary pesticide use such as policies on IPM, GAP, organic production and sustainable agriculture</b>	
A policy is in place to develop and promote the use of IPM	✓
A policy is in place to promote the adoption of GAP, organic production and/or sustainable agriculture standards	✓
A policy is in place to facilitate access to information on matters including pesticide hazards and risks, residues in food, IPM/Integrated Vector Management (IVM), alternatives to HHPs and related regulatory and policy actions	X
The country's policies to achieve the sustainable use of pesticides include quantitative objectives, targets, measures, timetables or indicators to reduce risks and impacts in parallel with the requirements of the EU directive 2009/128/EC (National Action Plan for the Sustainable Use of Plant Protection Products/Biocides (NAPS))	X
<b>Research</b>	
A policy is in place to encourage and promote research on alternatives to existing pesticides that pose fewer risks, such as non-chemical preventive and direct control measures	??
<b>Regulations related to the manufacture of pesticides</b>	
A regulation addressing the manufacture and packaging of pesticides exists:	✓
• It defines appropriate engineering standards and operating practices, including quality assurance procedures	X
• It defines necessary precautions to protect workers	X
• It ensures the proper siting of plants and stores, monitoring and control of waste, emissions and effluents	X
• It ensures that packaging or repackaging is carried out only on licensed premises that comply with safety standards	X
• It contains provisions for poisoning cases	X
• It ensures that lists of banned pesticides for manufacture are in harmony with the country's international obligations	?
<b>Legal framework for non-chemical preventive and direct control measures</b>	

Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
Registration is required for non-chemical preventive and direct control measures	X
A subsidy scheme for non-chemical preventative and curative control methods is in place	X
<b>Price and trade policy, including subsidies</b>	
Distribution and trade is a market-driven supply process / there is no government purchasing	
A subsidy scheme for pesticides is in place (The government provides pesticides when there are major outbreaks and for migratory pests)	✓
<ul style="list-style-type: none"> <li>• The subsidy scheme could potentially lead to excessive or unjustified pesticide use and may divert interest from more sustainable alternative measures</li> </ul>	X
<ul style="list-style-type: none"> <li>• There are subsidies for pesticides for field applications</li> </ul>	X
<ul style="list-style-type: none"> <li>• There are subsidies for pesticides for treatment of seed/planting material</li> </ul>	X
<ul style="list-style-type: none"> <li>• There are subsidies for pesticides for treatment of seed/planting material and/or for post-harvest applications</li> </ul>	X
<ul style="list-style-type: none"> <li>• The subsidy scheme is restricted to lower risk alternatives</li> </ul>	X
A subsidy scheme for PPE is in place	X
<b>Registration (synthetic pesticides and biopesticides)</b>	
The legislation establishes a mandatory registration system for pesticides, tailored to national needs	✓
The registration process involves the risk-based evaluation of comprehensive scientific data demonstrating that the product is effective for its intended purposes and does not pose an unacceptable risk to human or animal health or the environment	✓
The legislation identifies the body responsible for registration	✓
The legislation sets out the powers and functions of the registration body	✓
There is a mechanism in place for regional coordination / harmonization for the registration of pesticides	✓
The legislation indicates how the registration body will make its registration decisions	✓
The legislation lists the types of final decisions the registration body can take	✓
The legislation clearly defines the activities and types of pesticides requiring registration (eg all pesticide uses or a subset):	X
<ul style="list-style-type: none"> <li>• There are special requirements for products used on seed / plant material</li> </ul>	X
<ul style="list-style-type: none"> <li>• There are special requirements for products used for post-harvest application</li> </ul>	X
<ul style="list-style-type: none"> <li>• There are special requirements for non-chemical preventative and curative control methods</li> </ul>	X
<ul style="list-style-type: none"> <li>• There are provisions for experimental permits for the importation of limited quantities of unregistered pesticides for research, education or registration purposes</li> </ul>	✓
<ul style="list-style-type: none"> <li>• There are provisions for use of unregistered pesticides in emergency situations</li> </ul>	✓
Low toxicity / low risk pesticides are defined	X
The regulation provides a definition for what biopesticides/biocontrol agents are	✓
The legislation addressing registration contains a system designed to encourage the use of fewer or less toxic pesticides	✓



Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
• Fewer data requirements for less toxic alternatives	X
• Special process for biopesticides (or an equivalent grouping for pesticides of natural origin under a different name, e.g. "biocontrol agents")	✓
• Accelerated process or lower fees for registration of less toxic products	X
• New pesticides can only be registered if they replace more toxic pesticide products used for the same purpose	✓
The legislation provides for distinct registration pathways for biopesticides or biological control agents and chemical pesticides	
• The data requirements for biopesticides / biological control agents include:	
○ Identity, biology and ecology of the agent	X
○ Information for assessment of safety and effects on human health	X
○ Information for assessment of environmental risks	X
○ Information for assessment of efficacy, quality control and benefits of use	X
○ Toxicity for humans and the environments of additives (for microbial biological control agents only)	X
The legislation contains other provision which aims at facilitating the registration of biopesticides / biological control agents	X
The legislation indicates the validity period for registrations	X
The legislation describes procedures for denial of registration and appeal	X
The legislation describes requirements for label extension	X
The legislation provides for review of registered pesticides and empowers the registration body to impose new conditions in view of new information	X
The legislation describes requires mandatory re-registration at specified intervals	X
The legislation assigns responsibility for keeping records	X
The legislation includes provisions ensuring confidentiality of trade secrets	X
A pesticide register compiling all registered products is made publicly available by the responsible authority. It contains the following information:	X
• Trade names of the products	X
• Registration numbers	X
• Name(s) of the active ingredient(s)	X
• Concentration of the active ingredient(s)	X
• Formulation type	X
• Authorized uses including crops and target pests	X
• The name of the registrant	X
• The period of registration	X
• User groups (eg use of some pesticides is restricted to certified professionals)	X

Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
A separate list containing the pesticide products that are banned or severely restricted is published by the national authority. Likewise, biopesticides are identified in a separate list	X
<b>Analysis of registered pesticide list for HHPs and alternatives</b>	
List the time of last update	X
The number of AI registered	X
The number of products registered	✓
The number of registrants	✓
For the banned list, the last time it was updated, the number (and identity) of the banned pesticides	X
<b>Biocontrol agents that are not covered by the national authority which handles registration of pesticides, eg macro-organisms</b>	
The legislation contains provisions addressing export, shipment, import and release of biological control agents and other beneficial organisms. It contains the following requirements:	X
<ul style="list-style-type: none"> <li>• To carry out pest risk analysis of biological control agents</li> </ul>	X
<ul style="list-style-type: none"> <li>• To obtain, provide and assess documentation as appropriate, relevant to the export, shipment, import or release of biological control agents and other beneficial organisms</li> </ul>	X
<ul style="list-style-type: none"> <li>• To ensure that biological control agents and other beneficial organisms are taken either directly to designated quarantine facilities or mass-rearing facilities or, if appropriate, passed directly for release into the environment</li> </ul>	X
<ul style="list-style-type: none"> <li>• To encourage monitoring of release of biological control agents or beneficial organisms in order to assess impact on target and non-target organisms</li> </ul>	X
<b>Packaging and labelling</b>	
The legislation specifies the products to which the packaging and labelling requirements apply (e.g. equally to imported and domestically manufactured products)	X
The legislation specifies the technical requirements for packaging and repackaging	X
The legislation incorporates requirements for packaging and labelling into the registration process	✓
The legislation requires that packaging is safe	✓
The legislation requires packaging that will not degrade under normal conditions (e.g. the packaging material should be impermeable to its contents)	X
The legislation requires packaging that does not resemble common packaging of consumable goods	X
The legislation requires that packaging or repackaging only take place on licensed premises where staff are adequately protected	X
The legislation bans repackaging when effective controls are not possible in the national context	X
The legislation prohibits the repackaging or decanting of pesticide into food or drink or other inappropriate containers	X
The legislation prohibits reuse of containers except under exceptional circumstances (e.g. where there is a programme in place to refill containers)	X
The legislation requires that an officially approved label is a mandatory part of the product package	✓
The legislation lists the information which is required on the label	✓
<ul style="list-style-type: none"> <li>• Product name</li> </ul>	✓

Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
• Use type	✓
• Type of formulation	✓
• AI name	✓
• AI concentration	X
• Co-formulants	X
• Net content	✓
• Name of supplier	✓
• Manufacturer	✓
• Batch number	✓
• Registration number	✓
• Hazard and safety information following the Globally Harmonized System of Classification and Labelling of Chemicals (GHS)	X
• Directions for use	✓
• Warning against container reuse, instructions for storage and disposal	X
• Legal requirement that pesticides be used in a way that is consistent with the label	✓
The legislation lists how the information in the label should be communicated (languages, system of weights and measures, etc.)	✓
The legislation outlines physical requirements of the label, eg minimum size of packaging, use of a durable material, fade resistant ink	X
A handbook or manual is available to guide label design and/or review	X
<b>Marketing</b>	
The legislation contains provisions specifically addressing pesticide advertising	✓
• It defines pesticide advertising broadly to cover all forms;	✓
• It prohibits the advertising of unregistered or illegal pesticides	✓
• It prohibits false or misleading advertising of pesticides	✓
• It prohibits advertising contrary to approved uses or label instructions	X
• It designates the authority responsible for enforcement	X
<b>Transport</b>	
Regulation addressing the transport of pesticides is in place	✓
• It sets out requirements for vehicles and containers	✓
• It prohibits the transport of pesticides in the same vehicle as passengers, animals, food or feed	✓
• It requires physical separation in cases where joint transport or storage is unavoidable	X

Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
<b>Import and export</b>	
The legislation contains provisions specifically addressing the import and export of pesticides	?
<ul style="list-style-type: none"> <li>It prohibits the import / export of pesticides that have not been registered</li> </ul>	✓
<ul style="list-style-type: none"> <li>It prohibits import / export of counterfeit, substandard or outdated pesticides, or of pesticides otherwise not meeting the prescribed requirements</li> </ul>	✓
<ul style="list-style-type: none"> <li>It establishes application procedures for a pesticide import permit</li> </ul>	✓
<ul style="list-style-type: none"> <li>It develops procedures and criteria for decisions on import permits</li> </ul>	✓
<ul style="list-style-type: none"> <li>It requires inspection of pesticides at the point of entry</li> </ul>	X
<ul style="list-style-type: none"> <li>It fosters collaboration between the competent national authority and the customs department at points of entry</li> </ul>	X
<ul style="list-style-type: none"> <li>It establishes exceptions for donations or imports by public entities for specific purposes</li> </ul>	X
<ul style="list-style-type: none"> <li>It requires that exported pesticides meet the same quality standards as comparable domestic ones</li> </ul>	✓
<ul style="list-style-type: none"> <li>It requires the use of Harmonized System customs codes on shipping documents</li> </ul>	X
<b>Requirements for sale</b>	
The legislation contains provision specifically addressing the sale of pesticides	✓
<ul style="list-style-type: none"> <li>It sets requirements so that only those with competency and training may be licensed to sell pesticides</li> </ul>	X
<ul style="list-style-type: none"> <li>It includes among the decision-making criteria for the granting of a licence issues such as storage, display, training, knowledge, record keeping, safety equipment and emergency plans</li> </ul>	X
<ul style="list-style-type: none"> <li>It prescribes the separation of pesticide from food and medicine</li> </ul>	X
<ul style="list-style-type: none"> <li>It prescribes that pesticides may only be sold in their undamaged original container</li> </ul>	X
<ul style="list-style-type: none"> <li>It prescribes that pesticides may only be sold with a readable label</li> </ul>	✓
<ul style="list-style-type: none"> <li>It prescribes that pesticides must not be sold to minors</li> </ul>	X
<ul style="list-style-type: none"> <li>It prescribes that shops that sell pesticides must have firefighting equipment</li> </ul>	X
<ul style="list-style-type: none"> <li>It prescribes that shops that sell pesticides must have a warning board</li> </ul>	X
<b>Licensing</b>	
The legislation contains provisions to identify which pesticide-related activities are permitted only to operators that hold a valid licence	
<ul style="list-style-type: none"> <li>It prescribes the holding of a valid licence for manufacture and packaging</li> </ul>	X
<ul style="list-style-type: none"> <li>It prescribes the holding of a valid licence for sales</li> </ul>	✓
<ul style="list-style-type: none"> <li>It prescribes the holding of a valid licence for transportation, import and export</li> </ul>	X
<ul style="list-style-type: none"> <li>It prescribes the holding of a valid licence for special applications</li> </ul>	X
<ul style="list-style-type: none"> <li>It imposes specific and more restrictive requirements for severely restricted pesticides</li> </ul>	X



Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
• It provides for back up inspections	✓
• It establishes a system to receive and evaluate applications, in order to assess risk	?
• It sets out clear criteria for the granting or denial of the licence, as well as provisions for imposition of conditions, suspension and revocation	✓
• It establishes the term of validity and the procedures for renewal of the licence	✓
• It enables the authority to impose fees for services associated with licensing	✓
• It sets out an appeal process linked to the licensing scheme	✓
<b>Availability</b>	
The legislation contains provisions to regulate the availability and use of pesticides in accordance with the hazards involved and the existing levels of user training	X
• It takes into account the type of formulation, method of application and its uses when determining the risk and degree of restriction appropriate to the product	X
• It contains provision to limit the availability of pesticides that are sold to the general public through non-specialized outlets	X
• It contains restrictions specifically targeting products used on seed/planting material	x
• It contains restrictions specifically targeting products used for post-harvest applications	X
<b>Handling and use, including regulations on application equipment</b>	
The legislation contains provisions to prohibit the use of pesticides for a purpose, or in a manner, other than that prescribed on the label	✓
Responsibilities of pesticide operators (farmers and farmer workers) are identified in national regulations, e.g. to follow safety and hygiene norms, to follow recommendations relating to PPE use, to take reasonable precautions, to report risks, etc.	✓
The legislation requires employers to take the necessary measures to protect the health of workers and the environment	✓
• The required measures include provision of training	✓
• The required measures include provision of protective equipment	✓
• The required measures include health monitoring of the workers	✓
The legislation ensures that all workers, including those in agriculture, are protected under the legal framework	?
The legislation contains provisions to promote the use of pesticide application methods and/or equipment that minimize the risks	X
The legislation contains provisions to permit pesticide application equipment and PPE to be marketed only if they comply with established standards	X
The legislation contains provisions to prescribe the use of proper application equipment	X
• Respect of the recommended application	X
• Appropriate calibration of the spraying equipment for the pesticides to be applied	X
The legislation contains provisions to prescribe the responsible cleaning of application equipment	X
• To rinse the content of the tank with fresh water and to apply the remaining liquid on the treated field	X
• Application equipment must be rinsed externally in the field	X
The legislation contains any other provision to prohibit the use of pesticides in an unsafe manner that poses a threat to human health or the environment	✓

Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
<b>Requirements for training</b>	
A policy is in place to produce and disseminate relevant and clear educational materials on pesticide use and management	?
The legislation requires pest control operators to hold a licence or permit	?
<ul style="list-style-type: none"> <li>• For all products and application methods</li> </ul>	?
<ul style="list-style-type: none"> <li>• Only for specific products' application methods</li> </ul>	X
<ul style="list-style-type: none"> <li>• The content of the mandatory trainings is described in the law</li> </ul>	X
<b>Restrictions related to vulnerable groups</b>	
The legislation contains provision to prevent the use of pesticides by and sale of pesticides to children or pregnant and nursing women	X
The legislation requires employers to take the necessary measures to prevent use by children and other vulnerable groups	X
<b>Requirements for PPE</b>	
A policy is in place to promote the use of suitable PPE	✓
The legislation prescribes the use of PPE for the application of pesticides	✓
<ul style="list-style-type: none"> <li>• Operator risk and exposure is assessed at the time of registration in order to determine the PPE performance requirements</li> </ul>	X
<ul style="list-style-type: none"> <li>• Application of international standards (eg ISO 27065) or national standards for the classification of PPE by performance requirements (level of chemical resistance or some other measure to differentiate the level of protection provided by PPE)</li> </ul>	X
<ul style="list-style-type: none"> <li>• Only PPE which has met national standards may be marketed</li> </ul>	X
<ul style="list-style-type: none"> <li>• The label is required to list the elements of PPE (e.g gloves, protective footwear, face protection, apron) and their performance requirements</li> </ul>	X
<ul style="list-style-type: none"> <li>• Responsibilities of pesticide operators (farmers and farm workers) are identified in national regulations, e.g. to follow safety and hygiene norms, to follow recommendations relating to PPE use, to take reasonable precautions, to report risks, etc.</li> </ul>	✓
<b>Storage</b>	
The legislation makes provisions for safe storage of pesticides	X
<ul style="list-style-type: none"> <li>• It differentiates between private, end-user or home storage and bulk or commercial storage</li> </ul>	X
<ul style="list-style-type: none"> <li>• It imposes record keeping requirements on those storing pesticides</li> </ul>	X
<ul style="list-style-type: none"> <li>• It prohibits the reuse of a pesticide container for any non-pesticide storage reason</li> </ul>	?
<ul style="list-style-type: none"> <li>• It indicates the type of containers required</li> </ul>	X
<ul style="list-style-type: none"> <li>• The legislation specifies how and where pesticide products may be stored</li> </ul>	X
<ul style="list-style-type: none"> <li>○ Plant protection products are stored in their original containers and packs</li> </ul>	X
<ul style="list-style-type: none"> <li>○ Plant protection products are stored according to label storage requirements</li> </ul>	X
<ul style="list-style-type: none"> <li>○ Plant protection products that are liquid formulations are stored on shelving that is never above those products that are powder or granular formulations</li> </ul>	X
<ul style="list-style-type: none"> <li>○ Plant protection product storage facilities are built in a manner that is structurally sound and robust</li> </ul>	X

Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
○ Plant protection product storage facilities have sufficient and constant ventilation of fresh air to avoid a build-up of harmful vapours	X
○ Plant protection product storage facilities have or are located in areas with sufficient illumination by natural or artificial lighting to ensure that all product labels can be easily read while on the shelves	X
○ Plant protection product storage facilities are equipped with shelving that is not absorbent in case of spillage	X
○ Plant protection product storage facilities have retaining tanks or products are bundled according to 110% of the volume of the largest container of stored liquid, to ensure that there cannot be any leakage, seepage or contamination to the exterior of the facility	X
○ Plant protection product storage facilities and all designated fixed filling/mixing areas are equipped with a container of absorbent inert material such as sand, floor brush and dustpan and plastic bags that must be in a fixed location to be used exclusively in the case of training on plant protection products	X
○ An accident procedure including emergency contact telephone numbers shall visually display the basic steps of primary accident care and be accessible by all persons within 10 metres of the plant protection product/chemical storage facilities and designated mixing areas	X
○ All plant protection product/chemical storage facilities and all filling/mixing areas have eye washing amenities, a source of clean water at a distance no farther than 10 metres, and a first aid kit containing the relevant aid material	X
<b>Disposal of unused pesticides</b>	
A policy is in place to prevent the accumulation of obsolete pesticides and used containers	✓
A policy is in place to inventory obsolete or unusable stocks of pesticides and used containers, and establish and implement an action plan for their disposal	X
The legislation contains provisions to ensure that disposal of hazardous pesticide waste is carried out in an environmentally sound manner	✓
The legislation bans certain types of activities in relation to pesticide waste (eg pouring it down drains or into water sources, burying it in unapproved sites and burning it in unapproved incinerators)	X
The legislation places affirmative duties on industry to assist in proper disposal	?
The legislation requires any person or entity seeking to dispose of pesticides or pesticide waste to seek authorization from the competent authority	✓
The legislation contains provisions for the implementation of a toxic waste collection scheme	X
The legislation contains provisions for the establishment of facilities for the management of bulk quantities of toxic waste	X
<b>Disposal of empty pesticide containers</b>	
The regulation addresses the disposal of pesticide containers	x
● The regulation governing disposal of empty pesticide containers is the same across the country	?
● Appropriate PPE is required when handling empty pesticide containers	X
● Cleaning the container before final disposal is the responsibility of the person disposing of the container	X
● When a metal, plastic or glass pesticide container is empty, it should be immediately triple rinsed (or pressure washed) with the resulting residue from the pesticide container being added to the spray tank for application	X
● After rinsing, the container should be rendered unusable by puncturing, crushing or breaking	X
● The regulation contains specifications for the storage conditions of empty pesticide containers (eg bagged, stored in a secure, ventilated location)	X
● The regulation bans the reuse of empty pesticide containers	✓

Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
<ul style="list-style-type: none"> <li>Burying empty pesticide containers is prohibited. Or, if burying is allowed, specifications are provided for how the empty containers should be buried</li> </ul>	X
<ul style="list-style-type: none"> <li>Burning empty pesticide containers is prohibited. Or, if burning is allowed, specifications are provided for how the empty containers should be burned (eg to stay out of smoke, information on what should be done with the ash, etc.)</li> </ul>	X
<ul style="list-style-type: none"> <li>Empty containers are classified as hazardous waste regardless of whether they have been decontaminated</li> </ul>	X
<ul style="list-style-type: none"> <li>Empty containers must be transported in specially licensed vehicles</li> </ul>	X
<ul style="list-style-type: none"> <li>Empty containers may not be transported with food, beverages, medicines, feed, animals and people</li> </ul>	✓
<ul style="list-style-type: none"> <li>Users must return containers to the manufacturer, to the place of purchase or to the place indicated on the invoice issued at the time of purchase</li> </ul>	X
<ul style="list-style-type: none"> <li>Final disposal of empty pesticide containers must be carried out by authorized companies / Containers must be destroyed at a specialized facility</li> </ul>	X
<ul style="list-style-type: none"> <li>The procedure for disposal is described in legislation (recycling (if available), in a sanitary landfill, by incineration, etc.)</li> </ul>	X
<ul style="list-style-type: none"> <li>Pesticide waste generators (= pesticide users) are required to establish waste management plans for harm reduction</li> </ul>	X
<ul style="list-style-type: none"> <li>The legislation contains dispositions to establish a container management system</li> </ul>	X
<b>Post-registration monitoring</b>	
A policy is in place to collect reliable data and maintain statistics on the health effects of pesticides and pesticide poisoning incidents / on environmental contamination and adverse effects, including the monitoring of pesticide residues in feed, drinking water and/or the environment	✓
<ul style="list-style-type: none"> <li>The policy assigns responsibility for mandatory monitoring and data collection with respect to pesticides</li> </ul>	?
<ul style="list-style-type: none"> <li>The policy sets out the powers and responsibilities of the responsible body and the inspection corps with regard to information-gathering</li> </ul>	✓
<ul style="list-style-type: none"> <li>The policy imposes reporting requirements on manufacturers, importers, distributors and sellers of pesticides</li> </ul>	?
<ul style="list-style-type: none"> <li>The policy requires reporting of pesticide-related incidents to the competent authority</li> </ul>	✓
<b>Residue monitoring in food and MRLs</b>	
The legislation contains provisions to regulate and/or monitor pesticide residues in food	✓
<ul style="list-style-type: none"> <li>It defines which authority is in charge of the monitoring</li> </ul>	✓
<ul style="list-style-type: none"> <li>It defines which authority is in charge of setting the MRLs</li> </ul>	✓
<ul style="list-style-type: none"> <li>It applies for domestic production for national consumption as well as for imports / exports</li> </ul>	✓
<ul style="list-style-type: none"> <li>It applies only for a limited number of export crops</li> </ul>	X
<ul style="list-style-type: none"> <li>It prescribes following the MRLs set by the <i>Codex Alimentarius</i></li> </ul>	✓
<b>Other relevant human health and environmental protection regulations</b>	
A policy is in place to raise awareness among users about the importance and ways of protecting health and the environment	x
A policy is in place to carry out health surveillance programmes of those who are occupationally exposed to pesticides	✓
A policy is in place to provide guidance and instructions to health workers on the diagnosis and treatment of suspected pesticide poisonings	X
A policy is in place to establish national or regional poisoning information centres	X



Adherence to and implementation of international agreements relating to pesticides	Present or absent in legislation
<b>Compliance and enforcement</b>	
The legislation contains provisions to prohibit the import, packaging, repackaging, transportation, distribution or sale of a pesticide unless it is packaged in accordance with criteria provided in the law	✓
The legislation contains provisions to detect and control counterfeiting and illegal trade in pesticides	X
The legislation contains provisions to facilitate the exchange of information (eg actions taken to ban or severely restrict a pesticide; scientific, technical, economic, regulatory and legal information; the availability of resources and expertise; cases of counterfeit and illegal pesticides being traded; poisoning and environmental contamination incidents data) between regulatory and implementing authorities	X
The legislation designates the national authority responsible for inspection	✓
<ul style="list-style-type: none"> <li>• It defines the powers of the inspectors</li> </ul>	✓
The legislation provides procedures and criteria for inspections	✓
<ul style="list-style-type: none"> <li>• It provides procedures and requirements for sample taking</li> </ul>	✓
<ul style="list-style-type: none"> <li>• It contains provisions for the designation of official laboratories for analysis of samples</li> </ul>	X
<ul style="list-style-type: none"> <li>• It provides clear and effective procedures for intervention if irregularities are found during inspections</li> </ul>	✓
<ul style="list-style-type: none"> <li>• It defines the actions that will be considered as offences, including special offences for public officials</li> </ul>	✓
<ul style="list-style-type: none"> <li>• It determines which offences will be criminal and which administrative</li> </ul>	X
<ul style="list-style-type: none"> <li>• It determines proportional and deterrent fines and includes mechanisms to adapt the fines if their value declines</li> </ul>	?
<ul style="list-style-type: none"> <li>• It defines other consequences of the infringement, such as the revocation of a licence or forfeiture of materials used in connection with the commission of the offence</li> </ul>	✓

Theme of code of conduct	Coverage by Ethiopia legislation
<b>Adherence to and implementation of international agreements relating to pesticides</b>	<b>9/10</b>
Policies to promote reductions in unnecessary pesticide use such as policies on IPM, GAP, organic production and sustainable agriculture	1/4
Research	0/1
Regulations related to the manufacture of pesticides	1/7
Legal framework for non-chemical preventive and direct control measures	0/2
Price and trade policy, including subsidies	?
Registration (synthetic pesticides and biopesticides)	8/21 (1?)
The legislation provides for distinct registration pathways for biopesticides or biological control agents and chemical pesticides	0/25
<b>Analysis of registered pesticide list for HHPs and alternatives</b>	
Biocontrol agents not covered by the national authority that handles registration of pesticides, eg macro-organisms	0/5

Theme of code of conduct	Coverage by Ethiopia legislation
Packaging and labelling	19/30
Marketing	4/6 (2?)
Transport	1/4
Import and export	5/10
Requirements for sale	1/9
Licensing	5/11
Availability	0/5
Handling and use, including regulations on application equipment	5/16
Requirements for training	1/5 (1?)
Restrictions related to vulnerable groups	0/2
Requirements for personal protection equipment	3/7
Storage	1/17
Disposal of unused pesticides	4/7
Disposal of empty pesticide containers	1/18 (1?)
Post-registration monitoring	1/5
Residue monitoring in food and MRLs	5/10
Other relevant human health and environmental protection regulations	1/4
Compliance and enforcement	9/13

**Appendix Table 3: List of HHP AI registered for use in Ethiopia**

HHP AI	Chemical class	Use type	HHP1 Acute toxicity	HHP2 Carcino- genicity	HHP3 Muta- genicity	HHP4 Repro- ductive toxin	HHP5 POP	HHP6 PIC	HHP7 ODS	PAN HHP	EU approved	GIZ classification
Abamectin	Macrocyclic lactone - avermectin	Insecticide	1				No	No	No	Yes	Approved	B
Alachlor	Amide	Herbicide					No	Yes	No	Yes	Not approved	A
Aluminium phosphide	Fumigant	Insecticide, Rodenticide	1				No	No	No	Yes	Approved	B
Benomyl	Benzimidazole	Fungicide			1A / 1B	1A / 1B	No	No	No	Yes	Not approved	A
Butachlor	Amide	Herbicide		1B			No	No	No	Yes	Not approved	B
Carbaryl	Carbamate	Insecticide		1B			No	No	No	Yes	Not approved	B
Carbendazim	Benzimidazole	Fungicide			1A / 1B	1A / 1B	No	No	No	Yes	Not approved	A
Carbofuran	Carbamate	Insecticide, Nematicide	1B				No	Yes	No	Yes	Not approved	A
Chlorothalonil	Aromatic fungicide	Fungicide, Oomycide		1B			No	No	No	Yes	Approved	B
Cyfluthrin	Pyrethroid	Insecticide	1B				No	No	No	Yes	Not approved	A
Diazinon	Organophosphorus	Insecticide				1B	No	No	No	Yes	Not approved	B
Diclofop-methyl	Phenoxy	Herbicide		1B		1A / 1B	No	No	No	Yes	Approved	B
Diuron	Urea	Herbicide		1B			No	No	No	Yes	Approved	B
Endosulfan	Organochlorine	Insecticide, Acaricide					Yes	Yes	No	Yes	Not approved	A
Epoxiconazole	Triazole	Fungicide		1B		1A / 1B	No	No	No	Yes	Approved	A
Ethoprop	Organophosphorus	Insecticide, Nematicide	1A	1B			No	No	No	Yes	Approved	A
Flocoumafen	Coumarin	Rodenticide	1A				No	No	No	Yes	Not approved	A
Flucythrinate	Pyrethroid	Insecticide, Acaricide	1B				No	No	No	Yes	Not approved	A
Haloxypop-p-methyl	Phenoxy	Herbicide		1B			No	No	No	Yes	Approved	B
Iprodione	Dicarboximide	Fungicide		1B			No	No	No	Yes	Approved	B
Iprovalicarb	Carbamate	Fungicide		1B			No	No	No	Yes	Approved	B
Kresoxim-methyl	Strobilurin	Fungicide		1B			No	No	No	Yes	Approved	B

HHP AI	Chemical class	Use type	HHP1 Acute toxicity	HHP2 Carci- nogenicity	HHP3 Muta- genicity	HHP4 Repro- ductive toxin	HHP5 POP	HHP6 PIC	HHP7 ODS	PAN HHP	EU approved	GIZ classification
Magnesium phosphide	Fumigant	Insecticide	1				No	No	No	Yes	Approved	B
Mancozeb	Dithiocarbamate	Fungicide, Oomycide		1B			No	No	No	Yes	Approved	B
Methidathion	Organophosphorus	Insecticide	1B				No	No	No	Yes	Not approved	A
Metiram	Dithiocarbamate	Fungicide, Oomycide		1B			No	No	No	Yes	Approved	B
Oxydemeton-methyl	Organophosphorus	Insecticide	1B				No	No	No	Yes	Not approved	A
Propineb	Dithiocarbamate	Fungicide, Oomycide		1B			No	No	No	No	Approved	D
Thiacloprid	Neonicotinoid	Insecticide		1B			No	No	No	Yes	Approved	B
Thiophanate-methyl	Benzamidazole	Fungicide		1B			No	No	No	Yes	Approved	B
Topramezone	Pyrazole	Herbicide				1A / 1B	No	No	No	No	Pending	#N/A
Triadimefon	Triazole	Fungicide				1B	No	No	No	No	Not approved	B
Zinc phosphide	Inorganic-zinc	Rodenticide	1B				No	No	No	Yes	Approved	A



**Appendix Table 4: List of AI registered in Ethiopia which require exceptional authorization for recommendation or procurement**

Pesticide AI	Chemical class	Use type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU	Number of products registered
Abamectin	Macrocyclic lactone - avermectin	Insecticide	HHP	No	No	Yes	Approved	5
Acephate	Organophosphorus	Insecticide	Danger	No	Yes	Yes	Not approved	1
Acrinathrin	Pyrethroid	Insecticide, Acaricide	Warning	No	No	Yes	Approved	1
Aluminium phosphide	Fumigant	Insecticide, Rodenticide	HHP	No	No	Yes	Approved	14
Ametryn	Triazine	Herbicide	Danger	No	No	No	Not approved	4
Aminopyralid	Aromatic acid	Herbicide	Danger	No	Yes	No	Approved	1
Amitraz	Formamidine	Insecticide	Danger	No	Yes	No	Not approved	1
Atrazine	Triazine	Herbicide	Warning	No	Yes	Yes	Not approved	10
Bendiocarb	Carbamate	Insecticide	Danger	No	No	Yes	Not approved	1
Beta-cypermethrin	Pyrethroid	Insecticide	Missing data	No	No	Yes	Not approved	1
Bifenthrin	Pyrethroid	Insecticide	Danger	No	Yes	Yes	Approved	2
Bioallethrin	Pyrethroid	Insecticide	Warning	No	No	No	Not approved	1
Bromoxynil octanoate	Nitrile	Herbicide	Danger	No	Yes	Yes	Approved	2
Butachlor	Amide	Herbicide	HHP	No	No	Yes	Not approved	1
Carbaryl	Carbamate	Insecticide	HHP	No	Yes	Yes	Not approved	2
Carbosulfan	Carbamate	Insecticide	Danger	No	Yes	Yes	Not approved	4
Chlorantraniliprole	Pyrazole / diamide	Insecticide	Warning	No	No	Yes	Approved	2
Chlorfenapyr	Pyrrole	Insecticide, Acaricide	Danger	No	Yes	Yes	Not approved	3
Chlorothalonil	Aromatic fungicide	Fungicide, Oomycide	HHP	No	No	Yes	Approved	5
Chlorpyrifos	Organophosphorus	Insecticide, Acaricide	Danger	No	No	Yes	Approved	12
Copper hydroxide	Inorganic - copper	Fungicide, Oomycide, Bactericide	Danger	No	No	Yes	Approved	7
Cypermethrin	Pyrethroid	Insecticide, Acaricide	Danger	No	No	Yes	Approved	9
Deltamethrin	Pyrethroid	Insecticide	Danger	No	No	Yes	Approved	16
Diafenthiuron	Thiourea	Insecticide, Acaricide	Danger	No	No	Yes	Not approved	2

Pesticide AI	Chemical class	Use type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU	Number of products registered
Diazinon	Organophosphorus	Insecticide	HHP	No	Yes	Yes	Not approved	9
Diclofop-methyl	Phenoxy	Herbicide	HHP	No	No	Yes	Approved	1
Dicofol	Bridged diphenyl	Acaricide	Danger	No	Yes	No	Not approved	1
Dimethenamid-p	Amide	Herbicide	Warning	No	No	No	Approved	1
Dimethoate	Organophosphorus	Insecticide	Danger	No	No	Yes	Approved	8
Diuron	Urea	Herbicide	HHP	No	No	Yes	Approved	1
Fatty alcohols	Alcohol/ester	Plant Growth Regulator	Missing data	No	No	No	Not approved	1
Fenitrothion	Organophosphorus	Insecticide	Danger	No	Yes	Yes	Not approved	5
Fenthion	Organophosphorus	avicide, insecticide	Danger	No	Yes	Yes	Not approved	2
Fipronil	Pyrazole	Insecticide	Danger	No	Yes	Yes	Not approved	3
Fluazifop-p-butyl	Phenoxy	Herbicide	Warning	No	Yes	No	Not listed	2
Flufenoxuron	Insect growth regulator	Insecticide, Acaricide	Warning	No	Yes	Yes	Not approved	1
Folpet	Phthalimide	Fungicide	Warning	No	Yes	Yes	Approved	1
Glyphosate	Organophosphorus	Herbicide	Danger	No	No	Yes	Approved	29
Haloxfop-p-methyl	Phenoxy	Herbicide	HHP	No	No	Yes	Approved	1
Hexazinone	Triazinone	Herbicide	Warning	No	No	No	Not approved	1
Imidacloprid	Neonicotinoid	Insecticide	Warning	No	No	Yes	Approved	9
Indoxacarb	Oxadiazine	Insecticide	Danger	No	No	Yes	Approved	2
Iprodione	Dicarboximide	Fungicide	HHP	No	No	Yes	Approved	3
Iprovalicarb	Carbamate	Fungicide	HHP	No	No	Yes	Approved	1
Kresoxim-methyl	Strobilurin	Fungicide	HHP	No	No	Yes	Approved	3
Lambda-cyhalothrin	Pyrethroid	Insecticide	Danger	No	No	Yes	Approved	20
Magnesium phosphide	Fumigant	Insecticide	HHP	No	No	Yes	Approved	1
Malathion	Organophosphorus	Acaricide, Insecticide	Danger	No	Yes	Yes	Approved	8
Mancozeb	Dithiocarbamate	Fungicide, Oomycide	HHP	No	No	Yes	Approved	36
Mandipropamid	Amide	Fungicide	Warning	No	No	No	Approved	1
Mepiquat chloride	Growth inhibitor	plant growth regulator	Warning	No	Yes	No	Not listed	1

Pesticide AI	Chemical class	Use type	Hazard summary	Proposed POPs	Rotterdam notifications	PAN HHP list	Approved for use in the EU	Number of products registered
Metiram	Dithiocarbamate	Fungicide, Oomycide	HHP	No	No	Yes	Approved	1
Metribuzin	Triazinone	Herbicide	Danger	No	No	Yes	Approved	1
Novaluron	Insect growth regulator	Insecticide	Warning	No	No	No	Not approved	2
Paraquat	Quaternary ammonium	Herbicide	Danger	No	Yes	No	Not approved	1
Pirimiphos-methyl	Fumigant, organophosphorus	Fumigant, Insecticide, Acaricide	Warning	No	No	Yes	Approved	4
Polyoxin	Biopesticide - microbial	Fungicide	Missing data	No	No	No	Not approved	1
Prallethrin	Pyrethroid	Insecticide	Danger	No	No	Yes	Not listed	1
Profenofos	Organophosphorus	Insecticide	Danger	No	Yes	Yes	Not approved	11
Prometryn	Triazine	Herbicide	Warning	No	No	No	Not approved	2
Propoxur	Carbamate	Insecticide	HHP	No	No	Yes	Not approved	1
Saflufenacil	Amide	Herbicide	Warning	No	No	No	Not approved	1
Spinetoram	Biochemical biopesticides - microbial extracts / fermentation products / enzymes	Insecticide	Warning	No	No	Yes	Approved	1
Spinosad	Biochemical biopesticides - microbial extracts / fermentation products / enzymes	Insecticide	Warning	No	No	Yes	Approved	2
Sulfoxaflor	Sulfoximine	Insecticide	Missing data	No	No	Yes	Approved	1
Tetraconazole	Triazole	Fungicide	Warning	No	No	Yes	Approved	1
Tetramethrin	Pyrethroid	Insecticide	Warning	No	No	Yes	Not approved	5
Thiacloprid	Neonicotinoid	Insecticide	HHP	No	No	Yes	Approved	1
Thiamethoxam	Neonicotinoid	Insecticide	Warning	No	No	Yes	Approved	4
Thidiazuron	Urea	Herbicide	Warning	No	No	No	Not approved	1
Thiophanate-methyl	Benzamidazole	Fungicide	HHP	No	No	Yes	Approved	1
Triadimefon	Triazole	Fungicide	HHP	No	No	No	Not approved	2

**Appendix Table 5: Recommended herbicides for weed control on wheat in Ethiopia and Management strategies in the literature**

Weeds	Pesticides used (AI)	Other recommended management methods (e.g. Pest Management Decision Guides (PMDGS) in the literature
<b>Common weeds</b>		<b>Prevention</b>
Grasses (Wild oats, <i>Bromus pectinatus</i> , Lolium Sp., Couch grass ( <i>digitaria abyssinicus</i> ), Sedges ( <i>Cyperus Spp.</i> ), <i>Snowdenia polystachya</i> , <i>Avena fatua</i> , <i>Phalaris paradoxa</i>	Pyroxsulumxw	<ul style="list-style-type: none"> <li>Seeds and fragmented rhizomes are presumed to be important in the propagation and spread (Etagegnehu <i>et al.</i>, 2016)</li> </ul>
	Iodosulfuron methyl'sodium 7.5g/l+Mesosulfuron-Methyl 7.5g/l	<ul style="list-style-type: none"> <li>Use certified clean seed for growing crops; seeds considered as the main means of spread (Etagegnehu <i>et al.</i>, 2016)</li> </ul>
	Clodinafop-propargyl	<ul style="list-style-type: none"> <li>Clean tools and farm machinery to prevent tubers being spread (Etagegnehu <i>et al.</i>, 2016)</li> </ul>
	Clodinafop-propargyl+Pinoxade	<ul style="list-style-type: none"> <li>Practice crop rotation with pulses and oil crops to reduce the establishment (Etagegnehu <i>et al.</i>, 2016)</li> </ul>
	Clodinafos- propargyl 8%+Cloquintocet-methyl 2%	<ul style="list-style-type: none"> <li>Control established populations near waterways to prevent spread during flooding and storm events</li> </ul>
	Fenoxaprop-p-ethyl	<ul style="list-style-type: none"> <li>Repeated ploughing/cultivation of the field to destroy weed seedlings when the soil is moist before planting or during off-season in order to reduce the population of weeds germinating after planting</li> </ul>
	Phenoxaprop-p-ethyl	
	Fenoxaprop-P-Ethyl	
	Diclofop-methyl	
	Axial	<b>Monitoring</b>
	Glyphosate36%	<ul style="list-style-type: none"> <li>Look out for perennial plant, with long slender branching rhizomes that form a dense mat beneath the soil surface (Etagegnehu <i>et al.</i>, 2016)</li> </ul>
	Pinoxaden	<ul style="list-style-type: none"> <li>Annual and erect grasses will have an open leaf-sheath, while upper leaves have a swollen leaf-sheath that envelopes the inflorescence before flowering (Etagegnehu <i>et al.</i>, 2016a)</li> </ul>
Glyphosate	<ul style="list-style-type: none"> <li>Leaves are flat, up to 15 cm long and 2–8 mm wide (Etagegnehu <i>et al.</i>, 2016a)</li> <li>Inflorescences are branched with 2 to 25 upwardly pointing, 2–11cm long flower heads ('branches') (Etagegnehu <i>et al.</i>, 2016b)</li> <li>Check in crop fields starting from one week after sowing for presence of <i>Digitaria abyssinica Ural</i> (Etagegnehu <i>et al.</i>, 2016b) and fortnightly after sowing for the presence of the other grass weeds; consider control using manual or chemical control when found</li> </ul> <p><b>Direct control</b></p> <ul style="list-style-type: none"> <li>Hand weeding at least two times starting from three weeks after sowing until the crop canopy is formed (Etagegnehu <i>et al.</i>, 2016a)</li> <li>Practice deep tillage (&gt;12cm) in order to disturb as many of the rhizomes as</li> </ul>	



Weeds	Pesticides used (AI)	Other recommended management methods (e.g. Pest Management Decision Guides (PMDGS) in the literature)
		possible. Do this under dry conditions so the exposed rhizomes desiccate (Etagegnehu <i>et al.</i> , 2016b)
<b>Broadleaved</b>		
<p><i>Amaranthus sp, Argemone, Convolvulus, Datura, Galinsonga, Galium aparacne, Guizotia scabra</i></p>	Pyroxsulum	<p><b>Prevention</b> (Mathews, 2016)</p> <ul style="list-style-type: none"> <li>• Do primary tillage to allow the weed to germinate quickly (two weeks after onset of rains). Then destroy it using secondary tillage</li> <li>• Clean the equipment outside the field before use, as it may harbour the small seeds of the weed</li> <li>• For small fields, use organic mulch from broad leaved plant residues to suppress growth of weed and to conserve water</li> </ul> <p><b>Monitoring</b> (Mathews, 2016)</p> <ul style="list-style-type: none"> <li>• Look for rough, soft, grey-greenish or green-reddish leafy plants with alternate leaves. Leaves are oval or diamond shaped and broader at the base</li> <li>• Look for these weeds from germination of the crop</li> <li>• Monitor for this weed after every two weeks</li> <li>• Check randomly for the presence of the weed from different parts of the field.</li> <li>• Consider weeding when you notice that about 20% of the inspected parts show signs of the weed</li> <li>• Since the weed produces a lot of seeds, it should be controlled before it produces seeds</li> </ul> <p><b>Direct control</b> (Mathews, 2016)</p> <ul style="list-style-type: none"> <li>• Hand-pull the Amaranthus weeds</li> <li>• You may use them as a vegetable</li> <li>• Remove weeds using a hoe</li> </ul>
	Fluroxypyr+MCPA SL	
	Tribenuron-methyl	
	Mecoprop	
	2,4-D 720g/l AE	
	2,4-D 72 Acid Equivalent	
	2,4-D damine salt 720 gm/l	
	2,4-D 720 gm/l SL	
	2,4-D dimethyl- amine salt 720	

Weeds	Pesticides used (AI)	Other recommended management methods (e.g. Pest Management Decision Guides (PMDGS) in the literature)
	gm/l	
	2,4-D	
	XDF 6.25 GL+2,4-D 300 GL- Suspo emulsion (STD)	
	Aminopyralid 30%+flurasulan 15%	
	Bispyribac Sodium	
	Tembotrion 50 g/l + bromoxynil octanoate 262 g/l	
	Dicamba + mecoprop	
	Glyphosate	
	2,4-D 720 g/l AE	
	Mecoprop 600 G/L aqueous concentrate	
	2,4-D amine 720 gm/lt	
	2,4-D Amine 72% W/V SL	
	2,4-D Amine Salt	
	Fenoxaprop-P-Ethyl 69 gm/lt	

Appendix Table 6: Recommended herbicides for weed control on wheat in Ethiopia

Weeds	Pesticides used (AI)	Other recommended management methods (e.g. PMDGS)
<b>Common weeds</b>		
Grasses (Wild oats, <i>Bromus pectinatus</i> , <i>Lolium</i> Sp., Couch grass ( <i>digitaria abyssinicus</i> ), Sedges ( <i>Cyperus Spp.</i> ), <i>Snowdenia polystachya</i> , <i>Avena fatua</i> , <i>Phalaris paradoxa</i> )	Pyroxsulum	<p><b>Prevention</b></p> <ul style="list-style-type: none"> <li>Use certified clean seed for growing crops; seeds considered as the main means of spread (CABI, 2016)</li> <li>Clean tools and farm machinery to prevent spread of weed seeds (CABI, 2016)</li> <li>Control established populations near waterways to prevent spread during flooding and storm events (CABI, 2016)</li> <li>Repeated ploughing/cultivation of the field to destroy weed seedlings when the soil is moist before planting or during off-season in order to reduce the population of weeds germinating after planting (CABI, 2016)</li> </ul> <p><b>Monitoring</b></p> <ul style="list-style-type: none"> <li>Annual and erect grasses with an open leaf-sheath, while upper leaves have a swollen leaf-sheath that envelopes the inflorescence before flowering (CABI, 2016)</li> <li>Inspect the crop fields a fortnight after sowing for the presence of the weeds; consider control using manual or chemical control when found (CABI, 2016)</li> </ul> <p><b>Direct control</b></p> <ul style="list-style-type: none"> <li>Hand weeding once (3–4 weeks after sowing) for moderate infestation; however, if severe infestation additional hand weeding before heading of the crops (CABI, 2016)</li> </ul>
	Iodosulfuron methyl'sodium 7.5g/l+Mesosulfuron-Methyl 7.5g/l	
	Clodinafop-propargyl	
	Clodinafop-propargyl+Pinoxade	
	Clodinafos- propargyl 8%+Cloquintocet-methyl 2%	
	Fenoxaprop-p-ethyl	
	Phenoxaprop-p-ethyl	
	Fenoxaprop-P-Ethyl	
	Diclofop-methyl	
	Axial	
	Glyphosate36%	
Pinoxaden		
Glyphosate		
<b>Broadleaved</b>		
<i>Amaranthus hybridus ochroleuca</i> , <i>Argemone</i> , <i>Convolvulus</i> , <i>Datura</i> , <i>Galinsonga</i> , <i>Galium aparacne</i> , <i>Guizotia scabra</i>	Pyroxsulum	<p><b>Argemone ochroleuca</b></p> <p><b>Prevention and monitoring</b></p> <ul style="list-style-type: none"> <li>Control the weed infestations when they are small before the seeds mature to reduce future problems (CABI, 2011)</li> <li>Start with the least infested areas before dense infestations (CABI, 2011)</li> <li>Practice regular and timely weeding. Weeding should be carried out before the plant has set the seed because light tillage can destroy seedlings (CABI, 2011)</li> <li>Management of grazing levels is likely to reduce susceptibility to infestation of the weed (CABI, 2011)</li> <li>Twice hand weeding 25–30 and 55–60 days after crop emergence</li> </ul> <p><b>Amaranthus hybridus</b></p> <p><b>Prevention</b></p> <ul style="list-style-type: none"> <li>Suppress it by integrating cereals in the crop rotation</li> </ul>
	Flurasulam 75 G/L +Flumetsulam 100G/L	
	Fluroxypyr+MCPA SL	
	Tribenuron-methyl	
	Mecoprop	
	2,4-D 720g/l AE	
	2,4-D 72 Acid Equivalent	
	2,4-D damine salt 720 gm/l	
	2,4-D 720 gm/l SL	
	2,4-D dimethyl- amine salt 720 gm/l	
	2,4-D	

Weeds	Pesticides used (AI)	Other recommended management methods (e.g. PMDGS)
	XDF 6.25 GL+2,4-D 300 GL-Suspo emulsion (STD) Aminopyralid 30%+florasulan 15% Bispyribac Sodium Tembotrion 50 g/l + bromoxynil octanoate 262 g/l Dicamba + mecoprop Glyphosate 2,4-D 720 g/l AE Mecoprop 600 G/L aqueous concentrate 2,4-D amine 720 gm/lt 2,4-D Amine 72% W/V SL 2,4-D Amine Salt Fenoxaprop-P-Ethyl 69 gm/lt	<b>Convolvulus</b> <ul style="list-style-type: none"> <li>• Suppress it by ploughing and cultivating stubbles repeatedly</li> </ul>

**Appendix Table 7: Wheat Diseases and Recommended Fungicides**

Common diseases	AI	Control methods
Yellow/Stripe rust ( <i>Puccinia striiformis</i> sp. tritici)	Tebuconazole	<p><b>Prevention:</b></p> <ul style="list-style-type: none"> <li>Remove residues from the previous rust infected crop before planting, leave residues to improve the soil, and reduce water loss if there are no diseases present</li> <li>Crop rotation with pulses, maize or sorghum</li> <li>Remove alternative hosts (e.g. volunteer wheat, barley and wild species)</li> <li>Use rust resistant wheat varieties, e.g. Meda Welabu, Flag 5 and ETBW 5483</li> <li>Apply recommended rate of nitrogen fertilizer (150 N/kg). Too much nitrogen encourages excessive plant growth that can increase disease</li> <li>Use recommended seeding rate (100kg/Ha) with 30cm between rows. This establishes good crop stand and minimizes occurrence of foliar and head diseases (CABI, 2015)</li> </ul> <p><b>Monitoring</b></p> <ul style="list-style-type: none"> <li>Check fields regularly in early growing season especially during the rainy season when the temperature range is cool (10–16°C). Symptoms can be seen on the leaves and spikelets and sometimes on the stems. Yellow pustules form in rows on the leaves and leaf sheathes</li> <li>Look for rows of tiny yellow, light brownish powdery residues, and lesions on young leaves</li> <li>Examine a number of plants throughout the field and consider action when infection levels approach an average 1–2 infected plants with early symptoms/ m<sup>2</sup>. Action is too late if you find many plants with long rows of yellow coloured powdery residues, lesions and necrosis across many leaves per plant (CABI, 2015)</li> </ul>
	Trifloxystrobin 100g/lit + Tebuconazole 200gm/l	
	Propiconazole 25%	
	Triadimefon/Triadimenol	
	Epoxiconazole+Thiophanate-methyl	
	Azoxystrobin 200gm/l+Cyproconazole 80gm	
	Azoxystrobin +Cyproconazole	
	Azoxystrobin	
	Difenoconazole + Propiconazole	
	Tebuconazole	
	Pyraclostrobin+Epixiconazole	
	Chlorothalonil	
	Propiconazole	
Propiconazole 25%		
Brown leaf rust ( <i>Puccinia recondite</i> f.sp. tritici)	Propiconazole	
	Triadimefon	
	Azoxystrobin	
Stem rust ( <i>Puccinia graminis</i> f.sp. tritici)	Tebuconazole	<p><b>Prevention</b></p> <ul style="list-style-type: none"> <li>Use certified, disease-free seed</li> <li>Plant resistant varieties (Mada walabu, Shorima and Edase) or sow early maturing varieties to avoid the disease (Jaferson, Ogolcho, Edase and Huluqa)</li> <li>When selecting varieties make sure they are suitable for the altitude where they will</li> </ul>
	Propiconazole 25%	
	Triadimefon	
	Propiconazole	



Common diseases	AI	Control methods
	Epoxiconazole+Thiophanate-methyl	<p>be grown</p> <ul style="list-style-type: none"> <li>• Avoid planting new wheat crop next to an infected field</li> <li>• Avoid walking through fields during the wet season to prevent disease spread from one plant to another</li> <li>• Rotate wheat with non-cereal crops, eg bean and other vegetables</li> <li>• Remove volunteer plants and alternative hosts (barberry and barley) before planting</li> <li>• Follow disease forecasting systems from national and international information centres (CABI, 2014)</li> </ul> <p><b>Monitoring</b></p> <ul style="list-style-type: none"> <li>• Additional relevant crops: barley</li> <li>• Start field observation two months after planting</li> <li>• Observe the upper and lower leaves and stem for reddish brown elongated lesions or pustules</li> <li>• If there is warm weather rapidly followed by cold weather take action when the disease symptoms are noticed (CABI, 2014)</li> </ul> <p><b>Control</b></p> <ul style="list-style-type: none"> <li>• Remove and bury infected plant materials below 50 cm in the ground</li> <li>• Start working from the healthy part of the field before moving to the infected part (CABI, 2014)</li> </ul>
SeptoriaTriticiBlotch( <i>Septoria tritici</i> )andSeptoriaNodorumBlotch( <i>Septoria nodorum</i> )	Copper Oxychloride	
	Benomyl	
	Carbendazin	
	Fentin Acetate	
	Captafol	
Tanspot ( <i>Helminthosporium tritici-repentis</i> )		
Scab (HeadBlight)( <i>Fusarium</i> spp)	Benomyl (systemic)	
	Carboxin	
Loose and covered smut	Imidacloprid+Tebuconazol	
Root rot diseases	Thiram	

Common diseases	AI	Control methods
Seed and seedling diseases e.g. Take-all ( <i>Ophiobolusgraminis</i> )	Imidaclopride 250g/kg+ Thiram 200gm/kg	
Wheat bunt ( <i>Tilletia tritici</i> )	Carboxin	
	Thiram	

Appendix Table 8: Wheat insect pests and recommended insecticides in Ethiopia

Pest	AI	Control methods
<b>Common insects</b>		<b>Prevention</b> (Erick, 2016)
	Lambda-cyhalothrin 5%	<ul style="list-style-type: none"> <li>Plant early since late-planted crop suffer severe damage by second generation armyworms</li> </ul>
	Diazinon	<ul style="list-style-type: none"> <li>Keep the field free of grassy weeds as young grasses are food for young caterpillars</li> </ul>
African armyworm Spodoptera Sp.	Malathion	<ul style="list-style-type: none"> <li>Keep flowering broad-leaf plants around the fields as they host natural enemies of armyworm</li> </ul> <p><b>Monitoring</b> (Erick, 2016)</p> <ul style="list-style-type: none"> <li>Outbreaks mostly occur after the first rains when grasses have started growing</li> <li>Look for caterpillars with velvety black shiny heads with inverted V-shaped marks on the head and white strips along the sides and the back</li> <li>Look for translucent caterpillars hanging on green maize/grass and that turn green after feeding</li> <li>Damaged crop is ragged, leaving only midrib in severe cases</li> <li>Male moth catches in pheromone traps at agricultural offices and village monitoring centres (≥30/week) in the presence of green grass and rainfall (≥5mm/week) indicate a likelihood of outbreak in an area. Farmers should check fields and report caterpillar presence to agricultural agents</li> <li>Get forecast updates from community and government forecasters and control if caterpillars are frequently found in the field</li> </ul> <p><b>Direct management</b> (Erick, 2016)</p> <ul style="list-style-type: none"> <li>Mechanically pick and crush caterpillars from the field</li> <li>Dig a 30cm deep trench around the maize field to trap marching caterpillars and destroy them by crushing or burying</li> <li>Shallower trenches may aid pupation if mature 6<sup>th</sup> larval instars are buried</li> <li>Normally spray only once per outbreak choosing one of the following products. The PHI includes any intercropped crops in the treated field</li> <li>When using a pesticide or botanical, always wear protective clothing and follow the instructions on the product label, such as dosage, timing of application, PHI, max number of sprays and restricted re-entry interval</li> </ul>

Pest	AI	Control methods
<ul style="list-style-type: none"> <li>Russian wheat aphid (Diuraphis noxia)</li> </ul>	<ul style="list-style-type: none"> <li>Thiamethoxam 35% FS</li> </ul>	<p><b>Prevention</b> (Frehiwot, 2015)</p> <ul style="list-style-type: none"> <li>Remove wheat residue from the previous season before planting. However, if no major insect pest diseases had been in the previous cereal, then leave residues as they improve the soil and reduce water evaporation</li> <li>Plant early in the rainy season</li> <li>Seed treatment (Apron Star and Thiamethoxam)</li> <li>Remove alternative hosts (barley, triticale, rye, oats and wild grain species)</li> <li>Rotate with pulse crops and large cereals (eg Maize and Sorghum)</li> </ul> <p><b>Monitoring</b> (Frehiwot, 2015)</p> <ul style="list-style-type: none"> <li>Scout fields regularly following seedling emergence (especially during dry period)</li> <li>Check a minimum of 10 random plants across the field.</li> <li>Look for grey to light green soft-bodied tiny insects. Aphids are only 1 to 2 mm long</li> <li>At heavy infestation, stunted plant, curled leaves and white/yellow colour stripes on the leaves</li> <li>Consider action if 2–5 aphids/ plant are found at two leaf-early tillering stage, 10–12 aphids/ plant at late tillering-first node stage, 20–22 at booting, and 30–32 at head exertion stage or late</li> </ul> <p><b>Direct control</b> (Frehiwot, 2015)</p> <ul style="list-style-type: none"> <li>Spray homemade garlic (onion) mixture to repel aphids</li> <li>Spray homemade neem leaf extract to control aphids</li> <li>Dilute 1 litre of neem leaf extract with 9 litres of water; Add 100 ml of soap; Stir well spray on the infested plants</li> <li>Spray Chili extracts. In a pot, boil ripe pods or chili seeds in water for 15–20 minutes</li> <li>Take the pot from the fire and add 3 litres of water. Cool and strain. Add soap. Stir well and spray on infested plants</li> <li>Seed treatments with systemic insecticide help to some extent to prevent aphid attack, but only on younger plants. Seed treatment must be done by trained, certified service providers. It cannot be done by the farmer as the treatment method is too dangerous. Buy treated seeds on advice of local extensionists</li> <li>When using a pesticide or botanical, always wear protective clothing and follow the instructions on the product label, such as dosage, timing of application, PHI, max number of sprays and restricted re-entry interval. Do not empty into drains and water sources</li> <li>Always consult recent list of registered pesticides in Ethiopian Ministry of Agriculture, Animal and Plant Health Regulatory Directorate</li> </ul>

Pest	AI	Control methods
<i>Aphid Schizaphisgraminum</i>		<p><b>Prevention</b> (Frehiwot, 2015)</p> <ul style="list-style-type: none"> <li>Remove wheat residue from the previous season before planting</li> <li>However, if no major insect pest diseases had been in the previous cereal then leave residues as they improve the soil and reduce water evaporation</li> <li>Plant early in the rainy season</li> <li>Seed treatment (Apron Star and Thiamethoxam)</li> <li>Remove alternative hosts (barley, triticale, rye, oats and wild grain species)</li> <li>Rotate with pulse crops and large cereals (e.g. Maize and Sorghum)</li> </ul> <p><b>Monitoring</b> (Frehiwot, 2015)</p> <ul style="list-style-type: none"> <li>Scout fields regularly following seedling emergence (especially during dry period)</li> <li>Check a minimum of 10 random plants across the field</li> <li>Look for grey to light green soft-bodied tiny insects. Aphids are only 1 to 2 mm long</li> <li>At heavy infestation, stunted plant, curled leaves and white/yellow colour stripes on the leaves</li> <li>Consider action if 2–5 aphids/ plant are found at two leaf-early tillering stage, 10–12 aphids/ plant at late tillering-first node stage, 20–22 at booting, and 30–32 at head exertion stage or later</li> </ul> <p><b>Direct management</b> (Frehiwot, 2015)</p> <ul style="list-style-type: none"> <li>Spray homemade garlic (onion) mixture to repel aphids</li> <li>Spray homemade neem leaf extract to control aphids</li> <li>Dilute 1 litre of neem leaf extract with 9 litres of water; Add 100 ml of soap; Stir well spray on the infested plants</li> <li>Spray Chili extracts. In a pot, boil ripe pods or chili seeds in water for 15–20 minutes</li> <li>Take the pot from the fire and add 3 litres of water. Cool and strain. Add soap. Stir well and spray on infested plants</li> <li>Seed treatments with systemic insecticide help to some extent to prevent aphid attack, but only on younger plants. Seed treatment must be done by trained, certified service providers. It cannot be done by the farmer as the treatment method is too dangerous. Buy treated seeds on advice of local extensionists</li> <li>When using a pesticide or botanical, always wear protective clothing and follow the instructions on the product label, such as dosage, timing of application, PHI, max number of sprays and restricted re-entry interval. Do not empty into drains and water sources</li> <li>Always consult recent list of registered pesticides in Ethiopian Ministry of Agriculture, Animal and Plant Health Regulatory Directorate</li> </ul>
Locusts/grasshoppers	<p>Chlorpyrifos</p> <p>Fenitrothion</p>	<p><b>Prevention</b> (Wang Feng, 2017)</p> <ul style="list-style-type: none"> <li>Deep tillage improves soil for good plant growth and better crop tolerance to damage</li> </ul>



Pest	AI	Control methods
	Profenofos + Cypermethrin	<ul style="list-style-type: none"> <li>• Use tolerant and high yielding varieties</li> <li>• Reasonably irrigate and fertilize to create favourable conditions for wheat to increase its tolerance to damage</li> <li>• Remove residues after harvest to reduce food source of remaining locusts. If there are no major diseases or pests in the field, leave residues to improve the soil</li> </ul> <p><b>Monitoring</b> (Wang Feng, 2017)</p> <ul style="list-style-type: none"> <li>• Look for feeding holes and chewed leaves</li> <li>• Look on wheat leaves for locusts</li> <li>• Locusts are about 25mm, are often tawny and include three parts: head with antennae, chest abdomen, and long legs</li> <li>• Threshold: Counts of 1–5 locusts per square metre may require control action</li> <li>• If you have more than five locusts per square metre direct control is urgent</li> </ul> <p><b>Direct control</b> (Wang Feng, 2017)</p> <ul style="list-style-type: none"> <li>• Handpick or sweep net locusts</li> <li>• Use pneumatic sucking-capture machines to collect locusts</li> <li>• Apply biopesticides with beneficial fungi (2.5% metarhizium anisopliae), ultra-low volume sprayer, usually at 50ml/ha but check product labels. Make sure you use the right beneficial fungal strain</li> <li>• Apply neem botanicals (0.3% neem oil, ultra-low volume spray, usually at 150ml/ha)</li> </ul>
Teff Epilachina ( <i>Chnootriba similis</i> )		
<b>Storage pests</b>		
Sitophilus, Rhizopertha, Sitotroga, Orizophilus, Tribolium	Pirimiphos-methyl 500g/l	
	Pirimiphos-methyl 2% dust	
	Malathion 5% dust	
	Aluminium Phosphide	
<b>Rodenticides</b>		
Rodents	Brodifacoum	<p><b>Monitoring</b></p> <ul style="list-style-type: none"> <li>• Grains missing from plants</li> <li>• Birds can be seen actively feeding on the spikes, including pulling plant out of the ground and eating the remaining seed</li> <li>• Look for the tracks or droppings of birds or rodents in areas where emergence is poor. The damage often occurs in distinct patches or along the margins of fields where shrubs or trees provide a habitat</li> </ul>
	Bromadiolone	
	Flocoumafem 0.005%	
	Zinc Phosphide 80% Technical	
<b>Avicides</b>		
Weaver birds ( <i>Quelea quelea</i> )	Fenthion	

Pest	AI	Control methods
Quelea birds	Fenthion	<ul style="list-style-type: none"> <li>• Around maturity examine the spikes in different areas of the field for missing grain</li> </ul> <b>Control</b> <ul style="list-style-type: none"> <li>• Change the planting date</li> <li>• Apply a bird repellent to the seed</li> <li>• Poison rodents in burrows near the field</li> <li>• Plant varieties of similar maturity for the region</li> <li>• Employ a bird scarer/scarecrow</li> </ul>
<b>Nematicide</b>		
Nematodes	Ethoprophos	

**Appendix Table 9: Pesticides used in Ethiopia for pests of faba bean and recommended practices in the literature**

Pests	AI	Other control methods in the literature
<b>Herbicide</b>		
Annual grass and broad leaved weeds	Terbutryn	<b>Prevention</b> <ul style="list-style-type: none"> <li>• Use certified clean seed for growing crops; infected seeds are considered as the main means of spread (CABI 2016)</li> <li>• Clean tools and farm machinery to prevent spread of weed seeds (CABI 2016)</li> <li>• Hand weeding once to twice (25–30 DAE and 40–45 DAE) DAE = days after emergence (CABI 2016)</li> </ul>
Broad leaved weeds	Terbutryn+Terbutlazine	
Broad leaved weeds	Fluazitop-Butyl	
Parasitic plants ( <i>Oronche Spp</i> )	Imazaquin	
Grass weeds	Fusilade Super 12.5% EC	
<b>Common diseases</b>	<b>Fungicides</b>	
chocolate spot ( <i>Botrytis fabae</i> )	Mancozeb 800g/kg	<b>Prevention</b> <ul style="list-style-type: none"> <li>• Use improved varieties Gebelcho, Obse, Dosha, Degaga, Tumsa or Moti (CABI, 2015)</li> <li>• Practice crop rotation every 2–3 years with non-susceptible crops (cereal crops) (CABI, 2015)</li> <li>• Do not plant new plants in infected land, plant in a new plot at least 500 m from the old infection (CABI, 2015)</li> <li>• Avoid high planting density as doing this will reduce the humidity, which otherwise triggers the aggressive phase of the disease (CABI, 2015)</li> <li>• Check and use correct spacing for each variety (CABI, 2015)</li> <li>• Remove crop debris and volunteer bean plants (eg chickpea and lentils) and destroy by burning (CABI, 2015)</li> <li>• Make sure adequate drainage is provided and use correct rate of fertilizer (CABI, 2015)</li> </ul> <b>Monitoring</b> <ul style="list-style-type: none"> <li>• Start monitoring the crop from emergence of leaves until maturity as there are two phases to the disease (CABI, 2015)</li> <li>• The first disease phase is the non-aggressive phase: look for small brown/red spots peppered over the leaves and also on stems and pods (CABI, 2015)</li> <li>• During high humidity the aggressive phase develops: grey fungus grows on the spots as they become larger and darker, and defoliation can follow (CABI, 2015)</li> <li>• Consider applying a protectant fungicide when the plants emerge or at the first signs of the disease, especially if the weather is forecast to be wet – take action when there are 5–10 spots per leaf or 3–5 leaves per plant infected (CABI, 2015)</li> </ul> <b>Direct control</b> <ul style="list-style-type: none"> <li>• Remove severely affected plants and destroy by burying or burning to reduce the source of inoculum (traces of fungi) on the farm (CABI, 2015)</li> </ul>
	Chlorothalonil	
faba bean rust ( <i>Uromyces viciae-fabae</i> )	Mancozeb	<ul style="list-style-type: none"> <li>• Use improved varieties (tolerant varieties)</li> </ul>
	Chlorothalonil	

Pests	AI	Other control methods in the literature
	Copper	<ul style="list-style-type: none"> <li>An integrated approach is recommended for the control of Cercospora leaf spot, involving growing systems, resistant cultivars and fungicides <a href="http://www.plantwise.org/KnowledgeBank/Datasheet.aspx?dsid=12191">www.plantwise.org/KnowledgeBank/Datasheet.aspx?dsid=12191</a></li> </ul>
	Triadimefor	
	Propineb	
Cercospora leaf spot	Chlorothalonil	
	Carbendazin	
Black rot ( <i>Fusarium solani</i> )		<ul style="list-style-type: none"> <li>Drainage using broad bed and furrows and Camber beds</li> <li>Use resistant varieties and early planting (Habtegebriel B, Boydom A, 2016)</li> </ul>
Root rot ( <i>Rhizoctonia solani</i> )		<ul style="list-style-type: none"> <li>Use resistant genotypes</li> <li>Crop rotation with a grass-free, non-cereal crop (Grains Research &amp; Development Corporation, 2016), <a href="http://www.plantwise.org/KnowledgeBank/FactsheetForFarmers.aspx?pan=20147801508">www.plantwise.org/KnowledgeBank/FactsheetForFarmers.aspx?pan=20147801508</a></li> </ul>
Aschochyta blight ( <i>Aschochyta fabae</i> )	Mancozeb 800g/kg	<p><b>Prevention and control</b></p> <ul style="list-style-type: none"> <li>Select seed varieties with the highest level of resistance (Agriculture Victoria, 2016) <a href="http://agriculture.vic.gov.au/agriculture/innovation-and-research">agriculture.vic.gov.au/agriculture/innovation-and-research</a></li> <li>The seeds should be sourced from the 'cleanest' crops, as damaged seed may have reduced germination and reduced vigour (Agriculture Victoria, 2016) <a href="http://agriculture.vic.gov.au/agriculture/innovation-and-research">agriculture.vic.gov.au/agriculture/innovation-and-research</a></li> <li>Observe a break of at least three years between faba bean crops (Agriculture Victoria, 2016)</li> <li>Separate this year's faba bean crop from last year's faba bean stubble by a distance of 500m (Agriculture Victoria, 2016)</li> <li>A foliar spray is applied prior to infection to be effective (Agriculture Victoria, 2016)</li> <li>Plan to harvest as early as possible to minimize discolouration of seed caused by ascochyta infection (Agriculture Victoria, 2016)</li> </ul>
	Chlorothalonil	

Pests	AI	Other control methods in the literature
Faba bean Gall ( <i>Oidium viciae</i> )		<ul style="list-style-type: none"> <li>• First reported as a new species in 1912 in Japan, later in China in 1936 and then in Ethiopia in 2010 (Holleta Agricultural Research Centre). It is more severe in higher altitude, poorly drained soils, closely spaced crops and weedy plots. Can be transmitted through seed, infested plant and crop residues. Alternative hosts of faba bean gall include pea, rape seed, cabbage, cucumber, spinach and buck wheat</li> </ul> <p><b>Prevention</b></p> <ul style="list-style-type: none"> <li>• Plant certified varieties that are tolerant to faba bean gall, eg Degaga, NC58, Gora or Gachena (Abebe <i>et al.</i>, 2014; Alemu and Taddele, 2017), adjust planting date to a void high disease pressure</li> <li>• Rotate for at least two seasons with cereals such as maize, and plant in well drained soils at recommended spacing</li> <li>• Remove plants that appear affected and burn or bury. Seeds from infected plants should not be recycled</li> </ul> <p><b>Monitoring</b></p> <ul style="list-style-type: none"> <li>• Scout weekly from two weeks after germination onwards. Look for infected plants with either galls or necrotic irregular spots on underside of leaves</li> </ul> <p><b>Control – chemical</b></p> <ul style="list-style-type: none"> <li>• Apply appropriate recommended and registered fungicides as a seed treater protectant before incidence is over 5%. Rotation of active ingredients is recommended by Fungicide Resistance Action Committee (FRAC)</li> <li>• Wear protective clothing when handling pesticides and observe re-entry and pre-harvest intervals</li> </ul>
Downy mildew ( <i>Peronospora viciae</i> )	Carbendazim	<p><b>Prevention and control</b></p> <ul style="list-style-type: none"> <li>• Remove crop debris containing oospores to avoid build-up of soil borne</li> <li>• Treat seed with metalaxyl to reduce the number of primary infections (<a href="http://www.plantwise.org/KnowledgeBank/Datasheet.aspx?dsid=39738">www.plantwise.org/KnowledgeBank/Datasheet.aspx?dsid=39738</a>)</li> <li>• Avoid the growth of the host plant in fields heavily infested with oospores</li> <li>• Use (partially) resistant cultivars (CABI,2014)</li> </ul>
Faba bean necrotic yellow virus (FBNYV)		<p><b>Prevention and control</b></p> <ul style="list-style-type: none"> <li>• Eliminate sources of infection within the crop by rogueing of FBNYV-infected faba bean to reduces primary infection foci (CABI, 2017)</li> <li>• Combining genetic resistance, cultural practices (CABI, 2017)</li> </ul>
Bean leaf roll virus		
<b>Nematodes</b>	<b>Nematicides</b>	<b>Prevention and control</b>



Pests	AI	Other control methods in the literature
Stem nematode ( <i>Ditylenchus dipsaci</i> )		<ul style="list-style-type: none"> <li>Fumigation of infested seed with methyl bromide does not seem reliable but in-row treatments with oxime carbamate nematicides may eradicate seed or soil borne infestations from spring sown, but not winter sown crops (CABI, 2018)</li> <li>The use of seed free of stem nematode is recommended, particularly for new sites (CABI, 2018)</li> <li>Nematode-free (certified) seeds and planting material are most essential to prevent crop damage</li> <li>Using hot water with different temperature/time combinations, depending on type and state of seed material can control it (croptenebank)</li> </ul>
<b>Insect pests</b>		
Black Aphid ( <i>Acrythosiphon pisum</i> , <i>Aphis fabae</i> )	Pirimicarb	<ul style="list-style-type: none"> <li>Coccinellids useful in preventing over population of aphids (CABI Plantwise, 2017)</li> <li>Fungal pathogens are useful in reducing the pest (CABI Plantwise, 2017)</li> </ul>
Cutworm		
<b>Storage pests</b>		
Bean bruchid ( <i>Callosobruchus chinensis</i> )	Pirimiphos-methyl 2% dust	<b>Prevention</b> (UC IPM Pest Management Guidelines, 2016)
	Malathion 5% dust	<ul style="list-style-type: none"> <li>Use clean certified seed</li> <li>Intercropping with crops such as maize</li> <li>Clean the storage facility prior to storage</li> <li>Harvest beans as soon as they are mature to reduce the risk of heavy infestation</li> <li>Air-dry the beans to a moisture level of 12% or lower before storage</li> <li>Do not store old beans with newly harvested beans</li> <li>Store beans in air-tight containers if possible, such as in plastic sealable bags, drums or clay pots (UC IPM Pest Management Guidelines 2016)</li> </ul>

Sources: **Faba bean gall (*Olpidium viciae*) – Recommendations for management:**

- <http://www.eap.gov.et/sites/default/files/released%20crop%20varities.pdf>;
- <http://ipm.ucanr.edu/PMG/r735300311.html>
- <https://www.plantwise.org/FullTextPDF/2016/20167800976.pdf>
- <http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/grains-pulses-and-cereals/ascochyta-blight-of-faba-bean>
- <https://croptenebank.sgrp.cgiar.org/index.php/management-mainmenu-433/stogs-mainmenu-238/fababean/guidelines/nematodes>
- [https://grdc.com.au/\\_\\_data/assets/pdf\\_file/0018/170343/grdc\\_tips\\_and\\_tactics\\_rhizoctonia\\_western\\_web.pdf](https://grdc.com.au/__data/assets/pdf_file/0018/170343/grdc_tips_and_tactics_rhizoctonia_western_web.pdf)
- <https://www.cropsience.bayer.com/en/Crop-Compendium/Pests-Diseases-Weeds/Weeds/Amaranthus-hybridus.aspx>

**Appendix Table 10: List of the key pests of wheat and faba beans and the HHP and non-HHP AI that are registered for their management**

Target pest common names	Crop	AI effective against target pests that are registered and are not HHP	HHPs that are used to manage the target pest <sup>1</sup>
Grassy weeds	Wheat	Bromoxynil octanoate (GIZ class: B) Clodinafop-propargyl (GIZ class: not listed) Fenoxaprop-p-ethyl (GIZ class: D) Glyphosate (GIZ class: B) Iodosulfuron-methyl-sodium (GIZ class: not listed) Mesosulfuron-methyl (GIZ class: not listed) Pinoxaden (GIZ class: not listed) Pyroxsulam (GIZ class: D) Tembotrione (GIZ class: D)	Diclofop-Methyl
Black (stem) rust, <i>Puccinia graminis</i>	Wheat	Azoxystrobin (GIZ class: D) Propiconazole (GIZ class: C) Tebuconazole (GIZ class: C)	Epoxiconazole Thiophanate-methyl Triadimefon
Brown (leaf) rust, <i>Puccinia triticina</i>	Wheat	Azoxystrobin (GIZ class: D) Propiconazole (GIZ class: C)	Triadimefon
Yellow (stripe) rust, <i>Puccinia striiformis</i> f. sp. <i>tritici</i>	Wheat	Azoxystrobin (GIZ class: D) Cyproconazole (GIZ class: C) Difenoconazole (GIZ class: C) Propiconazole (GIZ class: C) Pyraclostrobin (GIZ class: D) Tebuconazole (GIZ class: C) Trifloxystrobin (GIZ class: D)	Chlorothalonil Epoxiconazole Thiophanate-Methyl Triadimefon
Aphids	Wheat	No non-HHP AI registered for use on wheat	Diazinon
Armyworms, <i>Spodoptera</i> spp.	Wheat	Chlorpyrifos (GIZ class: B) Fenitrothion (GIZ class: B) Malathion (GIZ class: B)	Diazinon Carbaryl
Grasshoppers	Wheat	Chlorpyrifos (GIZ class: B) Fenitrothion (GIZ class: B) Fipronil (GIZ class: B) Malathion (GIZ class: B)	Diazinon
Shoot fly, <i>Atherigona</i> sp.	Wheat	No non-HHP AI registered	Trichlorfon
Nematodes	Wheat	No non-HHP AI registered	Ethoprop

<sup>1</sup>The list of HHPs includes those that are registered for use against the pest and those farmers use / extension agents recommend even if they are not registered.

Target pest common names	Crop	AI effective against target pests that are registered and are not HHP	HHPs that are used to manage the target pest <sup>1</sup>
Storage insect pests	Wheat, faba beans	Deltamethrin (GIZ class: B) Malathion (GIZ class: B) Pirimiphos-methyl (GIZ class: B)	Aluminium Phosphide
Rodents in field and storage	Wheat / faba beans	No non-HHP AI registered	Brodifacoum Bromadiolone Flocoumafem Zinc Phosphide
Aschochyta blight (Aschochyta fabae)	Faba beans	No non-HHP AI registered	Chlorothalonil Mancozeb
Cercospora leaf spot	Faba beans	No non-HHP AI registered	Carbendazim Chlorothalonil
Chocolate spot, Botrytis fabae	Faba beans	No non-HHP AI registered	Chlorothalonil Mancozeb
Downy mildew (Peronospora viciae)	Faba beans	No non-HHP AI registered for use on faba beans	Carbendazim
Faba bean rust, Uromyces viciae-fabae	Faba beans	No non-HHP AI registered	Mancozeb Chlorothalonil Triadimefor Propineb
Aphids	Faba beans	Dimethoate (GIZ class: B)	Diazinon

**Appendix Table 11: Training topics of the best practices “Green Innovation Centres for the Agricultural and Food Sector – Ethiopia**

Crop Rotation Based Good Agricultural Practices (GAP) for Wheat and Faba Bean Production in Arsi Zone:

**Part 1: Introduction**

- 1.1. Elements of the set of learning material and their structure
- 1.2. Main requirements and assumptions
- 1.3. The structure of the flip-over
- 1.4. How to use the flip-over in the training session
- 1.5. Recall: facilitation hints

**Part 2: Technical hints / background material on the flip-over**

1. Introduction of the Gamachu family
2. Planning the coming production season
3. Land preparation
4. Faba bean seed dressing with bio fertilizer
5. Sowing faba beans and basal fertilizer application
6. Sowing wheat and basal fertilizer application
7. Weed management in faba beans (Importance of (timely) weeding; Different types of weeds; Integrated weed control; Chemicals for weeds in faba beans)
8. Safe handling of agro-chemicals (Why protection is needed; Protection tools; Proper identification of diseases or pests; Calculating the right dose; Correct application; Safe cleaning, disposal and storage)
9. Weed management in wheat (Importance of (timely) weeding; Major weeds; Prevention / cultural practices; Chemical weeding)
10. Mineral fertilizer application in wheat – topdressing with Urea (Timing of fertilizer application; Importance of additional fertilizer at different growing stages; Effect of wrong dose (too high, too low, wrong time))
11. Diseases and insect control in wheat (Diseases and pests in wheat and their effects)
12. Major diseases; Integrated diseases and insect management
13. Harvesting and drying wheat (Prerequisites in using the combine harvester)
14. Threshing and winnowing of wheat (Combine harvester or mobile thresher)
15. Harvesting and drying faba beans
16. Threshing and winnowing faba beans
17. Safe storage and reduction of post-harvest losses of wheat and faba beans (Importance of proper storage; Right piling technique; Principle of storage: hermetic closing; Storage types – cocoon, silo, improved Gotara, PICS bag)
18. Marketing
19. Effects of bio fertilizer







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