Environmental Governance of Pesticides in Ethiopian Vegetable and Cut Flower Production

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Environmental Governance of Pesticides in Ethiopian Vegetable and Cut Flower Production

Belay Tizazu Mengistie

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Preface

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Contents

Preface

Contents

Lists of figures, photos and tables

List of abbreviations

Chapter 1: Introduction 1

1.1 Environmental and human health concerns of pesticides in a globalized world 2
1.2 Governance of pesticide problems 8
1.3 Challenges to pesticide registration, distribution and use in Ethiopian agriculture 12
1.4 Pesticide use in the vegetable and cut flower sectors 15
1.5 Pesticide policy and regulation 17
1.6 Research objective and research questions 19
1.7 Theoretical perspectives 21
1.8 Research methodology 24
1.8.1 Research sites and the sector analysis approach 24
1.8.2 Methods of data collection 26
1.8.3 Data analysis 28
1.9 Research validity 29
1.10 Ethical considerations 30
1.11 Outline of the dissertation 31

Chapter 2: Information, motivation and resources: the missing elements in agricultural pesticide policy implementation in Ethiopia **33**

2.1 Introduction 35
2.2 Policy implementation framework: a contextual interaction theory 37
2.3 Research methods 40
2.4 Legal framework of state pesticide policy and registration system in Ethiopia 42
2.4.1 Pesticide regulatory framework 42
2.4.2 Pesticides registration procedures in Ethiopia 44
2.4.3 Pesticides registration challenges in Ethiopia 48
2.5 The role of policy actors in pesticide policy implementation in Ethiopia 51
2.5.1 Access to information in the implementation of pesticide policy 52
2.5.2 Motivation of policy actors in the implementation of pesticide policy 55
2.5.3 Resources of policy actors in the implementation of pesticide policy 57
2.6 Output of the pesticide policy implementation process 58
2.7 Conclusions and recommendations 62

Chapter 3: Private environmental governance in the Ethiopian pesticide supply chain: importation, distribution and use **65**

3.1 Introduction 67
3.2 Conceptualizing private environmental governance in pesticide supply chains 69
3.3 Research methods 71
3.4 Pesticide supply chain actors, supporters and influencers 72
3.4.1 Pesticide supply chain actors: import, distribution and use 72
3.4.1.1 Pesticide importers 72
3.4.1.2 Pesticide retailers 76
3.4.1.3 Pesticide end users (farmers) 81
3.4.2 Supply chain supporters: signs of hope 84
3.4.3 Supply chain influencers: international treaties on pesticide import, distribution and use 85
3.5 Discussion and conclusions 87

Chapter 4: Pesticide use practices among smallholder vegetable farmers in Ethiopian Central Rift Valley **93**

4.1 Introduction 95
4.2 A social practices approach for studying pesticide use 96
4.3 Research methods 99
4.4 Results 100
4.4.1 Lifestyle characteristics and their contribution to (un)safe pesticide practice 101
4.4.1.1 Lifestyle characteristics of farmers 101
4.4.1.2 Pesticide knowledge and perception as general dispositions of lifestyles 102
4.4.2 Local pesticide provision system 105
4.4.2.1 Types of pesticides used by farmers and system of provision 105
4.4.2.2 Provision of technical support 107
4.4.3 Pesticide use and selection practices 109
4.4.3.1 Using practices 109
4.4.3.2 Buying (selection) practices 116
4.5 Discussion 117
4.5.1 Using practices 119
4.5.2 Buying (selection) practices 120
4.6 Conclusions 121

Chapter 5: Pesticide governance through private environmental and social standards in the global cut flower chain from Ethiopia **125**

5.1 Introduction 127
5.2 Private certification as global pesticide governance instrument 129
5.3 Research methods 131
5.4 Environmental and social standards and certifications in floriculture 133

5.5 Results and discussions 135
5.5.1 Assessing the impact of certification on improved environmental safety of pesticide use 135
5.5.2 Impact of certificates on improvements in workers' health and safety 140
5.5.3 Buyer and consumer power in the cut flower supply chain 146
5.6 Conclusion 149

Chapter 6: Conclusion **153**

6.1 Introduction 154
6.2 Answering research questions 155
6.2.1 Challenges for effective policy implementation: What policy says and practice does? 155
6.2.2 Contribution of private actors to sustainability in pesticide importation, distribution and use 157
6.2.3 Pesticide selection and use practices among smallholder vegetable farmers 159
6.2.4 Governance of pesticides through private certification on cut flower supply chain 162
6.2.5 Comparing sectors 164
6.3 Reflection on theories 166
6.4 Reshaping state-business-civil society relationships in environmental governance of pesticides 170
6.5 Policy recommendations 175
6.6 Suggestions for future research 177

References 179

Appendices 207

Summary 245

Wass education certificate 251

About the author 252

Lists of figures, photos and tables

List of figures

1.1	Total global agro pesticide (active ingredients) production 1940-12015	4
1.2	Conceptual framework in investigating sustainable pesticide governance	22
1.3	Study sites: In the Oromia region of Ethiopia	25
2.1	Policy implementation process and the role of policy actors	39
2.2	Schematic diagram of the pesticide product registration process	46
2.3	Registered pesticide in Ethiopia	48
3.1	Governance mechanisms in the pesticide supply chains	69
4.1	Social practice model for studying pesticide use	98
5.1	Different channels for flowers entering the EU market	147

List of photos

2.1	Unsystematic arrangement of the dossier for pesticides registration in Ethiopia	50
3.1	Displaying and selling unknown chemicals and unlabelled pesticides at an open Market	79
4.1	Sprayers without protective devices, a manual knapsack and drum for mixing	114
5.1	Certification of flowers posted at wall of one of the sample farms and a poster displaying farms commitment to certifications at the entrance of one of the sample farms	135
5.2	Obsolete pesticides tagged as expired/ leftover on shelf	139
5.3	Unsafe empty pesticide containers (solid waste) management in flower farms	139
5.4	Workers working without PPE and hanging their lunchbox at the metal poles of the entrance of greenhouse	144

List of tables

1.1	Health and environmental hazards of most commonly used pesticides reported by case study farmers in four African countries: Benin, Senegal, Ghana and Ethiopia	7
1.2	Summary of research methodology	28
2.1	Information of state actors (agricultural extension workers)	52
2.2	Source of information for pesticides	54
2.3	Difficulties faced in using pesticides	55
2.4	Motivation of state actors	55
2.5	Resources of state actors	58
2.6	Interaction of state pesticide inspectors with traders and growers	59
3.1	Pesticides imports in to Ethiopia between 2000-2012 (metric tons)	74
3.2	World health organization(WHO)toxicity (hazard) classification	75
3.3	Pesticide distribution practices by retailers	81
3.4	Support services available to smallholder farmers	83

4.1	Socio economic background of smallholder vegetable farmers	103
4.2	Farmers knowledge and understanding about pesticide	104
4.3	Pictograms presented to farmers and level of understanding	104
4.4	Pesticides used by vegetable farmers in the central rift valley of Ethiopia 2013\14 crop seasons	106
4.5	Pesticide mixtures by small holder farmers in the CRV of Ethiopia	110
4.6	Some aspects of pesticide use practices	113
4.7	Information sources framers rely on for pesticide selection and use	117
5.1	Detail of sample flower growers	132
5.2	Sustainability standards in the interviewed cut flower farms	134
5.3	The impact of certifications on selected environmental aspects of pesticides	136
5.4	Some imported pesticides not approved for use in the EU	137
5.5	The impact of certifications on selected health and safety issue of workers between the two categories of growers	145

List of abbreviations

APHRD	Animal and Plant Health Regulatory Directorate
ASP	African Stockpiles Programme
CIT	Contextual Interaction Theory
CoC	Certificate of competence
CRV	Central Rift Valley
CSA	Central Statistical Authority
DA	Development Agents
DDT	Dichloro Diphenyl Trichloroethane
EHDA	Ethiopian Horticulture Development Agency
EHPEA	Ethiopian Horticulture Producer Exporters Association
EHPEA CoP	Ethiopian Horticulture Producer Exporters Association code of practice
EPA	Environment Protection Authority-Ethiopia
ETI	Ethical Trade Initiatives
FAO	Food and Agricultural Organization of the United Nations
FFP	Fair flowers Fair Plants
FFS	Farmers Field Schools
FT	Fair Trade
FTCs	Farmers Training Centres
Global GAP	Global Good Agricultural Practices
GTP	Growth and Transformation Plan
IPM	Integrated Pest Management
KAP	Knowledge Attitude Practice
MOA	Ministry of Agriculture
MPS ABC	Milieu Project Sierteelt (rating scale in floriculture)
MPS SQ	Milieu Project Sierteelt Socially Qualified
MRL	Maximum Residue Level
PAB	Pesticide Advisory Board
PAN-Africa	Pesticide Action Network – Africa
PAN-Germany	Pesticide Action Network – Germany
PAN-UK	Pesticide Action Network – United kingdom
PHRD	Plant Health Regulatory Directorate
PIC	Prior Informed Consent
POPs	Persistent Organic Pollutants
PRRP	Pesticide Risk Reduction Programme
SPA	Social Practice Approach
SPSS	Statistical Package for the Social Sciences
UNEP	United Nations Environment Programme
UNU	United Nations University
WHO	World Health Organization

Chapter 1

Introduction

1.1 Environmental and human health concerns of pesticides in a globalized world

Since the 1940s, pesticides have been used intensively in agriculture across the globe to control a variety of pests and diseases affecting crops. A pesticide is a substance or mixture of substances that is used to prevent, destroy, repel or mitigate any pest, ranging from insects (insecticides), rodents (rodenticides) and weeds (herbicides) to microorganisms (fungicides, algaecides, or bactericides) (FAO, 2014; EPA, 2009, 2016). Pests and diseases are the drivers that encourage the application of pesticides in agricultural production because without the application of pesticides, the loss of fruits, vegetables and cereals from pest injury would reach 78%, 54% and 32%, respectively (Cai, 2008; Pimentel, 2005). Thus**,** the use of pesticides is considered an indispensable practice for the production of an adequate food supply on limited areas of cropland for the increasing world population (FAO, 2009, 2015; World Bank, 2001). Other benefits of pesticide use are the improved shelf life of the produce and the reduced workforce needed for weeding, which frees labor for other tasks (Cooper and Dobson, 2007). The application of different pesticides, as well as their quantity, varies by region. For instance, the proportion of herbicides in pesticide consumption has increased rapidly from 20% in 1960 to 48% in 2005 (Zhang et al., 2011; FAO, 2015). Moreover, in Western Europe and North America, due to the high cost of labor, chemical control of weeds with herbicides is much more common than it is in East Asia, Latin America or Africa. However, in many tropical regions with widespread insect pests and plant diseases, insecticides are also applied in large amounts both in small farms and in industrial plantations. Concerning the current use of pesticides, developed countries, such as the USA and the EU countries, have moved toward the use of fewer chemicals and more substances that are less toxic, as well as making use of natural enemies of pests. However, developing countries have moved in a different direction regarding these issues. As there is a large need in developing countries for an increase in agricultural production, the use of cheap, broadly effective pesticides is often considered a simple strategy for obtaining better crop yields at relatively low direct costs (Jansen, 2008; Ntow, 2008; Skevas et al., 2003; Hoi et al., 2013).

Globally, the manufacturing and consumption of pesticides have been increasing rapidly. Use of pesticides increased greatly during the Green Revolution in the 1960s and beyond. This has been one of the factors that enabled the “green revolution”, i.e., the considerable increase in food production obtained from the same area of land with the help of fertilizers, more efficient machinery, intensive irrigation and more effective pest management (UNU, 2003). Worldwide, total expenditures on pesticides increased 61% between 1999 and 2009, from $1.1 billion to $1.9 billion. The global pesticide market was around $44 billion in 2011 and projected to increase 2.9% per year to $48 billion in 2014 (UNEP, 2011; The Freedonia Group, 2012b).

According to Food and Agriculture Organization Corporate Statistical Database (FAOSTAT) (2016), world pesticide production shows a steeply increasing trend from 1940 to 2015 (Figure 1.1). For example, total pesticide production has increased from one million metric tons in 1965 to nearly two million metric tons in 2000 (Carvalho, 2006; Pimentel, 2009). By the mid-1990s, developing countries consumed approximately 25% of all pesticides; 13% of this consumption occurred in Asia, 8% in Latin America, and 4% in Africa. Approximately 75% of global pesticide consumption occurred in developed countries (Schaerers, 1996; Brodesser et al., 2006; Aktar et al., 2009). The consumption of pesticides has been increasing dramatically over the last 3-4 years at a 6% rate and is likely to reach $64 billion by 2017. In terms of its volume, the global market for pesticides is projected to reach 3.2 million tons by 2019 compared to 2.5 million tons in 2015. In the EU alone, more than 200,000 tons of pesticides (active ingredients) are used annually (Pesticide action network (PAN)-Germany and PAN EU, 2012). Most of the pesticides worldwide are used to protect fruit and vegetable crops, but in developed countries, pesticides are mostly used for maize (PAN-Germany and PAN EU, 2012; Pimentel, 2009).

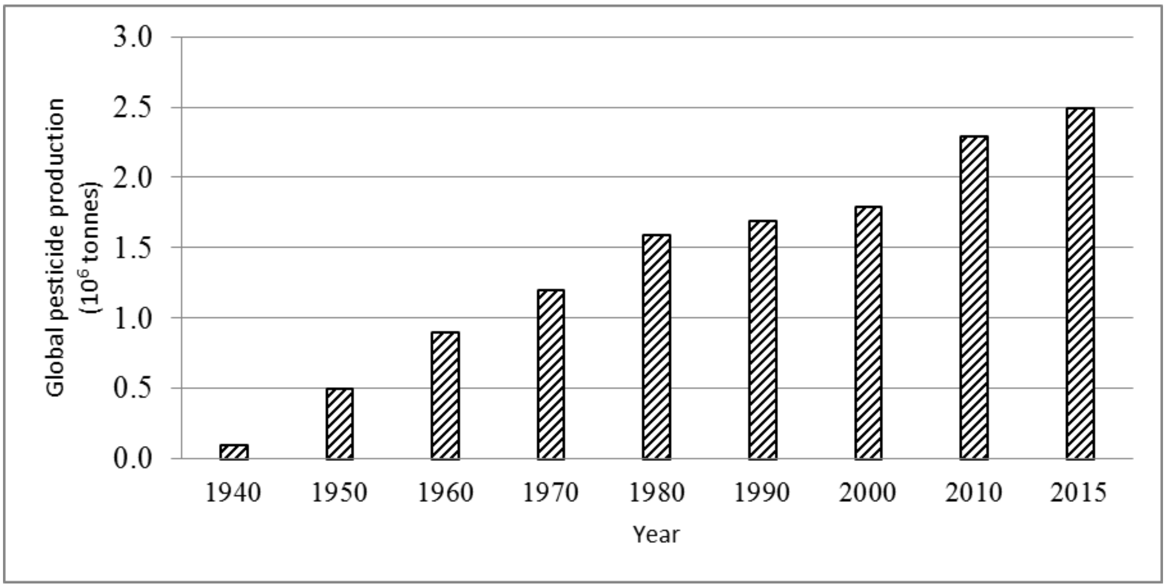

Figure 1.1 Total global agro pesticide (active ingredients) production 1940-2015.
Source: http://faostat3.fao.org/download/R/RP/E (FAOSTAT, 2016).

Pesticide use has risen in developing countries, particularly for use on high value export and industrial crops that generate foreign exchange; the fastest growing markets are in Africa, Asia, and South and Central America (UNEP, 2012). In the future, growing crop production, along with improved farming techniques, will drive demand in developing countries, which have strong growth potential due to their low utilization rates compared to developed countries. In contrast, demand growth in Western Europe, the US and Japan will be weak as it is hindered by strong regulation, market maturity and already high use rates (Global Chemicals Outlook (GCO) 2012; PAN-Germany, 2012; The Freedonia Group, 2012a, 2012b). In view of this, GCO (2012) and PAN-Germany and PAN EU (2012) predicted substantial global agrochemical production growth rates for the period 2012 to 2020. The total growth in North America and Western Europe over this period is predicted to be approximately 25% and 24%, respectively. Growth in Latin America is expected to be slightly higher at 33%; Russia and the emerging economies of Central and Eastern Europe have a similar forecast at 35%. Production in Africa and the Middle East is expected to grow 40%. In the Asia-Pacific region, growth is expected to be 46% with the most rapid growth in China and India (66% and 59%, respectively). Additionally, the Organisation for Economic Co-operation and Development (OECD's) *Environmental Outlook to 2050* reported that while annual global pesticide sales doubled over the period 2000 to 2009, OECD countries' share declined from

77% to 63% and the share of the BRICS countries (Brazil, Russia, India, Indonesia, China, and South Africa) increased from 13% to 28%.

Despite the beneficial effects of pesticides, their adverse effects on environmental quality and human health have been well documented worldwide and prove to be a major concern on the local, national, regional and global scales (Hough, 1998 & 2003; Waibel, 2007; Ntow, 2008). The WHO (2009) classifies pesticides in five groups based on their hazard level, ranging from extremely hazardous (class Ia), highly hazardous (class Ib), moderately hazardous (class II), slightly hazardous (class III) to unlikely to present acute hazards (class U). Therefore, changing patterns in the global distribution of pesticide production and use has implications for human health and the environment. This holds especially true in developing countries where good agricultural practices are often poorly implemented. Currently, approximately 500 pesticides with mass applications are in use. Of these, organochlorine pesticides are highly pollutant to the environment (Zhang et al., 2011). Pesticides commonly take the form of liquids, wettable powders, emulsifiable concentrates and dusts, and when they are sprayed, they move through the air and eventually end up in the environment. Only 1% of sprayed pesticides actually reach the target pest, while the remaining 99% should be considered a direct human health threat or a pollutant to the environment (bodies of water, soil, air, and non-target organisms) via drift, volatilization, leaching and run off (Aktar, 2009; Damalas and Eleftherohorinos, 2011). Although the use of most organochlorine insecticides came to an end 10-25 years ago, even today they remain in the environment at concerning levels. Very common contaminants of surface and groundwater such as endosulfan sulphate, the metabolite of endosulfan, are still in use in many countries (Ondarza et al,. 2010, 2011; Gonzalez et al., 2010; IUPAC, 2010). Furthermore, pesticides can be held responsible for contributing to biodiversity loss and the deterioration of natural habitats (Ntow, 2008). Residues of pesticides contaminate soil and water, persist in crops, enter the food chain, and finally are ingested by humans through food and water (Carvalho, 2006; Van Den Brink et al*.,* 2013). For instance, the Environmental Working Group (EWG) in the US (2014) has released a list of the 12 most pesticide-contaminated vegetables and fruits (i.e., apples, strawberries, nectarines, peaches, celery, grapes, cherries, spinach, tomatoes, sweet bell peppers, cherry tomatoes, and cucumbers), and apples have been ranked as the most contaminated crop for five years in a row. There have been reports on instances of pest resurgence, development of resistances to pesticides, secondary pest outbreaks and destruction of non-target species (Ntow, 2008; Gogo et al., 2014).

Pesticides can also be hazardous for human health when the degree of exposure exceeds safety levels. This exposure can be direct, such as the exposure of farm workers applying pesticides to various crops, or indirect, such as consumers using agricultural products containing chemical traces and bystanders near application areas (Hough, 2003; Skevas et al., 2013; Garming & Waibel, 2009). Although developing countries use only 25% of the pesticides produced worldwide, they experience 99% of the deaths. This is because the use of pesticides in these countries tends to be more intense and unsafe, while regulatory systems are generally weaker (WHO, 2008; Brodesser et al., 2006; Jansen, 2003 & 2008; Hoi et al., 2009 & 2013; Handford et al., 2015). A number of studies have highlighted the severity of occupational health problems related to pesticide use (Hurley et al., 2000; Greenpeace, 2015; Tawatsin*,* 2015). For example, according to a WHO and UNEP report, there are more than 26 million human pesticide poisonings worldwide, with approximately 340,000 deaths per year (Richter, 2002; Asita and Hatane, 2012). Another report by Rao et al., (2005) Pimentel (2005, 2009) state that approximately 3 million cases of pesticide poisonings were hospitalized annually with nearly 220,000 cases resulting in death and nearly 75,000 in chronic illnesses. Nearly 18.2 acute pesticide poisoning cases per 100,000 agricultural workers occurred (Calvert et al.,2008; WHO, 2009). A recent study by PAN International assumes that currently, among the total of 1.3 billion farm workers worldwide, approximately 41 million suffer from pesticide poisoning each year with an average poisoning rate of 32% (PAN-Germany, 2012). In Africa, PAN-Africa and Pan-UK documented 16 suicide cases in Benin, Senegal, Ghana and Ethiopia in the years 2002-2006 (PAN-UK, 2006) (Table 1.1). Among the typical symptoms of acute (short-term) poisoning in humans are fatigue, headaches and body aches, skin irritation, eye irritation, irritation of the nose and throat, feelings of weakness, dizziness, nausea, vomiting, excessive sweating, impaired vision, tremors, panic attacks and cramps. Chronic (long-term) poisoning leads to severe health problems, such as cancer, damage to the reproductive system, the liver, the brain, and other parts of the body (WHO, 2003, 2009). The problem is exacerbated by poor access to pesticide information, unavailable or unaffordable protective equipment and unawareness of the toxicity of pesticides among people living in poor nations, (World Bank, 2000; Alavanja, 2009; Lekei et al., 2014). Despite the fact that pesticides are also applied in other sectors, agriculture can undoubtedly be considered the most important source of these adverse effects (Ntow, 2008; Handford et al., 2015).

Table 1.1 Health and environmental hazards of most commonly used pesticides reported by case study farmers in four African countries: Benin, Senegal, Ghana and Ethiopia.

Active ingredient (chemical group)	WHO Class and acute hazards	Chronic and reproductive effects	Environmental hazards
Endosulfan (organochlorine)	Class II Acutely toxic	Endocrine disruptor	Very toxic to fish and phytotoxic to some plants. EU Water Framework list of possible priority substances. OSPAR Convention list for priority action. EU Dangerous Substances List II
Dimethoate (organophosphate)	Class II Acutely toxic Cholinesterase inhibitor	Endocrine disruptor Possible human carcinogen	Toxic to bees and phytotoxic to some plants. EU Dangerous Substances List II. Potential groundwater contaminant
Cypermethrin (synthetic pyrethroid)	Class II Mild eye and skin irritant. Possible skin sensitizer	Endocrine disruptor Possible human carcinogen	Highly toxic to fish. Toxic to bees and aquatic invertebrates. Potential groundwater contaminant.
Chlorpyrifos (organophosphate)	Class II Acutely toxic Cholinesterase inhibitor	Suspected endocrine Disruptor Immune system abnormalities. Possible birth defects	Highly toxic to fish and bees. High water pollution risk. Phytotoxic to some plants. EU Water Framework list of possible priority substances.
Fenitrothion (organophosphate)	Class II Acutely toxic Cholinesterase inhibitor	Endocrine disruptor	Toxic to bees. EU Dangerous Substances List II.
Malathion(organophosphate)	Class III Acutely toxic Cholinesterase inhibitor	Endocrine disruptor. Suggestive evidence of carcinogenicity	Toxic to bees and moderately toxic to fish. EU Dangerous Substances List II. Potential groundwater contaminant.
Glyphosate (phosphonic acid)	Class III Slight acute toxicity Mild eye and skin irritant (due to co-formulant)	Suspected endocrine Disruptor	Harmful to fish and aquatic life. Toxic to some soil microbes
Profenofos (organophosphate)	Class II Acutely toxic Cholinesterase inhibitor. Moderate eye & mild skin irritant	-	Toxic to fish and bees. Potential groundwater contaminant.
Deltamethrin (synthetic pyrethroid)	Class II Acutely toxic Mild eye irritant	Endocrine disruptor Suggestive evidence of carcinogenicity	Toxic to fish and bees.

Source: Pesticide action network (PAN)-UK, 2006

1.2 Governance of pesticide problems

It is evident that pesticide use in developing countries is a matter of public controversy and debate, and huge efforts need to be undertaken if countries are to reach a state of sustainability (Paarlberg, 1993; Hoi et al., 2010, 2013; Jansen, 2003, 2008; Jansen & Dubois, 2014). Therefore, governance of pesticides requires regulations and standards concerning pesticide administration, pesticide quality, and inspection on distribution and use. Governance, a central term in this thesis, is traditionally understood to be synonymous with government. However, the term has recently acquired a new meaning, referring to regulatory processes, methods and techniques in which government is only one of the actors alongside civil society and the private sector (Pattberg, 2006, 2010). In particular, environmental governance comprises the whole range of rules, practices and institutions dealing with environmental problems with the involvement of various actors at a range of levels, from local to national to global (Mol, 2009, 2016; Kooiman, 2003; Pattberg & Widerberg, 2015). This is reflected in the definition of pesticide governance: *Pesticide governance* refers to the range of political, social, economic, and administrative systems that are in place at different levels of society to regulate and manage pesticides from production, through use and to disposal (of containers and outdated pesticides). It is aimed at addressing all major aspects related to pesticide development, regulation, production and import, distribution and sale, use and application, disposal of obsolete pesticides and empty pesticide containers and impact assessment.

Until 1962, pesticide use in agriculture and public health was indiscriminate. Efforts to restrict the use of certain pesticides and promote alternative crop protection methods gained momentum only after the publication of *Silent Spring* by Rachel Carson in 1962 and the resulting increase in people's awareness of the negative effects of pesticides (Karlsson, 2004, 2007; Heyvaert, 2009). Pesticide policies were developed in many countries with the crucial aim of addressing recognized problems or weaknesses in pesticide registration, distribution and use, or to prevent potential problems from occurring (FAO, 2002). At that time, a change in the attitude of policy planners, researchers, pesticide manufacturers and pesticide users was observed. Several national and international policies have aimed to reduce pesticide use as larger groups of consumers have become aware of the adverse effects of pesticides on workers' health and the environment and have demanded pesticide-free agricultural products (Jansen & Dubois, 2014; Stadlinger et al., 2013; Damalas & Eleftherohorinos, 2011). Important results in the effort to reduce pollution have been made in developed countries through increasingly stringent environmental regulations. Regulations on the registration and marketing of pesticides, maximum residue levels and a strategy for the sustainable use of pesticides compose the puzzle of pesticide policy and governance in several advanced countries. Recently, Jansen & Dubois (2014) considered the extent to which information disclosure has helped empower developing countries in making choices about the importation of risky chemicals through their analysis of the Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998). They also reported on the unresolved implementation issues of PIC itself. Since the convention entered into force (2004), only four pesticides have been listed as qualifying for the PIC procedure. Finally, they concluded that the challenges of transparency came in the form of governance by disclosure through PIC in the international pesticide trade. Moreover, research conducted by PAN-Germany (2011, 2012) showed that approximately four hundred highly hazardous pesticide active substances are on the market worldwide. BASF, Bayer, and Syngenta, who together control nearly half of the global pesticide market, each offer more than fifty highly hazardous pesticide active ingredients on their websites, while most of the pesticides in WHO class I are banned or subject to strict regulations in the developed countries.

While developing countries still do not use as much pesticides as the developed world, pesticide distribution and use in many developing countries is not as regulated as it is in developed countries (Jansen, 2008; Karlsson, 2007). A study by Schaerers (1996) showed that approximately 25% of developing countries lack any type of legislation to govern the distribution and use of pesticides, and 80% lack the capacity (essentially the manpower and financial resources) to enforce legislation. Approximately 60% do not have the facilities to verify and control the quality of pesticides, and most do not have systems in place to adequately handle the importation of banned or restricted compounds. Pesticides are often freely available on the market in developing countries or smuggled in for use or sale. In developing countries, as much as 30% of the pesticides do not meet internationally recognized safety standards (WHO, 2009; Ecobichon, 2001; PAN Germany, 2011, 2012;

Handford et al., 2015). Some Western nations still export chemicals that are banned or restricted in their own markets, although this is becoming less common than it was in the past. In contrast, the "*circle of poison*" (Weir & Schapiro, 1981; Galt, 2008) argument (speculating that hazardous pesticides exported from the North to the South come back as residue in food exports to the North) has led to calls for stricter regulation of trade in pesticides. Jansen and Dubois (2014) see a ban as the key regulatory instrument in pesticide governance. Studies (Hoi et al., 2016; Willamson et al., 2011; Jansen, 2003, 2008; Stadlinger et al., 2013) have shown that poor farmers in developing countries are unable to use hazardous pesticides safely due to illiteracy, the lack of resources to buy personal protection equipment, and tropical circumstances (discomfort) that make it difficult to use such equipment. This situation has motivated many activists to call for bans and other forms of restrictive import regulations. In general, these scholars have long pointed out the weak capacity in developing countries to domestically regulate pesticide use and trade.

In particular, the risks and impact of pesticides used in Africa are much higher than elsewhere (Bull, 1982; PAN-UK, 2008; PAN-Africa, 2008). The above facts and figures lead to the conclusion that policy context matters in governing pesticide control, distribution and use. To be more incisive, while environmental and consumer health was addressed in developed countries, cases of human health endangerment and environmental risks from pesticide use grew in the developing world. The rational decisions made by farmers may have negative effects on other groups in the population and on the environment. The situation can be described as a collective action dilemma (Ostrom, 1990, 1995) in which uncoordinated action has led to the under-provision of human and environmental health. The adverse effects of pesticides can be exacerbated by poor governance mechanisms (UNU, 2003; Karlsson, 2007; Hoi et al., 2010, 2013; Jansen & Dubois, 2014).

There is a large amount of case study research conducted on knowledge, attitudes, perception and unsafe use of pesticides among farmers in Africa (Williamson, 2008, 2011; Damite & Tabor, 2015; Negatu et al, 2016; PAN Africa, 2008), Asia (Hoi et al., 2010, 2013; Jin et al., 2015; Panuwet et al., 2012) and Latin America (Jansen, 2003, 2008; Rios-Gonzalez et al., 2013). However, none of these studies applied a sector governance analysis approach for making the use of pesticides visible through and across registration, importation, distribution, use and interaction of the three key pesticide actors (state (regulator), traders (business) and users (farmers)). This perspective is highly relevant because many pesticide challenges are interlinked. For instance, recent studies by Hoi et al. (2009, 2010, 2013) on the governance of pesticide use in vegetable production in Vietnam have paid little attention to the registration system and the potential role of pesticide traders in the state-centric system of Vietnam. Pesticide registration is the first step in quality control and an arena in which a number of conflicts between traders (businesses) and regulatory bodies come together. For a pesticide to be registered, large amounts of information (dossier) regarding its chemical identity, efficacy and environmental and (human) health safety have to be submitted to the relevant regulatory authorities. After registration, unsafe pesticide distribution and use expose the inability of current governance regimes to address such challenges. Moreover, despite the existence of a vast governance literature that crosses several disciplinary fields, the governing facets (and possible governance shifts) in the realm of pesticide policies have only been superficially contemplated. Until now, pesticide policies have only been featured in the governance literature as occasional references in studies concerned with shifts in the field of environmental and food safety governance (e.g., Fleischer & Waibel, 2003; Halkier, 2001; Hoi et al., 2009; Oosterveer, 2007; Oosterveer et al., 2011 & 2015). There are still significant gaps in our knowledge of pesticide governance, and our understanding of how those gaps may be filled is quite limited. While this thesis acknowledges that these studies offer precious insights enhancing our understanding in many aspects of pesticide issues, I argue that it is also important to place pesticides at the center of the analysis. As discussed above, pesticide policy has evolved into a separate field of state policy, and therefore, the governing trends and developments within this policy field may or may not be similar to other fields.

Arguably, governance failures are the origin of many environmental and human health problems regarding pesticides in developing countries. This paper argues that the influence of state and non-state actors and the relative importance of their interactions are the major structural characteristics of pesticide governance. However, it is still important to ask what governing mechanisms and actors are available and what can be developed further to promote sustainable pesticide governance. Therefore, the focus of this research aims at gaining a deeper understanding of processes at the policy-practice nexus in the context of pesticide registration, distribution and use. While a large number of governance mechanisms to implement a pesticide policy have been initiated, the effectiveness of these mechanisms has not yet been systematically analyzed. Issues and problems may well be increasingly constructed in global terms, but decision-making and implementation remain domains that must be analyzed within the context of the nation state (Parsons, 1995; Mol, 2016). This holds particularly true for the focus of this study, Ethiopia, which is predominantly an agricultural country.

1.3 Challenges to pesticide registration, distribution and use in Ethiopian agriculture

With a population of 97 million (World Bank, 2016), Ethiopia is the second most populous country in Africa. Agriculture plays an important role in Ethiopia's economy and provides livelihood for a growing population. As a whole, the agricultural sector has a share of approximately 44% of the country's GDP, 80% of the workforce and 70% of the export earnings (FAO, 2014). Ethiopia's current development agenda is guided by a key strategy called the Growth and Transformation Plan (GTP), which aims to eradicate poverty and reach the level of a middle-income economy by 2025. To achieve this GTP goal, the government of Ethiopia has prioritized key sectors, such as agriculture and industry, as drivers to promote sustained economic growth and job creation. With a growing population, decreasing agricultural land availability and increasing domestic as well as foreign demand for agricultural products, farmers have diversified and intensified agriculture and enhanced yields. Insect pests are among the major bottlenecks of crop production throughout the world, including Ethiopia, and more than 68 insect and mite pests have been recorded in Ethiopia (Shiberu & Mahammed, 2014; Gorfu & Ahmed, 2011; Abate; 1983; EIAR, 2011; Debele, 2014; Abate & Ampofo, 1996), such as early and late blight, bollworm, spider mites, aphids, trips, powdery mildew, downy mildew, botrytis, nematodes, mealy bugs, and caterpillars (MoA, 2014). Crop yield losses due to pests and diseases in Ethiopia (as well as elsewhere in Africa) stand at 30-40%. Data on yield losses caused by insect pests in Ethiopia differ per crop: cereals 32-60%, pulses 19-63%, vegetables 24-49%, citrus 2-9%, and cotton 36-60% (Abate, 1996; Amera & Abate, 2008; MoA, 2013). Pesticides have been used in response to these losses and played major roles in increasing agricultural production. This has resulted in an increased demand for pesticides, which has also been strongly pushed by interest groups, such as pesticides importers, wholesalers and retailers.

In Ethiopia, the use of pesticides to control plant pests can be traced back to the mid-1940s when arsenic and later benzene hexachloride (BHC) in bran bait were used to control desert locust outbreaks. However, the use of chemical pesticides against crop pests increased only with the development of commercial farms in the early 1960s (Abegaz, 1996; Abate & Ampofo, 1996; MoA, 2013). According to PRRP (2012) and MoA (2013), there are now 302 commercial pesticides registered and imported in the country, representing over 160 active ingredients, and the volume of imports increases from year to year (see chapters 2 & 3). Among these, the largest proportion falls under class II of the WHO hazard classification system (MoA, 2013). In the recent past, the misuse of pesticides was a common problem mainly because farmers lacked appropriate knowledge about pesticides and there was no effective administrative measure governing their use. For instance, DDT, which has been a banned pesticide since the 1970s world-wide, remains in use in Ethiopia for the control of the mosquito malaria vector by MoH and has been reported to have been illegally diverted to agricultural pest control in some areas (MoA, 2013). Records indicate that highly dangerous pesticides such as DDT, aldrin, heptachlor, pyrimifos methyl, and fenitrothion are the main components of the obsolete stocks dumped at more than 1000 sites in Ethiopia (Mekonen et al., 2014). Moreover, MoA (2012) also reported that four class I pesticides were among the eight used by the *Limu* coffee enterprise development program between 2007-2011, namely, Glyphosate 480 g/l (SL), Gramoxone 20 SL: 200 g/l+ Piperophos + 2,4-D IBE, Glyphosate (Phosphonomethyl glycine) and Glyphosate 36 SL. Moreover, in spite of their ban, aldrin and dieldrin have recently been found in the soil in Ethiopia. Other organophosphate pesticides, such as diazinon and malathion, are still commonly used in agro-industries and frequently enter the food chain (Westbom et al., 2008; Daba et al., 2011). Scenarios for the future use of seven selected pesticides indicated that agricultural use of chlorothalonil, deltamethrin, endosulfan and malathion in some crops may result in medium to high risks to aquatic species in the Ethiopian context (Teklu et al., 2015). In addition, Negatu et al. (2016) report a large increase in pesticide usage intensity, illegitimate usages of DDT and Endosulfan on food crops and direct import of pesticides without passing through the formal Ethiopian registration process. Moreover, Gebremichael et al. (2013)

report the presence of DDT from their analysis of organochlorine pesticide residues in human and cow's milk in Southwestern Ethiopia. Overall, however, there are only a few data on illnesses due to chronic poisoning as a result of pesticide use or pesticide contamination of food. Stockpiles of obsolete pesticides are another severe problem in many areas of the country (ASP, 2013). In 2005, the Global Environment Facility (GEF) committed $25 million to clean up 3,310 tons of obsolete pesticides from 897 sites in Ethiopia, Mali, Tanzania, Tunisia, and South Africa (Africa Stockpiles Programme (ASP, 2013).

Ethiopia has no industry to produce active ingredients and only one local pesticide formulating company, *Adami Tulu* Pesticide Company. This company uses imported active ingredients and solvents to formulate a portion of the pesticides required in Ethiopia. Between 2000 and 2012, the company produced 17,662 metric tons of pesticides for agricultural and public health purposes. Of this production, public health products for vector control accounted for a significant share: 8,858 metric tons (MoA, 2013). During these years, 32,230 metric tons of agricultural pesticides were imported (see chapters 2 & 3). The pesticide market is therefore heavily dependent on imports by local agents representing international manufacturing/formulating companies (MoA, 2013). Currently, 40 pesticide importers are legally registered with the Ministry of Agriculture (See appendix V), and they act as distributors of pesticides to retailers and to end-users, while some companies combine imports with wholesale and retail. These companies import pesticides mainly from Germany, Switzerland, France, Belgium, the USA, Israel, China and India. Some pesticides are imported from other African countries such as Kenya and South Africa (MoA, 2014). The increase in imports and use of agrochemical inputs has followed the expansion of the crop production area in Ethiopia and contributed to yield increases. The total agricultural area in which pesticides were applied during the 2014/15 production season was more than 3.2 million hectares (CSA, 2013/14). Currently, importing pesticides into Ethiopia is not a well-controlled process. Importation of illegal pesticides continues to pose significant threats in Ethiopia. For instance, according to the Fana Broadcasting Corporation (2016), 274 steel barrels (approximately 96,000 kg) filled with expired Endosulfan entered Ethiopia from Israel, passing through four custom sites.

Last but not least, there are different ministries in Ethiopia. These agencies and bureaus are in charge of various aspects of the management of chemicals. The Ministry of Agriculture, Ethiopian Agricultural Research Institute, Environmental Protection Authority, Ministry of Health, Ministry of Labor and Social Affairs, the Ministry of Trade and Industry, Custom Authority, Standards & Quality Control Agency among others at the federal level and local level are operating at a very weak capacity in terms of pesticide management. They lack effective coordination/interaction, clearly harmonized mandates, clarity regarding the role of regional states, and they have insufficient links with federal institutions, witness mergers and the creation of new institutions from time to time to address the weak implementing capacity of institutions (Damtie & Kebede, 2012; FEPA, 2004; Vieira & Abarca, 2009).

1.4 Pesticide use in the vegetable and cut flower sectors

Vegetables and cut flowers are important sectors of Ethiopian horticulture in which pesticides are used intensively. Although these two areas share similar histories of pest control, increased pesticide use and pesticide problems, they differ in terms of their structure, the size of farms, on-farm technical and human capacities, the state's commitment and involvement, the degree of international embeddedness of the product chain, and the actions (strategies) in influencing pesticide use. Policy implementation also typically occurs at the local level, in specific locations and by particular groups of people (Nagendra & Ostrom, 2012).

In Africa, the 33 million small farms with less than two hectares compose 80% of all farms on the continent (FAO, 2009). Therefore, the majority of crop farming takes place in a smallholder context as opposed to the large, industrialized farming systems of many Western countries that take advantage of economies of scale. In Ethiopia, some 6 million smallholders provide 95% of all vegetables and fruits supplied to domestic and regional export markets, such as neighboring African countries and the Middle East. The export of vegetables increased from 25,300 tons in 2002/03 to 137,000 tons in 2012/13 (Ayana et al., 2014). However, these exports remain largely uncontrolled and unguided. Farmers' profitability, product safety, quality, and overall sustainability raise concerns. Some of the biggest problems confronting vegetable growers in Ethiopia are diseases and pests, which ravage their crops. Vegetables are highly vulnerable and attract a wide range of pests and diseases that require intensive pest management (Dinham, 2003, 2004).

A wide range of pesticides is available for vegetable growers in Ethiopia, and farmers can purchase them in containers ranging from 0.25 to 5 l (sometimes even 200 l) or in packets ranging from 0.5 to 25 kg. Approximately 41 different types of commercial pesticides with different chemical formulations are commonly used. Because all pesticides have side effects of some sort, both beneficial and damaging (side) effects are subject to regulations and monitoring regarding the area of application, time of application, dosage, application methods and spraying and protective equipment. Ethiopian smallholder vegetable farmers using pesticides are, however, not adequately informed about their hazards. Pesticide usage by smallholder farmers is frequently accompanied by misuse leading to acute poisoning and health issues such as headaches, vomiting, skin irritation and eye irritation, as well as high levels of pesticide residues in food and drinking water (Mekonnen & Agonafir, 2002; Williamson, 2003; Ahrne, 2004). Moreover, Mekonen et al. (2014) have demonstrated that intensive and improper pesticide use in the field results in pesticide residues (MRLs) that are too high according to the Codex Alimentarius on marketed maize, *teff*, red pepper, and coffee. Some banned pesticides and those not authorized for use in cereals, vegetables, and coffee, such as organochlorines (e.g., DDT and endosulfan), were also detected (MoA, 2013).

Moreover, the recent rapid expansion, especially of large-scale floriculture industries, has resulted in an increased use of pesticides and their poor management in the country (Tadele, 2009; Getu, 2009; Tamirat, 2011; Sahle & Potting, 2013). The floriculture sector is booming in Ethiopia, making the country the second largest exporter of flowers in Africa and the fourth largest supplier of flowers to the world market. Moreover, the sector has become the country's second highest foreign exchange earner. There are currently (2016) 84 foreign and local companies growing flowers: 26 farms are fully domestically owned, 52 are fully foreign owned and six are owned by joint ventures (EHPEA, 2015). The total area of land held by floriculture investors is approximately 2000 hectares, used for growing flowers in greenhouses and in open fields. Despite the enormous economic advantages, the situation of flower production (intensive use of unregistered pesticides and water and problems with worker health and safety) has made the sector susceptible to criticism about its working conditions and environmental impact (Tamiru, 2007; Tadele, 2009; Getu, 2009; Tamirat, 2011; Sahle & Potting, 2013). For instance, according to PAN-UK (2007), Tamiru (2007), Vieira & Abarca (2009), Tilahun (2013) and MoA (2014), flower farms have imported 96 types of insecticides and nematicides and 105 types of fungicides between 2007 and 2014; of these, 37 have not been registered in the country. Vieira & Abarca (2009) found that flower farms use ten different organophosphates: Acephate, Cadusafos, Chlorpyrifos, Diazinon, Dichlorvos, Dimethoate, Fenamiphos, Monocrotophos, Omethoate and Profenofos (see appendix VI). Organophosphates are one of the pesticide classes most toxic to vertebrates; they have been banned since 1990. Thus, of these ten organophosphates that are used in Ethiopian floriculture, seven were forbidden (namely, Acephate, Diazinos, Dichlorvos, Monocrotophos, Omethoate, Profenosfos and Cadusofos). In 2009-2010, Alterra conducted water quality research at three sampling sites near a floriculture complex built next to Lake *Ziway*. They tested for 200 pesticides and found 30 with concentrations of 0.1 µg/l and higher, five of which are classified as high-risk pesticides (Jansen & Harmsen, 2011). In addition, wastewater from floriculture industries discharged into nearby rivers has enormous effects on the degradation of ecosystems (Sisay, 2007). In general, the water quality of Lake *Ziway* has been threatened and is becoming less suitable for the variety of purposes it serves (Tadele, 2009). Therefore, it is important to note that not only do adequate policies need to be developed but these policies and regulations also need to be enforced.

1.5 Pesticide policy and regulation

Trends in pesticide use are affected by several economic, biological or climatic factors, as emphasized in pesticide policy initiative reports (Williamson et al., 2008; Ajayi et al., 2002). Changes in state and private sector provisions and control of agricultural inputs exert a strong influence on agrochemical use patterns, particularly in the case of smallholders (Williamson, 2003; Kelly et al., 2003). Thus, the development and enforcement of realistic policies and regulations are essential components when addressing problems related to pesticide registration, importation and distribution and for reducing risks to human health and the environment from the use of pesticides. In view of this, various policies and regulations have been developed over time with the crucial aim of addressing recognized problems or weaknesses in pesticide distribution and use or to avoid the occurrence of potential problems. The most important policies and regulations in Ethiopia are the *Plant Protection Decree No. 56 of 1971* (article 5), the *Pesticide Registration and Control Special Decree No. 20/199*0 (issued in 1990) and the current *Pesticide Registration and Control Proclamation No. 674/2010* (issued in 2010). Under the current policy, many international obligations and agreements (such as the Stockholm Convention on Persistent Organic Pollutants (POPs), the Rotterdam Convention on the Prior Informed Consent (PIC), and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal) are incorporated into national legislation. The Pesticide Registration and Control Proclamation has eight sections and 37 articles and includes provisions on the *registration of pesticides* (requirement, application, decision on application, validity, renewal, amendment, re-registration, temporary registration, suspension and cancelation, recall, and re-evaluation), provisions on the *certificate of competence and licensing* (import permit, packaging, labelling, advertising, transport and disposal of pesticide), *safety measures* (occupational safety and reporting of accidents), *analysis of pesticides* (designation of official laboratory and analyst, certificate of analysis, residue analysis and supervision, pesticide advisory board and inspectors, function and operation of the board, and pesticide inspectors) and *miscellaneous provisions* (prohibition, record keeping, penalties, power to issue regulations and directives, transitory provision, and repealed laws).

The overall aim of the existing pesticide policy is to (i) contribute to a sustainable pesticide management system to regulate pesticide use by farmers, considering the whole pesticide life cycle from registration and procurement, from the import/local manufacturing of pesticides to their distribution, use and monitoring, including quality control and waste management; and (ii) improve the environment, health of growers and the surrounding community, and stimulate the economic performance of the Ethiopian agricultural sector. Pesticide registration is an important step in the governance of pesticides because it allows authorities to regulate the used active ingredients and formulated products (their chemical and physical properties, toxicology, efficacy, residues and fate in the environment) by deciding which pesticide products are permissible and for what purposes and by exercising control over the quality, labelling, packaging and advertising of pesticides. This should ensure that the interests of pesticide end-users and food consumers, as well as the environment, are well protected (FAO, 2006; Damalas & Eleftherohorinos, 2011). Unregistered pesticides pose a great risk because they are potentially more dangerous. Therefore, before any pesticide can be imported and used commercially, several tests are conducted that determine to what extent a pesticide has the potential to cause adverse effects on the environment, humans and other non-target organisms. Registration is not a complete solution by itself. Even registered and approved chemicals may be subject to abuse and misuse by their end-users. Recent reports (MoA, 2012, 2013; PAN-Ethiopia, 2014) on the state of pesticides highlight that there are increasing problems of environmental and human health effects soon after products are distributed to user communities in Ethiopia. When pesticides are registered, distributed and used improperly, they can affect agricultural productivity and sustainability and can result in adverse effects on human health and the environment. Therefore, sustainable growth of agriculture and protection of human health and the environment in Ethiopia require effective governance of pesticides. However, it is still an open question as to whether the policies on pesticide registration, distribution and use are implemented in an effective and sustainable way.

1.6 Research objective and research questions

Research on crop protection and recommendations on pesticide use based on the results of screening trials or experience gained in neighboring countries has been prominent since the 1970s and early 1980s (Abate, 1996). In addition, while the Ethiopian population is becoming increasingly concerned about the adverse long-term effects of pesticides on the environment and on the health of workers and consumers, little scientific research has been conducted to address these issues (Abate et al, 2000; Daba et al., 2011; Sahle & Potting, 2013; Debele, 2014; Mekonen et al., 2014; Teklu et al., 2015; Negatu et al., 2016). By the same token, various projects and studies have been conducted in Ethiopia to strengthen and support the development of the horticulture sector, including vegetable and cut flower production, processing and marketing for local and export markets, either financed by the Ethiopian state or by international donors (e.g., Ethiopian Horticulture Development Agency, Common Fund for Commodities (CFC), the World Vegetable Centre, The Netherlands Embassy in Ethiopia, FAO, Croplife Ethiopia in collaboration with Croplife International, African stockpiles). These projects and studies have produced a huge number of reports related to the *status quo* as well as to potential improvement strategies for pesticide use in horticulture production in Ethiopia. However, these reports (e.g., FEPA, 2004; EHDA, 2012; ASP, 2013; MoA, 2013; PAN-Ethiopia, 2014) hardly touch upon the effectiveness of pesticide registration, import procedures, distribution systems, the actual use practices of pesticides on vegetables, or the impact of flower supply chains on growers' pesticide use practices. To achieve safe, sound and sustainable agricultural production, safe and sustainable pesticide management plays a crucial role. Pesticide management includes all aspects of the safe, efficient and economical handling of pesticides (Bull, 1982). The proper use of pesticides in Ethiopia means taking into account the health, social and economic realities of life. It implies using only pesticides that can be applied safely and only when necessary. It is crucial to understand such structures to understand the challenges to pesticide governance and devise ways to address them. The above-mentioned negative environmental and health-related effects of the use of pesticides in agriculture demands effective governance mechanisms. Up until now, almost no study has analyzed these pesticide policy and practice issues along the pesticide chain from the perspective of environmental governance. Therefore, this study is designed to examine the interface between policy and practice with respect to governing registration, importation, distribution and use of pesticides and review how different actors (state, private and farmers) can better govern pesticides to achieve environmental sustainability and workers' health and safety. Four research questions are central in this thesis:

(i) What are the main obstacles (barriers) to effective state enforcement of the existing pesticide policy in Ethiopia?
(ii) How, why and under what circumstances can private actors contribute to addressing sustainability problems and offering solutions across the pesticide supply chain?
(iii) In what ways have pesticide selection and use practices among smallholder vegetable farmers been influenced by their lifestyles and the systems of provision?
(iv) How and to what extent do private certification standards govern environmental and social dimensions of pesticide use practices along the global flower supply chain?

1.7 Theoretical perspectives

Scholars have identified a variety of new forms of governance addressing environmental problems, including network-like arrangements of public and private actors and civic-private partnerships (e.g., Arts, 2001; Mol, 2008, 2016; Pattberg & Widerberg, 2015). The emergence of these new forms is referred to as the shift from government to governance (Arts, 2001; Pierre & Peters, 2000; Kooiman, 2003). Nevertheless, in these new governance arrangements, the role of the state remains very relevant in protecting environmental quality in a restructured, redefined and renewed manner, often characterized by more consensual approaches, participative steering modes and new capacities of state environmental authorities (Mol, 2010, 2016; Pattberg, 2006, 2010; Pattberg & Stripple, 2008). The diversity of the actors involved and the ways in which they interact are becoming increasingly important factors in building (successful) forms of pesticide policy implementation (Murphy & Coleman, 2000; Hart, 2003). The emergence of these forms of governance is based upon the recognition that no single actor possesses the capabilities to effectively address the multiple challenges of sustainable pesticide registration, distribution and use.

Pesticide governance is increasingly relevant to theoretical and applied governance discussions due to pesticides-related environmental and human health concerns in a globalized world. This thesis applies the idea of public-private governance to assess why, how, to what extent and in what aspects state (public) and private (market) actors and growers (farmers) are playing a role in governing sustainable pesticide registration, distribution and use (Figure 1.2). The governance approach focuses on the interactions taking place between or among these governing actors. The interactions shape actor behavior and actors shape interaction patterns (Kooiman, 2003).

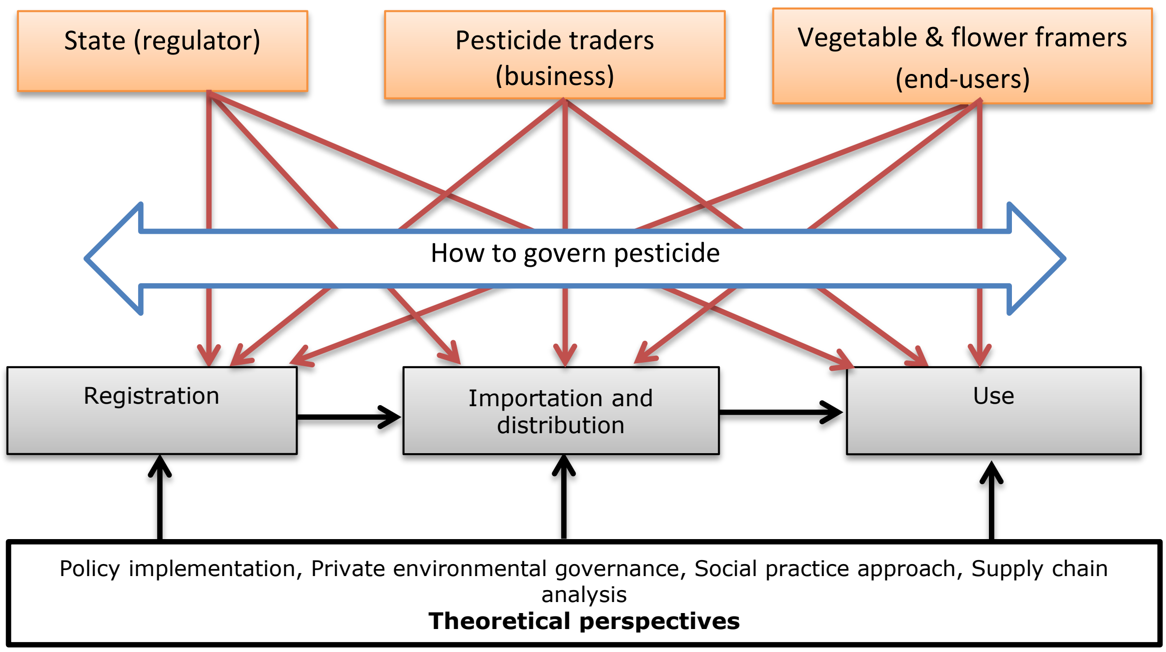

Figure 1.2: Conceptual framework in investigating sustainable pesticides governance

This study follows an actor-based framework to examine the various innovative governance interventions led by selected actors: the government, farmers and traders. Figure 1.2 denotes the linkages/interplay between/among the key pesticide actors, including their institutional and informational aspects, in improving the quality of pesticide registration, distribution and use to reduce the adverse effects of pesticides on the environment and human health. In assessing pesticide governance processes, this study applies various theoretical perspectives, drawing on both environmental governance and sociological theories.

Firstly, to understand how and why state policy is put into effect, implementation theory is applied (EEA, 2001; Schofield & Sausman, 2004; O'Toole, 2004). There have been various attempts to identify variables influencing implementation processes, both empirically (e.g., Brinkerhoff, 1999) and conceptually (e.g., Van Horn & Van Meter 1974, Mazmanian & Sabatier,1981; Bressers, 2004, 2007). An understanding of implementation requires a recognition of the importance of the role of state actors and accepting the multi-actor characteristic of the process (O'Toole, 2000). Governance involves a much wider range of actors than only the national government, and it also involves more diffused modes of governing and authority. In addition to market authority (see below), state actors use softer modes of governing and authority such as information dissemination or the use of best practice examples to set social and cultural norms. The Contextual Interaction Theory (CIT) was applied to capture policy implementation barriers in Ethiopia with respect to pesticide policy based on the characteristics of the involved state actors, particularly their motivation, resources, information and interaction (Bressers, 2004, 2007).

Secondly, private actors and private governance mechanisms are beginning to address environmental problems (Pattberg, 2006, 2010; Pattberg & Widerberg, 2015). The emergence of private governance arrangements, not just in the form of lobbying governments but more importantly in establishing and implementing agreements, is considered an innovative response to the limitations and limited successes of state authorities in coping with environmental problems (Pattberg, 2010; Cashore, 2002; Robert, 2003). A large number of publications have provided theoretical and empirical evidence of private sector involvement in addressing environmental issues (Pattberg, 2006; Kooiman, 2003). However, debate continues on the different partnership structures, the division of tasks and responsibilities between public and private sectors and the results in terms of successes and failures of such public-private arrangements (Mol, 2007, 2016; Hart, 2003). There is an increasing focus on the potential role of private actors in implementing pesticide policies through their expertise, market authority and capacity to innovate and produce new technologies for safety and sustainability (Fisher & Surminski, 2012). The assumption in private forms of environmental governance is that these are able to address the weaknesses of state governance. This thesis assesses why and how pesticide private chain actors (pesticide importers and retailers) engage in governing pesticides (import, transport, storage, and retail of pesticides) in Ethiopia, making use of private governance notions and theories.

Thirdly, analyzing pesticide use as a social practice (Warde 2005; Spaargaren & Oosterveer, 2010) bridges the farmers' lifestyles and the socio-technical systems of pesticide provision. The three components of the social practices approach (SPA) (lifestyle, practices and systems of provision) provided an intricate way to investigate these dynamics. For this topic, SPA is applied to analyze vegetable farmers' pesticide buying and use practices and how improvements in these areas need to be attentive to both lifestyle and system perspectives.

Fourthly, global supply chain analysis (Ponte, 2008; Ponte, Gibon & Riisgaard, 2011) helps to understand how pesticide governance through private standards and certifications takes place involving various actors (growers, importers, florists, supermarkets and consumers*)* in international cut flower chains. Various private standards and certifications in agro-food supply chains have evolved over time and they differ in their institutional structure, the issues they seek to regulate and the ways in which these standards are exercised. Producing for international markets requires meeting certain quality standards. Moreover, quality produce needs to be supplied in a sustainable way to win markets (Ponte, 2008; Riisgaard, 2011; Trienekens, 2011). Global market preferences are changing towards low-pesticide agricultural products, stricter rules on residues and safer pest management. There is frequent competition among exporting countries, especially developing ones, in securing export markets by supplying products that conform to these international - partly private - standards (Scott, 2002; Raynolds, 2012).

1.8 Research methodology

The research methodology is a procedural plan that guides a researcher in how to conduct the study (Kumar, 2005: 84). Its main function is to ensure that the evidence obtained enables the researcher to answer the research questions (De Vaus, 2001). In this study, there are a number of common research methodology elements, as well as some research methodology characteristics that differ among the four empirical case studies that answer the four research questions. The characteristics of the applied research methods for each empirical study, described by objective, main research question, nature of the study, the data sources and the data analysis, are presented in Table 1.2.

1.8.1 Research sites and the sector analysis approach

Ethiopia (3°-15° N and 33°-48° E), officially the Federal Democratic Republic of Ethiopia, is a country in Africa bordering Eritrea to the north, Djibouti and Somalia to the east, Kenya to the south, and Sudan and South Sudan to the west (Figure 1.3). Ethiopia is the tenth largest African country by area with a total area of approximately 1,104,300 sq. km., and it is the second most populous African country with a population of 96.6 million, of which more than 84% live in rural areas (World Bank, 2014). The country has nine regional states: namely, Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, Southern Nations Nationalities and People Region (SNNPR), Gambella and Harari, and two Administrative states (Addis Ababa City Administration and Dire Dawa City Council). The regional states as well as the two city administrative councils are further divided into eight hundred districts (*woredas)* and approximately 15,000 *kebeles* (the lowest administrative unit in Ethiopia) (CSA, 2015).

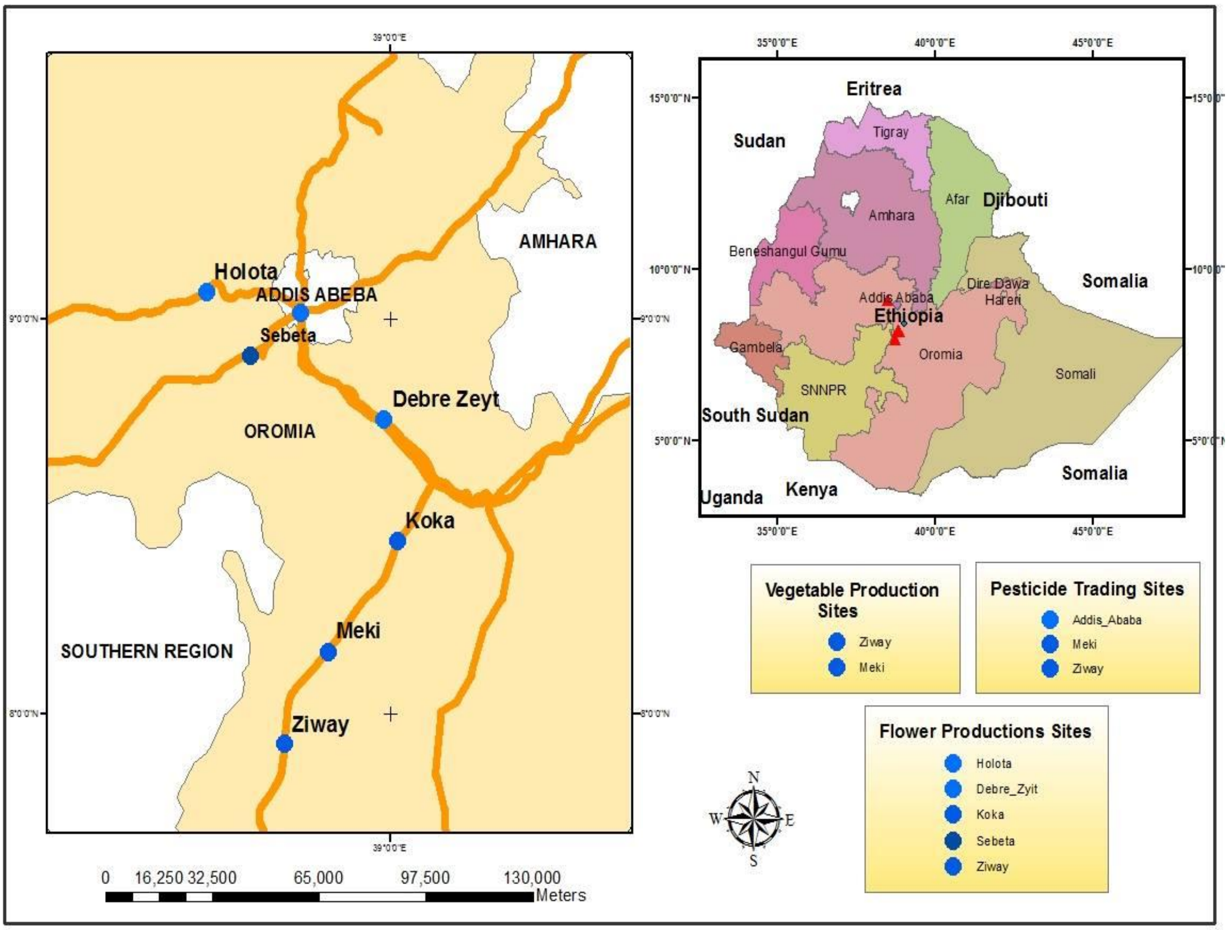

Figure 1.3: Study sites: In the Oromia region of Ethiopia. Source: Constructed by the author (2016).

This study was conducted in the vegetable and flower growing areas of the Oromia region and the commercial sites of pesticide trading (Addis Ababa, *Ziway and Meki*). The central Rift Valley in Ethiopia is a hotspot for vegetable and flower production due to the availability of irrigation facilities and the accessibility and closeness to agro-processing industries. Vegetables are grown in two seasons: the wet season using rainfall and the dry season using irrigation. Vegetables that are produced in Ethiopia include kale (Ethiopian cabbage), onions, tomatoes, peppers, chilies, carrots, garlic, cabbages and green beans (EHDA, 2012). Moreover, according to EHPEA (2015), 84 flower farms operate in the major flower producing areas in Ethiopia: *Holeta* (27 farms), *Sebata* (21 farms), *Debre Zeit* and *Awash* (16 farms), *Ziway, Koka and Hawassa* (11 farms), and *Sendafa, Suluta, Debrebrihan* and *Bahir Dar* (9 farms). These farms are located in different agro-ecological zones. The agro-ecological variation also affects the types of pest and disease problems encountered by the flower farms. Divided by the country of origin of the owner, The Netherlands, India and Israel take the lead in flower farm ownership with approximately 34%, 22%, and 12% of the total number of farms (EHPEA, 2014), respectively.

In this thesis I followed a sector-based analytical approach to determine the main elements to take into account when analyzing pesticide governance in two particular agricultural sectors: vegetables and cut flowers. The pesticide governance agenda is strongly interlinked with three major elements: the registration procedure, the distribution of pesticides, and the application and use of pesticides. Each of these three aspects is analyzed to understand the specific contexts and dynamics of the related practices and processes, taking into consideration the perspectives and actions of key actors (state/regulator, traders and users).

1.8.2 Methods of data collection

Primary and secondary data collection were conducted by fieldwork for all four empirical studies. Surveys, key informant interviews, field observations, and document analysis were applied. This mixed methods approach enables triangulation and enhances the validity and reliability of the results (Rao & Woolcock, 2003; Small, 2011). Interviews were entirely carried out face-to-face by the dissertation author himself. The details of the methods of data collection, sampling procedures, issues raised and data analysis are summarized in Table 1.2 below and are more extensively explained in each of the specific empirical chapters:

(i) Key informant interviews with 115 key informants were conducted to obtain in-depth information from a wide range of state and non-state actors (state pesticide experts, extension workers, cooperatives, pesticide advisory board members, pesticide importers and retailers, flower importers and florists) (see appendix IV). Key informants that were interviewed included officials (experts) at different levels and from different organizations (see appendix I for an overview of the interview guides). Their insights were highly useful in understanding the nature of the problem.

(ii) Survey*:* Primary data were collected through structured surveys using closed and open ended-questions. Surveys were held with state extension workers, pesticide importers, pesticide retailers, vegetable and flower farmers and pesticide sprayers (see appendix II for examples of the questionnaires being used). The surveys provided useful quantitative data. Different sampling strategies (purposive, random, snowball) were chosen for different actor categories to claim that the data collected are representative for the category of respondents. The surveys contained several detailed and specific issues that are discussed in each of the chapters.

(iii) Direct observation was used throughout the fieldwork with the aid of checklists (see appendix III). The ways in which farmers store, mix and spray pesticides were noted, and photos of these activities were regularly taken. During the questionnaires and interviews, observations and pictures were also made to support the qualitative and quantitative information provided by the respondent/interviewee about things such as the condition of the retail shops and the licenses, the quality of polyester sheets/spraying suits to cover the sprayer's body, safety precautions and pesticide storage, availability and quality of facilities (toilet, shower) and condition of incinerators.

(iv) Document analysis*:* Secondary data were collected through analysis of information from relevant documents at the farm, district and national levels. Grey and official literature and documents on the past and current state of pesticide registration (dossier evaluation), import and distribution, proclamations and conventions were also reviewed.

1.8.3 Data analysis

In each of the empirical research chapters (2 to 5) of this thesis, a different theoretical framework is applied to analyze the data. Thus, qualitative information is analyzed based on theoretical frameworks, while the quantitative parts are analyzed through descriptive statistics.

Table 1.2 Summary of research methodology

	Study 1	Study 2	Study 3	Study 4
Objective	Assessing main obstacles (barriers) to effective enforcement of existing pesticide policy	Assessing role of private actors contribution to problems and solutions across the pesticide supply chain	Examining the influence of farmers lifestyle and system of provision on pesticide selection and use practices	Assess the power of private certification on standards governing pesticides' use in the global flower supply chain
Main research questions	What are the main obstacles (barriers) to effective enforcement of the existing pesticide policy?	How, why and under what circumstances do private actors contribute to problems and solutions across the pesticide supply chain?	How have pesticide selection and use practices been influenced by lifestyles and system of provision among smallholder vegetable growers?	To what extent do private certification standards govern environmental and social dimensions of pesticide in the global flower supply chain?
Nature of the study	Combination of qualitative and quantitative methods.	Combination of qualitative and quantitative methods.	Combination of qualitative and quantitative methods.	Combination of qualitative and quantitative methods.
Topics discussed	Access to information and resources, their motivation and their interactions with other actors. Challenges on the pesticide registration process, inspection and quality control.	-Information sharing within pesticide flows -Services: training and capacity-building -Information: environmental health and safety. Challenges on pesticide importation, distribution and retailing.	Selection and use of pesticides: -Pesticides used and their sources, stores, mixing, frequencies and dosages, protective devices, disposal of pesticide containers. -Training and support either by suppliers (retailers), or state extension workers and farmers' union staff.	-Status of certification Environmental aspects of pesticide (pesticide type, strategies to IPM, obsolete, empty containers, waste disposal. -Workers health and safety: (quality and availably of protective gears, training on safety, medical check-up, experience of accident). -Distribution channel.
Data sources	-Key informant interview (KII) (n=46), state experts, with importers, retailers and Pesticide advisory board. -Survey interviews with retailers (n=30), vegetable farmers (n=65),& extension workers (n=30). -Document analysis.	-KII (n= 13), crop life, union extension worker, protectionist. -Survey interviews with Pesticide importers (n=32), retailers (n=60), vegetable growers (n=120). -Document analysis. -Direct observations.	-KII (n=23), protectionist, retailers, extension worker, farmers union. -Survey interviews with Smallholder vegetable farmers (n=220) Pesticide retailers (12). -Document analysis. -Direct observations.	-KII (n=33), Hivos, FSI, flower importers, florists, supermarkets. -Survey interviews with flower growers (n=29 Pesticide sprayers (n=180) Pack house workers (n=32) Harvesters (30), flower endures (48). -Direct observations -Document analysis.
Data analysis	Combination of quantitative and qualitative methods.	Combination of quantitative and qualitative methods.	Combination of quantitative and qualitative methods.	Combination of quantitative and qualitative methods.
Year of study	2012/13	2013/14	2014/15	2015/16

The quantitative analysis was conducted with the help of the Statistical Package for the Social Sciences (SPSS). Summary frequencies were run to check the completeness and accuracy of the data. Percentages were used to explain proportions and the Likert scale was used to capture the evaluation of pesticide policy issues. Cross-tabulations, Chi-square analyses and Fisher test analyses were performed to understand the relationships between the variables and test their statistical significance. Each of the main chapters provides a detailed explanation of the theoretical models and methodologies used to analyze the empirical data.

1.9 Research validity

The validity of research refers to the accuracy of the findings and can be increased in a number of ways (Creswell, 2014). Validity also refers to the ability of an instrument to measure what it is actually designed to measure (Kumar, 2005). To enhance validity, the researcher has to make an effort to capture the essence of subjective information by using the appropriate tools to generate answers to the research questions (Creswell, 2014). Notably, validity must be ensured in terms of the quality of the data gathered, the data collection procedures pursued, and the analysis of that data. This includes "*external validity,"* referring to the ability to generalize results as well as the integrity of the conclusions reached, and "*internal validity,"* referring to the causal relationship between the independent and dependent variables that enables us to say that the conclusions accurately reflect what is being analyzed in this thesis.

For reasons of validity and reliability, questionnaires in this study were refined based on pretesting. Apart from that, triangulation was used to ensure validation of data through cross verification from two or more sources. A combination of qualitative and quantitative approaches strengthened the reliability and validity of the research findings (Kumar, 2005). As Scrimshaw (1990: 89) said: "qualitative methods are acknowledged to be more accurate in terms of validity, while quantitative methods are considered to be better in terms of reliability or replicability." As explained above, the analyses in this thesis rely on a combination of qualitative and quantitative research methods, thereby enabling a triangulation of data sources (Creswell, 2014; Yin, 2009). Structured and semi-structured interviews, the most important data collection methods, are combined with surveys, field observations and document analysis. This process also included a large number of people who are involved in pesticide registration, distribution and use from the national to the farm level (from registration to container disposal).

An important way to guarantee internal validity of the research findings is long periods of exposure during fieldwork, which gives the researcher an in-depth understanding of the object of research (Creswell, 2014). Formal and informal discussions about the research took place with scientists in Ethiopia, with the project managers at Alterra and PHRD, and during presentations of preliminary results at workshops. The findings of each of the chapters were presented and discussed during international conferences, workshops and PRRP project meetings. Finally, the validity of the research was checked by peer reviewers who reviewed the four empirical chapters for publication. Three of the four chapters have been revised based on reviewers' comments; a fourth is still under review.

Concerning external validity, the research was designed to increase the external validity of the findings, i.e., the generalizability of the findings beyond the specific practices investigated (Yin, 2009). Firstly, careful selection of research objects ensured representativeness of the outcomes for wider Ethiopian pesticide practices beyond the Ethiopian objects directly studied. Secondly, the analyses in this thesis were complemented with a review of literature, thereby constantly checking the generalizability of the findings. Thirdly, the three dimensions of pesticide policy (registration, distribution and use) were chosen to represent fundamental issues that relate to many pesticide governance debates as well as debates regarding the changing nature of environmental governance more broadly. Each of the analyses in this thesis focuses on pesticide management for (a number of) the three dimensions of pesticide governance.

1.10 Ethical considerations

This research followed established ethical guidelines for collecting data. Ethical considerations include cultural concerns, legislation and intellectual property rights, anonymity, confidentiality and procedures for handling information (Jankowski et al., 2001). Permission from the administrative authorities and informed consent from the respondent/informant in the study area are vital for conducting research ethically. Before starting the fieldwork, applications for research permits were made at the MoA and the Ethiopian Horticulture Producer Exporter Association (EHPEA). These institutions provided approval letters on the research conducted and on the topic researched. All respondents were asked for their informed consent to participate in the research after explaining to them what the research addressed and how the information (including pictures) obtained from them was going to be used. For the pictures of the pesticide sprayers in the greenhouses, permission was requested from the farm managers of the respective farms. Having a local expert to accompany the enumerators increased the respondents' confidence in the legitimacy of the fieldwork and their willingness to provide information. To maintain the confidentiality of the respondents, pseudonyms (Kaiser, 2009) have been used instead of real names in the flower cases.

1.11 Outline of the dissertation

This work is composed of six chapters including this introductory chapter. Each of the four research chapters following this introduction concentrates on one of the research questions outlined in section 1.3. Chapter 2 examines the challenges of state pesticide actors involved in policy implementation in gaining a better understanding of the successes and failures of governmental pesticide policy implementation. Chapter 3 investigates private environmental governance as an innovative response to the limitations and limited successes of state authorities in coping with pesticide distribution problems. Chapter 4 focuses on pesticide use practices by investigating the lifestyle factors and specific systems of provision among Ethiopian smallholder vegetable farmers with an eye on the potential for safer use and handling of pesticides. Chapter 5 analyzes pesticide governance mechanisms through private environmental and social standards along the global supply chains of Ethiopian cut flowers. Finally, chapter 6 highlights and synthesizes the main findings of the study, its theoretical contributions, the major policy implications and suggestions for future research.

Chapter 2

Information, motivation and resources: the missing elements in agricultural pesticide policy implementation in Ethiopia[1]

If a well-written policy is designed, why is it not being implemented?

[1]This paper is published as: **Belay T. Mengistie**, Arthur P.J. Mol, Peter Oosterveer & Belay Simane (2015) Information, motivation and resources: the missing elements in agricultural pesticide policy implementation in Ethiopia, *International Journal of Agricultural Sustainability*, 13 (3): 240-256.

Abstract

To promote pesticide governance that protects the environment and human health, Ethiopia has developed a legal framework for pesticide registration and control. However, in Ethiopia, pesticides are still registered, traded and used inappropriately. This research analyses how Ethiopia's pesticide policy is implemented and identifies the barriers for an effective implementation of this policy. Contextual interaction theory (CIT) of policy implementation provides a helpful framework to analyse the challenges of implementation processes based on the information, motivations, resources and interaction of pesticide actors. Data are collected from state pesticide experts, extension workers, traders and end users (farmers) through in-depth interviews and surveys. The overall result reveals that major gaps exist between pesticides policy on paper and its implementation in practice. The key policy actors scored low on each of the three characteristics: they have poor information available, have low motivation to implement policies and lack sufficient resources. Involvement of and collaboration with private actors is likely to improve the implementation of pesticide governance, and implementers need to pay attention to context and policy actors in implementation strategy in Ethiopia.

Keywords: pesticides, Ethiopia, state actors, policy implementation, registration, inspection

2.1 Introduction

Pesticides are important agricultural inputs in crop production processes worldwide. In many countries, the pesticide sector is an important contributor to national income, employment and international trade (Hoi et al., 2009, 2013; Kateregga, 2012). Simultaneously, countries are facing increasing national and global concerns about pesticide use and interrelated risk on the environment and human health. This negatively impacted on agricultural production and reduced agricultural sustainability (Pesticides Action Network (PAN) UK 2006, Williamson et al., 2008; Pretty et al., 2011, Food and Agricultural Organization (FAO) and World Health Organization (WHO) 2013). Governments are trying to change pest governance practices to more sustainable approaches, and to strengthen regulatory control on the distribution and use of pesticides to reduce these risks. These are major reasons among others behind the development of the pesticide policy (Kateregga, 2012; FAO/WHO, 2013).

Most of African countries lack proper pesticide management capacities and this situation has resulted in environmental, health and economic problems (Williamson, 2003; Williamson et al., 2008). In a similar manner, Ethiopia is in the process of intensifying and diversifying its agriculture to meet not only national demands for food, but also to increase agricultural exports (e.g. coffee and flower). This may lead to increased use of agrochemicals such as pesticides. However, pesticides, when used wrongly, can affect agricultural productivity. It can also result in unintended effects on human health and the environment. This implies that sustainable agricultural production requires an effective governance of pesticide along the entire pesticide phases (from registration to waste disposal) (Pesticide Risk Reduction Programme (PRRP)-Ethiopia, 2012).

Pesticides in agriculture were introduced in Ethiopia in the mid of 1940s and increased in the 1960s when different types of pesticides were imported by both private and public companies with the expansion of commercial farms in the early 1960s. Since then, the use of pesticides has increased rapidly (Abate & Azerefegne, 2007; Ministry of Agriculture (MoA) 2013). Currently, the need to feed the growing population of Ethiopia and the interest to produce exportable volumes to access the global market entail an increasing pressure to intensify agriculture and use chemical pesticides. For instance, during the main crop season

(Summer) of 2011/2012, the total area where pesticides were applied by more than 3.48 million farmers was 2.27 million hectares (divided among 2,124,307 ha of cereals, 79,122 ha of pulses, 21,613 ha of root crops, 9120 ha of vegetables, 6019 ha of chat and 757 ha of coffee (MoA, 2013). This figure only shows the treated area but not the frequency of pesticide application which is relatively high especially in vegetable growing areas in the Rift Valley.

Currently, pesticide usage by small holder farmers is frequently accompanied by misuse of pesticides leading to acute poisoning of users and health defects such as head ache, vomiting, skin irritation and eye irritation, and also to pesticide residues in food and drinking water (Mekonnen & Agonafir, 2002; Williamson, 2003; Jansen & Harmsen, 2011). In a study conducted in 2009 and 2010; Jansen & Harmsen (2011) found that most surface water samples taken from the agricultural areas of Ziway and Meki contain pesticide residues. The presence of dichloro diphenyl trichloroethane (DDT) and its breakdown products in surface waters in the areas shows that although DDT is considered as an obsolete and high-risk pesticide, it is still being used (Jansen & Harmsen, 2011). A study by Williamson et al. (2008) found that some farmers in Ethiopia develop their own recipes (formulation), a popular one being a mix of malathion with DDT (the latter is banned globally for all agricultural purposes under the Stockholm convention) but widely available in Ethiopia's malaria control programme called illegal diversion of DDT to the agriculture sector and applied to the hair to kill lice or to the skin to try and cure wounds. A survey conducted by Williamson (2011) showed a high poisoning rate among Ethiopian women and children.

In response, the government of Ethiopia has developed pesticide legislation ('Pesticide Registration and Control Proclamation No. 674/2010'). This law takes into account the whole pesticide life cycle: from registration and procurement, via import/local manufacture and distribution to end-use and monitoring, including quality control and waste management. However, a good law is not enough as law implementation and enforcement is a real problem for most developing countries (O'Toole, 2000; Bressers, 2004, 2007), including Ethiopia.

Several studies have been conducted to analyse the environmental and health effects of pesticide use in Ethiopia (Williamson, 2003; PAN UK, 2006; Abate & Azerefegne, 2007; Amera & Abate, 2008; Jansen & Harmsen, 2011; PRRP, 2012). However, no study has been carried out yet to ascertain the country's pesticide policy implementation. Therefore, this paper aims to analyse how, why and under what circumstances policy implementation might work or fail, by investigating the information, motivation and resources of actors involved in the policy implementation process. After introducing the conceptual framework and the research methodology, a detailed analysis of the pesticide registration system, inspection and quality control on distribution and use is presented to identify the roles of different actors and how they influence the implementation process. The final section formulates conclusions on the perspectives for an effective implementation of the pesticide policy to improve agricultural sustainability, the environment and the health of farmers.

2.2 Policy implementation framework: a contextual interaction theory

Implementation problems constitute an interesting subject in the field of environmental policy evaluation. After review of policy implementation literature and using the lens of the empirical and theoretical perspectives, this paper is an attempt to understand how state actors influence policy implementation. Policy implementation scholars (Kutting, 1998; Younis & Davidson, 1990; Weaver, 2010; O'Toole, 2000; Koduah et al., 2015) have presented several details for the implementation and effectiveness of policies at different policy levels in different policy fields, to answer the question 'are we being effective?' (EEA, 2001; Gysen et al., 2006). With the help of such theories it is possible to analyse policy intentions, identify intervention strategies and effectiveness and understand processes of implementation and change. Policy evaluation assists in identifying policy successes and failures: what works and what doesn't and what factors contribute to particular outputs, outcomes and impacts (Mickwitz, 2003; Kutting, 1998; EEA, 2001).

In order to realize the aim of this article, which is to assess the challenges facing the implementation of pesticide policy in Ethiopia, we applied the contextual interaction theory (CIT). This theory was developed for environment protection policies indicating a need for the involvement of key actors in the implementation process. The CIT (Bressers 2004, 2007) theorizes that the implementation of a policy is a social process wherein policy actors and their interactions define the outputs and outcomes. CIT developed in the early 1980s (Mazmanian & Sabatier, 1981; Younis & Davidson, 1990) and its usefulness is fully tested and extended on context factors by a number of authors (Bressers & Klok, 1988; Klok 1995; Bressers & Ringeling, 1995; Owens, 2008; Lulofs & Bressers, 2010; De Boer, 2012) in policy implementation. The context is not only important in as far as how it impacts the original intent of the policy, but also gives it a place of importance in the expectation of the more widely defined preferred output.

The basic notion of CIT is that the course and outcome of the policy process depend not only on inputs but more importantly on the characteristics of the actors participating, particularly their information, motivation, resources and interactions. Governance is concerned with understanding of implementation requires recognition of the importance of the role of actors; accepting the multi-actor characteristic of the process and the requirement of coordination. The theory does not deny the value of a variety of other possible factors, but all other factors that influence the implementation process can best be understood by assessing their impact on the information, motivation and resources of interacting actors (Sabatier, 1991; O'Toole, 2000; Bressers 2004, 2007). The policy implementation process involves three important components (Figure 2.1). The first component is the *input*s, which includes rules and regulations required for the implementation of a policy. The second component is the *process*, which implies a conversion process produced by the interaction of various actors and activities during the policy implementation process. The third component is the *outputs,* which is the outcome of the process in the form of behavioral or physical change. The output of any policy depends on the assessment of the contribution of the policy goals. The interactions are done in an environment (arena), in which rules and regulations of actions, various issues, and actors may be precisely specified or defined to facilitate policy implementation process (Bressers, 2004, 2007; Birkland 2001). We focused on output evaluation, which addresses how the policy operates on the ground, how state and non-state actors are functioning and whether the policy achieves its objectives. Outputs are the tangible results of a measure or the noticeable effects shortly after or even during implementation. Policy implementation entails the crucial transition from a policy design with its particular goals and instruments to its actual performance in influencing everyday reality (Figure 2.1). This policy implementation phase is realized by different actors; so the policy output depends on actor performance. In this study, three key variables are concurrently drawn into the analysis: the information held by the governance actors, their motivation and their resources. CIT assumes that is that the factors influencing the implementation process are interactive. The influence of any factor, whether positive or negative, depends on the particular contextual circumstances. These variables jointly influence the implementation process and have a major impact on policy success (Bressers, 2007;Weaver 2010).

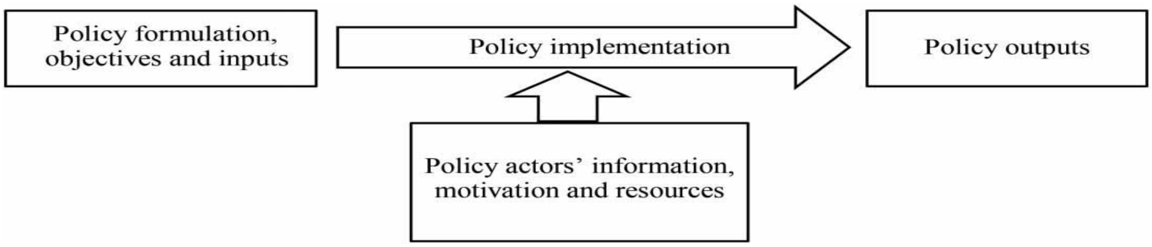

Figure 2.1 Policy implementation process and the role of policy actors.

Information refers to observations and knowledge gathered about reality, but also includes interpretations of that reality, influenced by frames of and interactions with other actors. Within the wider informational governance literature (Mol, 2006, 2009), information is regarded as a (re)source that is formative in environmental governance processes. When examining the accessibility, quality and kind of information in a network, one needs to be aware of the possible influence from different actors (Bressers, 2007).

Motivation and interest of a person towards a certain activity determine the quality of the activity he/she performs. Motivation orients behaviour but cannot be directly measured or observed. So, indirect indicators are required. For instance, successful experiences can increase actors' motivation and the opposite might also happen. When valuing motivation, one should not take into account the position of the actor towards the issue involved only, but also their relations with other actors (Ford, 1992; Karwai, 2005). This is because motivation can be strengthened through positive feedback from other actors. Scholars have developed different approaches when intending to measure motivation, such as (un)fairness and (in)equality (Adams, 1963). In this study, satisfaction/dissatisfaction is used to measure motivation.

Resources can be attributed to actors by other actors (formal powers such as legal or institutional rights) and/or rooted in resources such as money, skills and agreement. With regard to resources, one should pay attention to the possible additional resources that an actor, who is active in the process, can access via other actors in their network (Van Horn & Van Meter, 1977; Birkland, 2001).

The governance approach focuses on the interaction taking place between governing actors with information, motivation and resources. The interaction shapes actors and actors shape interaction patterns. The three variables information, motivation and resources may mutually influence each other as well. Access to resources may increase the motivation of actors and motivation will be affected by the reading of reality or access to information that actors may have (Bressers, 2007). While resources are necessary for gathering additional information, information can become a strategic asset that increases the resources of certain actors.

While assessing the characteristics of the actors in the implementation process, it is important to be aware of the existence of policy networks. A policy network is described by its actors and the linkages between them (Sharpe, 1985; O'Toole, 2000; Oosterveer, 2009). Through such networks, the policy implementation process acquires its particular shape.

2.3 Research methods

This section covers the methodology used in conducting the study. It explains what the study entailed and tools used for the study. Different sets of questionnaires were developed depending on the group of pesticide actors targeted by this study such as regulators (their role in controlling pesticides trade), traders (suppliers) and the end users of the pesticide.

To increase the reliability and validity of research through triangulation, Kumar (2005) suggests the use of qualitative and quantitative methods. Hence, this research uses the combination of qualitative and quantitative methods. To assess how, why and under what circumstances the pesticides policy implementation in Ethiopia works, we analysed the information, motivation and resources that different policy actors disposed of when dealing with pesticides registration & inspection (quality control). This research also includes two case studies: on pesticide dealers and growers (farmers). These case-studies provide a more detailed understanding of the extent to which local actors achieve implementation of the pesticide policy. A number of structured and semi-structured interviews were conducted with relevant public and private actors from federal to district levels between May and November 2012.

(i) A total of 12 in-depth interviews were conducted with policy-makers, including state pesticide experts from Animal and Plant Health Regulatory Directorate (APHRD) of the MoA. The interviews focused on the registration process, inspections and quality control, information, motivation and resources.

(ii) Interviews were also conducted with 15 pesticides importing companies randomly selected from a total of 40 (see appendix V), and 30 randomly selected pesticides' retailers from Addis Ababa, *Ziway* and *Meki.* Fieldwork was conducted in Addis Ababa, because it is the main commercial centre of Ethiopia where the majority of pesticides' imports take place. *Ziway* and *Meki* districts have a large number of pesticides' retailers and are important vegetable producing areas in Ethiopia. However, due to the absence of a detailed list of pesticide shops/retailers at the national or local level, we applied snowball sampling to identify the retail shops that were interviewed to gather information about their interactions with regulatory bodies, their trading practices, inspections and interactions with pesticide users. During the interviews, direct observations on the condition of the retail shops and the licences were also made.

(iii) Survey interviews were also carried out with 65 smallholder vegetable farmers to examine the level of support from state or other actors in *Ziway* and *Meki*, because these farmers are the main users of pesticides in the country. The *kebeles*[2] in these districts were

[2] The lowest administrative unit in Ethiopia.

clustered into rain-fed and irrigation-users. Hence, 65 farmers from the 8 irrigation-user *kebeles* were selected through the systematic random sampling technique.

(iv) Because flower growers are potential users of the pesticides in the country, interviews were also conducted with them. Out of the total of 85 flower growers in Ethiopia, 15 were selected, which all had at least 5 years of operation.

(v) Further in depth interviews were conducted with 30 development agents (DAs) or agricultural extension workers who have a plant science background and work in irrigated vegetable-producing *kebeles*. These DAs were asked about problems they face in running their day-to-day activities and in particular on the key variables: access to information and resources, their motivation and their interactions with local actors. Furthermore, four key informant interview**s** were conducted with pesticide advisory board (PAB) to obtain vital information about their contribution on safe pesticide distribution and use.

The data were subjected to both qualitative and quantitative techniques with the help of SPSS (version 19) to extract information on the key variables considered. These key variables were measured using a five-point Likert scale. Accordingly, any score (mean and/or grand mean) between 1.00 to 1.99 was considered as an indication of *very low;* 2.00 to 2.99 was an indication of *low*; 3.00 to 3.49 was an indication of *moderate*; 3.50 to 3.99 was an indication of *high*; and 4.00 to 5.00 was considered to be *very high* information, motivation and resources of actors. This reliability of the scales was determined using Cronbach's alpha method (Peretomode, 1992; Eisinga et al., 2013).

2.4 Legal framework of state pesticide policy and registration system in Ethiopia

2.4.1 Pesticide regulatory framework

Policy plays a vital role in the implementation of any regulatory framework (O'Toole, 2000; Mickwitz, 2003). In view of this, and by considering the overall issues associated with pesticide, the government of Ethiopia has formulated pesticide legislation at different times in order to govern pesticide use by farmers. The first pesticide regulation was a single article included in the Plant Quarantine Decree No. 56 of 1971 (MoA, 2009; PRRP, 2012). In this decree, MoA was given the mandate to control the import, production and sale of pesticide in the country. In 1972, the Crop Protection and Regulatory Division was established within the MoA, and plant protection activities started in a more organized manner. As a result, the control of pests was given more emphasis and pesticide use and sales spread widely. However, this decree lacked the necessary details to establish an effective pesticide registration scheme. In 1990, after persistent efforts from crop protection experts, a Special Decree was approved to register and control pesticides. The Special Decree was based on the FAO guidelines and had 5 sections and 29 articles. According to this decree, the manufacture, import, sale or use of unregistered pesticides is prohibited. However, the decree did not adequately incorporate international obligations and agreements to which Ethiopia is a member. It lacked definitions of relevant technical terms, of the scope and operational provisions of the advisory committee, and of a pesticide register. Little power was given to inspectors and penal sanctions to combat illegal trade were lacking (PRRP, 2012; MoA, 2013).

In order to address these gaps and to deal with the growing amounts and types of imported pesticides, the government of Ethiopia promulgated a new pesticide proclamation: the 'Pesticide Registration and Control Proclamation' (No. 674/2010) which was enacted in 2010 by the government in cooperation with the FAO legal section (Negarite Gazzeeta, 2010). This proclamation gave authority to MoA to regulate all pesticides, including pesticides used for vector control in the public health sector. According to the proclamation, 'all pesticides intended to be used in the country need to be registered in accordance with article 3 (1)'. Many international obligations and agreements are adequately incorporated in this proclamation and it also includes important issues that were not considered in the 1990 Decree. The proclamation has 8 sections and 37 articles and includes the registration of pesticides, certificates for competence and licensing, safety measures, analysis, a Pesticide Advisory Board (PAB), inspectors and some miscellaneous provisions. In this proclamation, the PAB was created under section 7(27 and 28) to assist the APHRD of MoA in formulating national policies, regulations and guidelines for the safe management and use of pesticides and in the implementation of international conventions. The Board consists of nine members including an officer designated by the Minister (Chairperson), an officer in charge of pesticides registration and representatives of different relevant Ministries.

2.4.2 Pesticides registration procedures in Ethiopia

To have a wide picture of how the pesticide registration is conducted in Ethiopia, it is important to realize that what does registration mean and what is its impact on quality control.

Pesticide registration is an evaluation of scientific data and assessment of risks and benefits associated with the use of a pesticide product and its potential effect on human health and the environment (FAO, 2010; EPA, 2009, 2016; Damalas & Eleftherohorinos, 2011). The registration is an important step in the governance of pesticides as it enables state authorities to regulate which pesticide are permitted to be used and for what purposes, and also to exercise control over quality, thus ensuring that the best interest of end-users as well as the environment are well protected (Aktar et al.,2009; FAO, 2010; EPA, 2016). The registration process is restricted to the notion that pesticides are only used for their intended function and envisages proving that such use does not promote unreasonable effects either on human health or on the environment. Therefore, before any pesticide can be used commercially, several tests are conducted that determine whether a pesticide has any potential to cause adverse effects on humans and the environment. The basic procedures for the registration of a pesticide are: (i) research conducted by the manufacturer prior to its decision to pursue registration; (ii) submission of data report by the manufacturer to the registration authority; (iii) review of the data by the registration authority; and (iv) a decision by the registration authority either to register the pesticide, based on the merits of the submitted data, or to deny registration depend on a benefit-to-risk analysis of the required data. Therefore, it is indispensable that all steps in the registration process are transparent, based on sound criteria and guidance documents, with full information shared with the applicant on the outcomes of the various steps in the registration procedure (FAO, 2010; Damalas & Eleftherohorinos, 2011).

Similarly, the registration authority ensures that each registered pesticide continues to meet the highest standards of safety to protect human health and the environment. Within this context, older pesticides are being reviewed to ensure that they meet current scientific and regulatory standards. This process, called re-registration, considers the human health and ecological effects of pesticides and results in actions to reduce risks that are of concern. The registration process for a pesticide usually requires the manufacturer (registrant) to conduct, analyze, and pay for many different scientific tests. Data required to support an application of a registration should cover all relevant aspects of the product during its full life-cycle. These should include the identity and physical and chemical properties of the active ingredient and formulated product, analytical methods, human and environmental toxicity, proposed label and uses, safety data sheets, efficacy for the intended use as well as residues resulting from the use of the pesticide product, container management, and waste product disposal (FAO, 2010; EPA, 2016).

The current structure of MoA shows that the Ministry is working on three major sectors: agricultural development, natural resources and disaster prevention and food security. Of these three sectors, agricultural development has most to do with pesticides' management. This sector is divided into four directorates, of which the APHRD is responsible for the development and promotion of the pesticide lifecycle management system including the registration and post-registration activities. Additionally, efficacy tests are carried out by the Ethiopian Agricultural Research Institute and agricultural universities who send their reports and recommendations directly to the MoA for decisions. The regional bureaus are autonomous public bodies responsible for the implementation of regional pesticide issues (MoA, 2013). The approval of pesticide registration for agricultural products is the responsibility of the PHRD of MoA.

To promote pesticide governance that protects the environment and human health, Ethiopia has developed a pesticide registration system based on concepts and guidelines recommended by FAO. The overall objective of pesticide registration is to ensure that the right types of pesticides are imported and safely used in Ethiopia (MoA 2009, 2013). Through pesticide registration, the responsible national or regional authority approves the sale and use of a pesticide following the evaluation of comprehensive scientific data demonstrating that the product is effective for the intended purpose and does not pose an unacceptable risk to human or animal health or to the environment (FAO/WHO, 2013). It is mandatory to register any pesticide in accordance with the registration guidelines adopted by the MoA before importation and distribution (MoA, 2009, 2013).

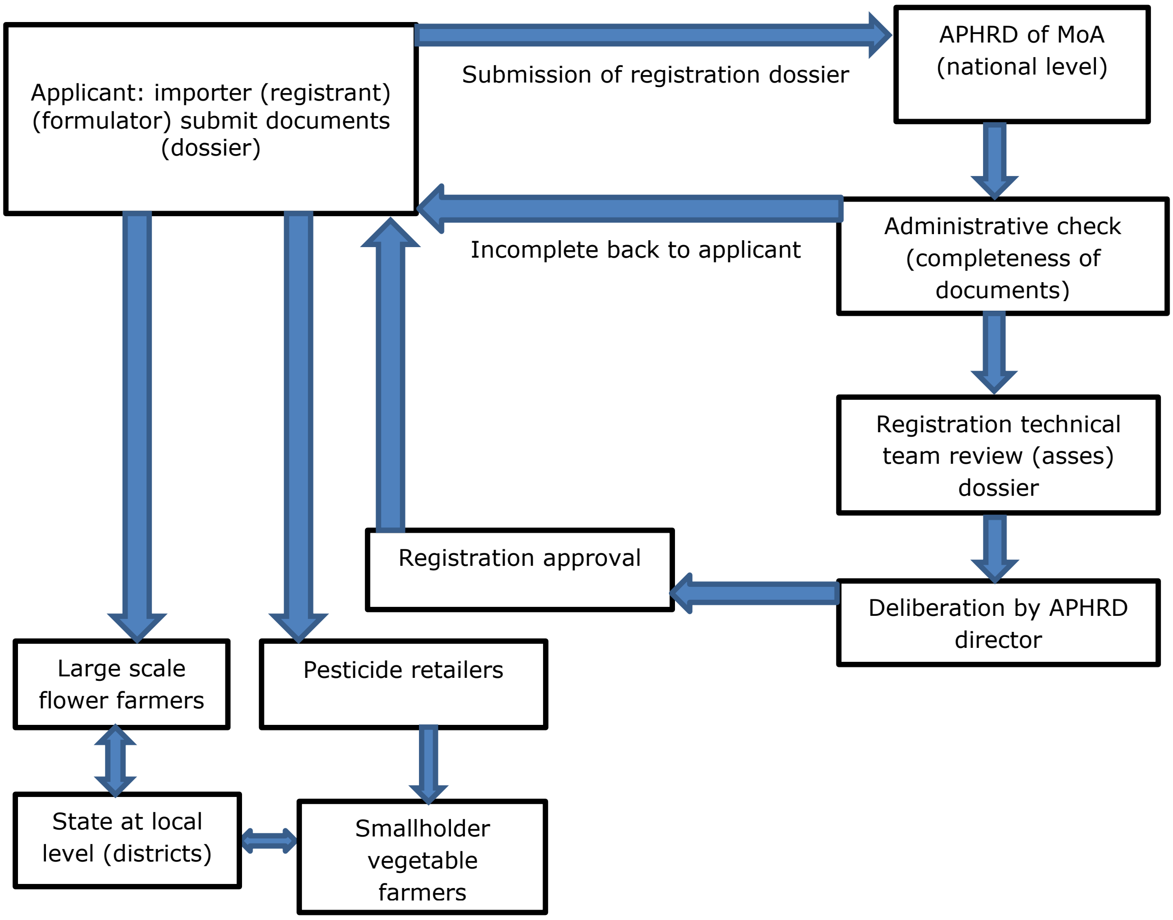

Figure 2.2 Schematic diagram of the pesticide product registration process

In Ethiopia, the registration process (Figure 2.2) is usually carried out through the assessment of data provided by the agent/importer (MoA, 2009). These include (1) the application for registration[3], (2) the active ingredient and formulated product dossier index (chemical and physical properties, toxicology, efficacy, residues and fate in the environment) and (3) country specific requirements such as (i) agency agreement between the agent and the manufacturer; (ii) batch certificate of analysis from independent accredited laboratory test; (iii) locally generated efficacy data from independent recognized research organization;

[3] The application form contains (i) name and address of the registrant (ii) name and address of the manufacturers of the pesticide (iii) trade name of the pesticide (iv) common name, content by percentage weight and other particulars and (v) size, type and specifications of the package in which the pesticide is to be sold.

(iv) samples of the pesticide submitted; (v) manufacturing licence in the country of origin of that particular brand by a recognized formulation plant and (vi) label in English and *Amharic*[4] for the intended pest and crop and according to pack size (MoA, 2012).The registrant should submit to the registrar a duly filled-in application for the registration of a pesticide and product dossier index (MoA, 2009). Once, the application file is complete, it is sent to the pesticide registration technical team of APHRD for evaluation, depending on the pesticide category. The team evaluates the document in detail and gives a recommendation on whether the product in question can be registered or not based on justifiable reasoning. Finally, a summary of the data will be submitted to the director of APHRD for the approval of registration. Subsequently, a Pesticide Registration Certificate is issued to the applicant by the Pesticide Registering Officer. This certificate lasts for five years and can be renewed upon expiring.

Following this procedure, since pesticide registration started, 274 different types of pesticides were registered for agricultural and household uses. Of these, 44 constituted mixtures of 2 or more active ingredients while the rest contained single active ingredients. The year when the highest number of pesticides was registered was 2009. In the year 2008, the year that the Ministry was reformed, only one pesticide was registered. The increase in the number of pesticides registered in 2009 may be accounted for the increased demand and the slowdown of the registration process in the previous year. Pesticide registration declined again in 2010 due to the shortages of foreign exchange (Figure 2.3). Overall, the registered pesticides included insecticides (34.74%), fungicides (28.36%), herbicides (20.56%), acaricides (4.97%), aerosols (4.69%), rodenticides (2.84%) and anti-transpirants, adjuvants (3.84%) (MoA, 2012).

[4] Official working language of the Federal Democratic Republic of Ethiopia

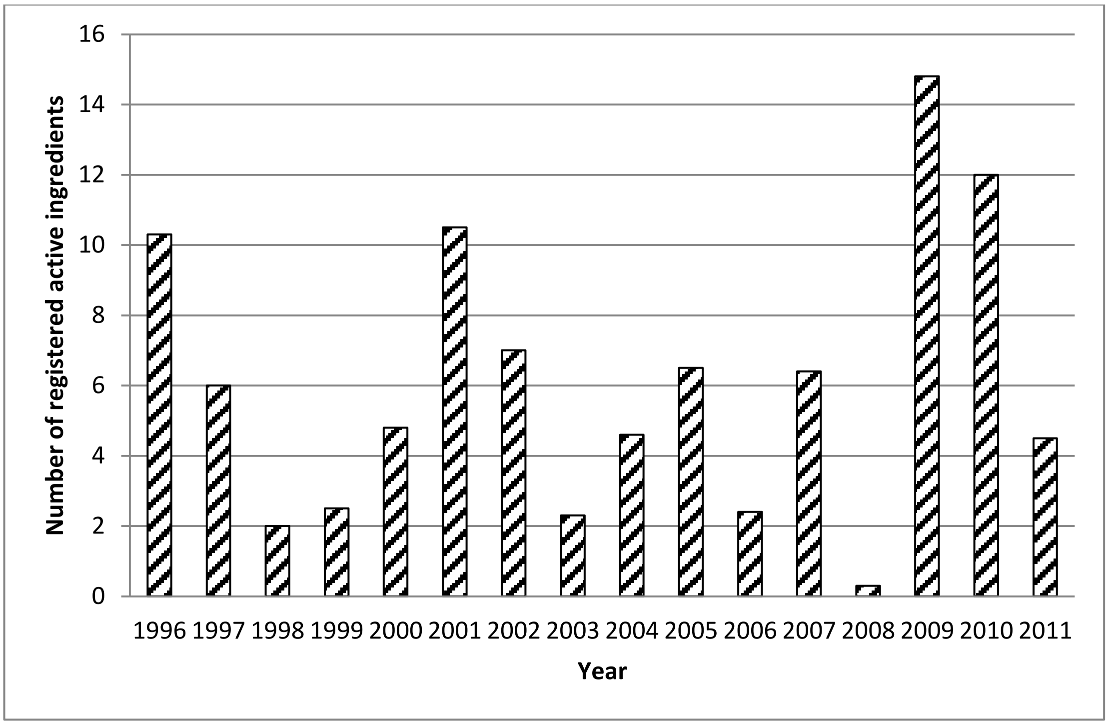

Figure 2.3 Registered pesticides in Ethiopia. Source: MoA (2012).

2.4.3 Pesticides registration challenges in Ethiopia

Pesticide registration is a complex process and takes considerable time, resources, and expertise on the part of the registration authority, the pesticide manufacturing industry, and various public interest groups. An expanding series of tests based on improved technology is used to provide precise pesticide residue detections and toxicological assessments in response to public concern. Improved methods for hazard predictions, novel approaches to hazard reduction measures, and incorporation of the broadening scope of relevant scientific knowledge into industry and government policy decisions contribute to changes and improvements in the pesticide registration process (Damalas & Eleftherohorinos, 2011; EPA, 2016**)**. In this study, several challenges were identified that hinder proper implementation of the pesticide registration system in Ethiopia:

(i) During our survey, we observed serious human resource (experts)constraints that affect pesticide registration, For instance, most of the experts have at least an MSc-degree, but their expertise is not evenly distributed along the broad range of subjects that are relevant for dossier evaluation of pesticide registration. There are three pathologists, two biologists, one herbologist, two chemists, two entomologists and two inspectors. However, as informants from APHRD mentioned, the current registration is hindered by lack of skilled manpower in pesticide dossier evaluation, lack of nationally applicable criteria for the acceptability of pesticides, delay of the efficacy trial, lack of pesticide laboratories to test samples, submission of incomplete documents by registrants (importers), failure of committee members to attend meetings regularly, insufficient post-registration monitoring on imported pesticides. As informants from APHRD mentioned that lack of qualified experts on environmental risk assessments, residue and toxicology are the critical problems of the directorate to ensure proper dossier evaluation and registration of hundreds of imported pesticides.

(ii) It was also reported that at present, the registration process is carried out through the assessment of data provided by the registrant (importers) themselves. Trial data from the country of origin are submitted to the APHRD and the values of efficacy and safety were obtained from the Codex Alimentarius or EU-MRL databases. The registration process is not supported by the independent laboratory test (experimental details) because MoA has no facilities to determine and control the quality of the pesticide. There is no in-depth inspection and control over inert active ingredients, while pesticides with the same active ingredients can vary a lot in efficacy and toxicity due to differences between the inert ingredients used. Pesticides with similar names may also have been registered differently as active ingredients and mixture of inert ingredients. The pesticide inspectors pointed out that the absence of laboratory facilities to take samples and test its quality makes the inspection process very difficult as well. The inspectors are expected to take samples from the markets and at the points of entry for laboratory analysis. However, without laboratory analysis, it is very difficult to identify fake and substandard products that are held by retailers, traders, transporters or farmers.

(iii) Information is essential to rational decision making about the registration. For a pesticide to be registered, huge amounts of information have to be submitted to APHRD of MoA (regulatory body). However, currently it is debated whether a pesticide may be registered if it can be demonstrated to be equivalent to another, already registered pesticide. Particularly, the major challenge on pesticide registration is double/ triple registration of pesticides with the same active ingredient (ai) but under different commercial or trading names and requests to import unregistered pesticide (MoA, 2013). For instance pesticides such Unizeb, Fungozeb, Indom and Indofil among others are available on the market under different trade names but they all contain the same active ingredient (Mancozeb 80% WP). The seemingly simple issue of equivalence is an arena where a number of conflicts of interest between importers (registrants) and APHRD. These concern claims about confidentiality of information submitted. Another way to explain this challenge is by what Mol (2006 & 2009) calls it lack of informational governance which take into account the chemical identity, efficacy and environmental and health safety of a pesticide. The government of Ethiopia also allows for unregistered pesticides for flower farms in special circumstances. In this survey, it is also important to note that a conflict of interest is reported between commercial pesticide importer and flower growers who allow to import un registered pesticides (only with import permits) in the pesticide business.

Similarly, pesticide registration dossiers are important information sources and contain confidential documents. However, the regulatory body have no pesticide database system called pesticide stock management system (PSMS) in order to monitor pesticides along their life cycle and to keep track of records. For instance (see Photo 1.1) pesticide dossiers are piled up in a room in a disorganized manner and it is often difficult to find documents and extract information from the dossiers.

Photo 2.1 Unsystematic arrangement of the dossier for pesticides registration in Ethiopia
(Photo by Belay Mengistie**)**

(Iv) Long registration process due to mainly (limited staff at APHRD to evaluate dossier, delay of the efficacy trial and submission of incomplete document from registrants) affecting the pesticide distribution by favoring few suppliers dominate the market. The demand side plays an important role in **"**encouraging**"** corruption and illegal pesticide trade (smuggling) through boarder. An informant from custom office reported that it may be very difficult to detect, stop and seize illegal pesticides. Some similar products are not declared as "dangerous goods" and often importing documents for the same shipment are different/inconsistent), or fake/fraudulent names and misleading/ deceptive labels are used. It may sometimes be very problematic for authorities to stop suspicious shipments for sampling and analysis. Custom inspectors considered pesticide as medicine or cosmetics and releases pesticide consignment without getting import permit or certificate from the ministry of agriculture. This is because of the fact that those persons assigned at custom have not agricultural training or background at all. The pesticide policy requires that all pesticides sold or distributed in Ethiopia should be registered at APHRD of MoA. According to this policy it is illegal to trade/sell any pesticide which is not registered in the country for general use. However, from the previous reports (MoA, 2013) and observation from the field it seems that the percentages of pesticides imported through unknown channels have increased. For instance, recently, according to Fana Broadcasting Corporation (2016) 274 steel barrels (approximately 96,000 kg) of expired Endosulfan entered Ethiopia from Israel passing through four custom sites.

After registration, the MoA is responsible for controlling the importation of pesticides by issuing an import permit, provided the application submitted by importer contains the necessary data as prescribed by the MoA. Moreover, a pesticide may not be allowed to enter the country unless it is inspected by MoA inspectors and packed and labelled as provided in the proclamation, and unless the importer produces a written permission (import certificate) from MoA.

2.5 The role of policy actors in pesticide policy implementation in Ethiopia

This section reports on the empirical findings regarding the practical problems that the state pesticide policy and its implementation encountered with respect to pesticide registration, inspection and quality control. Our primary focus is on the characteristics of the state pesticide actors involved, particularly their information, motivation and resources.

2.5.1 Access to information in the implementation of pesticide policy

Access to information for policy implementers was considered inadequate at the national level and local level and seen as a major operational challenge. There is a lack of information among development agents (DAs) or agricultural extension workers and experts at the district level. The information gap at the local level was even more pronounced when pesticide policies were considered. When asked about their knowledge of the new pesticide law (proclamation), few respondents immediately referred to the old pesticide Decree of 1990 and all experts reported that they had only heard of the proclamation of 2010, but had never seen it (Table 2.1).

Table 2.1: Information of state actors (agricultural extension workers) (n=30)

Items	**Mean**	**Standard deviation/ Std**	**Ranking**
Information / technical knowledge			
I am informed on pesticide law (proclamation)	1.00	0.00	4
I have the necessary knowledge, and skill to identify symptom of pest attack?	3.10	1.09	2
I know different pesticide application methods	3.26	1.11	1
I have technical knowledge on field diagnosis of pest	2.50	1.13	3
Grand mean	**2.46**		

Cronbach Alpha (α) = 0.70

All APHRD staff from MoA at the national level described themselves as being very familiar with both the 1990 Decree and the proclamation of 2010, but none of the extension workers in both districts claimed to have heard of the pesticide law (1.00, very low information). Also, all pesticide retailers at the district level noted that they are not familiar with the proclamation of 2010. In theory, in the decentralized system of Ethiopia, decision-making is shifted to the local level but in practice the top-down approach is still in place. APHRD has only 12 experts in 2 teams dealing with quality control, risk assessment, inspection and certification. The lack of experts is a significant challenge to disseminate information on the pesticide policy with a simplistic approach.

Additionally, empirical findings showed that the lack of technical knowledge among DAs and extension supervisors, dealing with pesticides at the local level, is a major barrier for safeguarding the current pesticide distribution system and use in Ethiopia. The DAs reported that they have no enough information and technical knowledge of the hundreds of different agricultural pesticides that are available in the market. The survey revealed that the DAs technical knowledge to identify symptoms of pest attacks is moderate (3.10) as well as their knowledge of pesticide application methods (3.26). However, their knowledge of field diagnosis of pests, diseases and weeds is low (2.50), so performing this is likely to go beyond the capability of many field extension agents.

Some DAs blamed the existing curriculum for this lack of knowledge, but most DAs pointed out that the trainings given were mainly theory-based with inadequate practical application due to shortage of the equipment, practical tasks, labs, tools and teaching materials. For instance, all the interviewed farmers in Ziway and Meki districts stated that they faced crop diseases during the 2011/2012 crop season and that they used pesticides to control pests and diseases. The most common pesticides currently used by vegetable farmers are DDT, Malathion, Seleron, Thionex, Mancozeb and Ridomil. Besides, farmers are using highly toxic, broad spectrum pesticides (e.g. lambda-cyhalothrin and aluminium phosphide) (PRRP, 2012). Pesticides whose use is restricted in industrialized countries are widely used in Ethiopia. For example, DDT (banned in 49 countries) is used in Ethiopia for the control of the mosquito malaria vector and against agricultural pests by small-scale farmers. Similarly, Williamson (2003) Stadlinger et al., (2013) found that pesticide dealers in developing countries misguide farmers by convincing them to buy excessive quantities of often more toxic pesticides that lead to severe health exposures. The absence of knowledgeable personnel in most retail shops does not comply with both articles eight of FAO code of conduct on pesticide distribution and use and the Ethiopian Pesticide Proclamation No. 2010, which aims at ensuring advice on risk minimization and proper use of pesticides.

The average age of the pesticide retailer was 33 years. The youngest retailer was 12 years old, which is against the FAO guidelines on retail distribution of pesticide: ‘pesticide must not be sold to a minor, usually any person below 18 years of age’. Only 6 of the 30 interviewed retailers had a formal education regarding pesticides at higher education institutions and the remaining 24 had no agricultural background or at least one year of related work experience or training. During the interviews, most farmers responded that they do not receive adequate technical assistance and information on the safe handling, storage and recommended doses from the official state extension services. Lack of information and advice are shown to inhibit safe use and handling at the farm level.

Information is normally considered vital in environmental governance (Mol, 2006, 2009). Therefore, vegetable farmers were asked about their main source of information for crop protection measures and the majority (41%) responded that they depend on their own experience (Table 2. 2).

Table 2.2 Source of information for pesticide: (n=65)

Items	Percentage
Their own experience	41
Retailers when buying pesticides	25.6
Government extension services	22.1
Their neighbours' experience	11.3

Although the competence of retailers is questionable, many farmers prefer to contact a pesticide retailer instead of an extension official when problems arise, because pesticide shops can be accessed easily at any time. There is little direct contact between the farmers and the state DAs at the farm level. Interviewed farmers (68%) stated that they contact DAs only when they face particular problems and not so frequently. This implies that there is a very low level of interaction between farmers and extension agents. The extension supervisors indicated that one of the main reasons for the limited contact between the farmers and extension agents is the relatively small number of DAs. The average farmer to DA ratio was 980:1, which makes regular visits clearly beyond their reach.

This lack of advice and technical support for farmers on pesticides use may lead to different problems. Indiscriminate use, high frequency of application and application of similar pesticides may lead to pest resistance and indirect costs (Pimentel, 2005; Oluwole & Cheke, 2009). During the survey, we observed that farmers were spraying pesticides on perishable vegetables without clear sign or symptom of pest/disease presence. Mixing two or more pesticide products (fungicides with insecticides) was a usual practice in Ziway and Meki districts as mentioned by plant protection experts. The survey showed that the high price of pesticide is the most common constraint (53% of the farmers), forcing them to use pesticides with low quality (potentially contributing to resistance). Reduced efficacy of pesticides is encountered by 48% of the farmers (Table 2.3). There is perhaps a large number of farmers who bought their pesticides from unauthorized retailers, indicating that quality problems exist in the pesticides' distribution network.

Table 2.3 Difficulties faced in using pesticide (n=65)

Items	Percentage
High price	53
Low quality (resistance)	48
Lack of safety devise	9
Unavailability when it is needed	0

2.5.2 Motivation of policy actors in the implementation of pesticide policy

The motivation of state actors is crucial to transfer knowledge to farmers and enhance the implementation of policy at the farm level. Motivation is orienting behaviour, but it cannot be measured directly. So is job satisfaction, the presence of promotion opportunities and the level of salary are used as proxy indicators (Table 2.4).

Table 2.4 Motivation of state actors (n=30)

Items	Mean	Std	Ranking
Motivation			
Frequent organizational restructuring on the current job is satisfactory.	2.13	1.22	4
In-service training, and skills development on the current job is satisfactory.	2.70	1.36	1
The work itself is interesting.	2.30	1.44	3
Career structure that promotion on current job is satisfactory.	2.43	1.45	2
Salary is encouraging.	2.03	1.27	5
Grand mean	**2.31**		

Cronbach Alpha (α) = 0.77

Regarding interest at work, about 12 (out of the 30) respondents said that they were interested in their job. The majority of the subjects (18) said that the salary they earned was not proportional to the workload they had (2.03). This might be an important reason for disliking their job. One DA said, 'I became a DA just for the sake of survival without any motivation for working in rural areas'. He also pointed out that he lacked motivation for his job because there were few incentives and facilities (such as clean water, electricity and internet). Moreover, low social appreciation and tiresomeness of the profession were also mentioned. We observed that some DAs were exhausted; they lacked physical happiness during their work. Therefore, both the actual observations and interviewees' responses illustrate that most DAs have little interest and motivation in staying in their profession.

A main factor undermining the motivation of DAs is lack of training. This study revealed that in-service training, in the form of orientation training for new staff, refresher training and career development training are not available/accessible (2.70). As many of the DAs in Ethiopia are diploma holders with very limited technical skills, it is expected that their involvement in inservice training programmes will benefit them a lot in advancing their skills and build confidence in what they are doing. However, this does not seem to be a priority for the authorities, because most DAs reported that they did not receive any in-service training on pesticides since they had begun working as extension worker. Similarly, the top 5% of DAs (selected for the best performance) are allowed to upgrade themselves to the BSc level. This is because promotion, reward and incentive systems will attract and motivate DAs. However, the lack of a clear career structure that includes incentives, promotion, awards and/or other opportunities (e.g. scholarships) for extension workers remains a major constraint and causes low motivation/lack of satisfaction (2.43).

During the interviews, some DAs pointed out that district experts usually evaluate DAs' performance on the basis of their political accomplishments rather than their performance of professional duties. Additionally, supervisors and DAs are not trained as inspectors, so they have little understanding about what is going on in the retail shops at the district level. This has serious implications for quality control of pesticides at the local level.

The frequent restructuring of MoA and the regional bureaus of agriculture is found to be another major factor affecting the motivation of staff. Informants reported that organizational restructuring has taken place at least every two years in Ethiopia, often without evaluating the impact of the previous restructuring. Performance indicators to measure the success or failure of the current extension programme do not exist. Restructuring the public sector including MoA involves the dismantling of some departments and creating new ones. Although government officials aim at improving the quality of service provision through restructuring the organizations, most respondents expressed their views that restructuring has been used as a means for political revenge through sacking staffs affiliated to opposition parties. When an organization goes through frequent restructuring, the motivation of employees will be significantly affected (Karwai, 2005) and tensions created among the employees, who are scared of being fired or reallocated to inaccessible areas. All these might discourage actors to serve and strive towards institutional goals. For instance, in the study areas where pesticide use is intensive and many retail shops are located, no pesticide inspector was found.

2.5.3 Resources of policy actors in the implementation of pesticide policy

The implementation of a policy is influenced by the resources of actors (Van Horn & Van Meter, 1977; Mazmanian & Sabatier, 1981). So, financial and human resources are core variables for determining policy implementation. During our survey, we noted that shortage of qualified experts (inspectors) is not limited to the agricultural offices at the district level, but also to the regional bureaus of agriculture and even to MoA for monitoring on imported pesticides. Most importantly, this study reports that the primary challenge for the implementation of policy is the lack of adequate resources both in terms of funds, motivated and well-trained human resources as well as a lack of well-equipped laboratory for the implementation for pesticide quality analysis.

Most extension workers reported a critical shortage of extension material and infrastructural support for the extension service. At the local level the study indicates that the majority of the extension workers respond that there is a lack of appropriate extension material (2.23), like images of pesticide warning symbols. This implies that appropriate teaching aids and guidelines have not been given to the DAs to effectively work and communicate with the local farmers. It is striking that all the DAs stated that they have received just one type of extension material (like hand-outs or booklets) over a period of three years. Apart from problems with an extension material, districts also face a serious lack of adequate transportation facilities. The DAs pointed out that inadequate transportation facilities (2.40) cause a major barrier for their efforts to assist farmers in their use of agricultural inputs including pesticides. This problem should be seen in the context of the districts' and *kebeles'* poor infrastructure (Table 2.5)

Table 2.5 Resources of state actors (n=30)

Resources	**Mean**	**Std**	**Ranking**
Transportation facilities are sufficient to access farmers	2.40	1.45	1
The number of DAs assigned to farmers is proportional	1.86	1.66	3
Extension materials are available to effectively work and communicate with the farmers	2.23	1.33	2
Grand mean	2.66		

Cronbach Alpha (α) = 0.79

About 70% of all farms are located at more than 4–6 hours walking distance from the office of the extension agents. The DAs reported that they have to travel up to 10-12 km to visit some of their target farmers and about 52% of them have to do this on foot and the remaining 48% use motorcycles or bicycles. Another constraint is the shortage of human resources (DAs) when assisting the farmers. The DAs in the study districts face heavy workloads for at least two reasons. First, a large number of farmers are assigned to them leading to disproportionality (1.86). For instance, in Ziway, the average extension worker to farmer ratio is 1:964. In Meki, this is 1:878, which is beyond everyone's reach (AoD, 2012). As a result, most DAs are forced to cover the gaps by providing support and training to farmers outside of their field of study. Once DAs are assigned a position, they must serve as generalists, rather than as specialists. For example, when a farmer approaches a DA, he has no idea that the DA is a 'specialist' in a particular field. The farmer may ask for advice on a wide range of subjects and is dissatisfied if the DA cannot help him or her to resolve the particular problem. In general*,* pesticide end users, especially smallholder farmers, in Ethiopia lack resources, information and training to avoid risky practices.

2.6 Output of the pesticides policy implementation process

The policy implementation process, analysed in the previous section, directly influences the output of the pesticide policy in Ethiopia. Despite the formal authority (Article 30 (1)) pesticide inspectors have to carry out periodic inspections of facilities for pesticides, very few importers, retailers or growers report to have been inspected (Table 2.6).

Table 2.6 Interaction of state pesticide inspectors with traders and growers

Pesticide actors	Samples (n)	Inspected	Not inspected
Pesticide importers	15	3	12
Pesticide retailers	30	0	30
Smallholder vegetable farmers	65	0	65
Large scale commercial cut flower growers	15	4	11

This research shows that 12 of the 15 importers responded that MoA never inspected their pesticide stores unless inspectors were invited for inspection as a pre-condition for the renewal of licences by the Ministry of Trade and Industry. It proved that, although the proclamation requires *every importer to have records that show all quantities of pesticide product imported, type of pesticide, origin, port of entry, purpose, storage, and sale by the company* (Article 32). However, from 15 interviewed importers, only seven have documented records. Also none of the inspectors pointed out that they had conducted a regular inspection of pesticide storage facilities owned by importers to ensure compliance with statutory regulations during the 2011/2012 crop year. This situation may lead to misconduct by corrupt or illegal pesticide dealers who import pesticides unlawfully and stock unauthorized pesticides on their sites. Interviews with pesticide retailers revealed that none of their shops had ever been inspected by the inspector from district or federal state. More specifically, pesticide traders are required to have a Certificate of Competence (CoC) from the appropriate regulatory body, but none of the retailers had a CoC. Another requirement for pesticide retailers is to have a licence to guarantee quality control and it is the responsibility of the regulatory authorities to assure this. From the 30 interviewed retailers, 7 had no valid licence to sell pesticides, 14 had licences but they were not renewed and only the remaining 9 had renewed valid licences. Most retailers were not even aware that pesticides were supposed to be registered with APHRD before they were allowed to sell them.

Ethiopia lacks an effective supervisory mechanism for controlling pesticide overuse and pesticide residues at farmsteads. None of the vegetable farmers in Ziway and Meki districts had been inspected and this may contribute to misuse of pesticides by smallholder vegetable farmers. Similarly, 11 of the 15 flower farms in our sample responded that they were supervised or inspected neither by MoA nor by other relevant actors from federal or regional government offices for health, environment or social affairs during the last two years. Although labour inspectors have the mandate to enter the workplace, take samples and investigate the health situation of workers, none of the sampled farms were inspected by them.

Additionally, considering the urgency of addressing pest problems in floriculture, the government made an interim arrangement for flower growers to allow the import without restrictions of unregistered pesticides they required for their own farms. Although this arrangement was important to solve the problem temporarily, it should not become a permanent solution. Still the government did not try to stop this special interim arrangement by providing a legal frame for pesticide regulation and protect the country from a pile of obsolete pesticides. Policy implementation has also suffered from the absence of active collaboration between the relevant state pesticide actors. According to article 27, *Pesticide Advisory Board(PAB) comprising members from related government agencies were established to advise the MoA in formulating and implementing policies, regulations and guide lines in relation to safe use and management of pesticides in general and registration and decision making on quality of pesticides in particular*. PAB are drawn from the Ministry of Health, the Environmental Protection Authority (EPA), the Quality and Standards Authority, the Ethiopian Institute of Agricultural Research (EIAR), the Institute of Biodiversity, the Ministry of Labor and Social Affairs ,and the Authority of Revenue and Customs. The MoA was delegated with the task of providing the chair and secretariat to the board in the implementation of the proclamation (*Negarite Gazeta,* 2010). The PAB was so weak that it was identified as a major contributor to the failure of pesticide registration. Three of interviewed key informants from PAB stated that a responsible office at MoA is not active in this case. Besides, although the proclamation stated that the PAB shall meet at least four times a year, from the survey, we identified that the board met only once two years ago to get introduced to one another. In the current board, some very important private stakeholders such as the pesticide importers and local producer company, and Ethiopian Horticulture Development Agency are missing. Similarly, there is very poor communication between the federal and regional authorities as well as between the regional- and district-level authorities in issues related to pesticide governance. For instance, districts, zones and regions have no data regarding registered pesticide in Ethiopia, and this is only available at the federal level. Similarly, there is a lack of recording pesticide distribution and use at *kebele*, district, region, or federal levels. The only available data are based on import figures. Moreover, Ethiopia is a large country with thousands of kilometres of porous borders with five countries, which makes illegal pesticides' imports easy.

Monitoring and surveillance can help to identify pesticide pollution, spot dangers and provide useful information to refine risk assessment for registered pesticides under re-evaluation (FAO/ WHO, 2013). So far, however, systematic monitoring and surveillance are lacking and the regulatory body has no information regarding the products once they are registered. Besides, there is no Pesticide Stock Management System to monitor the distribution and use of imported pesticides. The only available records are about import data.

Last but not least, contextual interaction theory does not only consider key actors in the policy implementation process. It may also involve other stakeholders who may have an important role to play to make the implementation process a successful activity. Good coordination networks have been proposed as the best solution to the implementation of policy, program, or project. A well-organized and coordinated network helps actors in the policy implementation and in achieving the organizations' end results (Bressers, 2007; Brinkerhoff, 1999). In line with this, in Ethiopia there are different ministries, agencies and bureaus that take charge of various aspects of the management of chemicals at federal level and local level are operating at a very weak in pesticide management. However, according to key informants at local and federal level, they lack effective coordination among these actors, overlap in mandates, and insufficient linkage with federal institutions, restructure institutions from time to time and weak implementing capacity of institutions. For example, the illegal import and trade in expired pesticides has grown, putting farmers' livelihoods at risk as unregulated and often toxic chemicals enter the market. These untested and substandard chemical can be hazardous to the environmental and human health. But despite the potential threats, and even though it is illegal to import and retail such type of pesticides Ministry of Agriculture, Custom Authority, Ministry of Trade and Industry and/or regional offices can't seize them. Such problems arise from weak coordination (information sharing) between these organizations and lack of legal action on the importers and retailers who are importing, distributing and selling expired and unlabelled pesticides. However, the overall performance and interaction between growers, pesticide traders and relevant sate and NGOs is weak in pesticide governance.

2.7 Conclusions and recommendations

Ethiopia has a relatively well-developed pesticides legislation on registration and control of pesticides intended to address its environmental and health effects. The overall conclusion from the study is that there are gaps between policy and practice. The gap and the challenges implied by its implementation is the main barrier to realize sustainable agricultural production. These findings have a number of implications for environmental policy and agricultural sustainability in general and the pesticide policy in particular. The central argument in this paper is that policy implementation processes are interaction processes between actors with their respective information, motivations and resources. The spectacular failure of the pesticide policy implementation in Ethiopia is mainly due to factors pertaining to the motivation of governmental actors to further elaborate the support system and address the administrative and material obstacles for building proper registration, distribution and use of pesticide. In Ethiopia, policy-makers in control of pesticide quality have not only to 'talk the talk' in creating policy but also to 'walk the walk' by implementing their policies to achieve sustainable agriculture. In view of this, weak policy implementation exposes communities and the environment to the side effects of pesticides and it is often the poorest people who, indirectly, are most negatively affected by weak institutions (Baba, 2012; Hoi et al., 2013; Stadlinger et al., 2013).

Most importantly, our study reflects on the governance literature. Private governance, which is the stronger involvement of non-state actors and a shift of state tasks and responsibilities to them, requires a 'policy space' for non-state actors, provided by the state (Sharpe, 1985; Peters & Pierre, 1998; Mol, 2007). In relation to this, the governance literature, as well as current development strategies, has shown the importance of the involvement of private actors next to the public sector, requiring important changes in the public sector institutions and policies (Peters & Pierre, 1998; De Vries et al., 2005; Pretty et al., 2011). The lessons being drawn from this paper point to the significance of moving concretely to governance reforms in Africa, related to among others transparency and more close involvement of non-state actors. State failures seem to be commonplace in environmental policies in most African countries, caused by weak recognition of sustainability in most policies, the absence of a national programme for the promotion of sustainable consumption and production, lack of enforcement capacity, weak institutional capacity for monitoring and lack of decentralization to local authorities, among others (Oosterveer, 2009; Pretty et al., 2011). With a growing population, Africa is in urgent need of increasing agricultural production, which will unquestionably increase the use of pesticides. As demands for pesticides increase, effective pesticides policy implementation becomes even more important. The overall situation with regard to pesticide governance in Africa consists of a number of elements. There is an inadequate awareness of the possible risks posed by pesticides among major segments of the African population.

This is further complicated by the general lack of reliable data and information on toxicity, safe use and sound disposal practices for pesticides. Insufficient international cooperation and very slow progress in defining national, regional and international best available technologies/safe pesticide alternatives make that pesticide risks in Africa remain inadequately recognized.

Harmonization and cooperation in pesticide of trade and policies among African countries could contribute to strengthening policies and strategies for the implementation and enforcement of sustainable governance of pesticides. Best practices exchange has been promoted to some extent by, among others, the formation of National Cleaner Production Centres, which now exist in 11 African countries. Additionally, some African countries, most notably Nigeria, Senegal and the Gambia, have started implementing the Globally Harmonized System of Classification and Labelling of Chemicals, which can provide a more integrated approach to pesticides management, not only in Africa (Baba, 2012; Kateregga, 2012; Bennett & Franzel, 2013).

Finally, political will and commitment for collaboration between state and private actors (farmers, companies, NGOs, etc.) at multiple scales could play an important role in overcoming failures in pesticides policies. Besides comprehensive human and institutional capacity development of all actors involved in the manufacture, distribution and use of pesticides, the emphasis should be on alternatives to pesticide-based agriculture, such as the adoption and implementation of integrated pest management and the promotion of organic agriculture, with its use of multiple non-pesticide production methods (Oosterveer et al., 2011; Pretty et al., 2011; Bennett & Franzel, 2013).

Conclusively, it is argued that in order for policy implementers of any policy to achieve the desired goals (output of the policy), they have to ensure that the other two components of policy implementation as described in the contextual interaction theory are well addressed during the policy development process. This means that inputs required for the policy implementation (adequate resources in terms of well-trained human resources, technology, finance, and equipment) must be assured, and process involved in the implementation of the policy (the arena where interaction of actors and non-actors takes place) should be well organized.

Chapter 3

Private environmental governance in the Ethiopian pesticide supply chain: importation, distribution and use[5]

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Abstract

Agricultural pesticides are important chemicals that are used to mitigate crop damage or loss and improve productivity. However, pesticides may cause negative environmental and human health effects depending on their specific distribution and use. Securing environmental safety and sustainability of pesticide distribution and use is widely seen as an important challenge for pesticide governance. This paper analyses how, why and under what circumstances Ethiopian pesticide supply chain actors deal with (un)safe distribution and use of pesticides and assesses their potential contribution to securing the quality, environmental safety and sustainability of pesticides importation, distribution and use. The framework developed for this is based on sustainable supply chain governance in order to assess the roles of and the interactions between the different chain actors, supporters and influencers. On the basis of field research in Ethiopia among key chain actors (importers, retailers, farmers) we analyse their involvement in three different environmental governance mechanisms: governing material flows of pesticides, managing information on health and environmental safety and providing training and capacity-building services. The study found the organisation of the pesticides supply chain in Ethiopia as atomistic. Environment and health hardly played a role in pesticides handling by the different supply chain actors, which was dominated by immediate profit motives. As a consequence smallholder farmers are put at risk because they are refrained from training, support or information provision on pesticides. Indeed, it was a failure of state governance that led importers and retailers to aggressive marketing and distributing pesticides unsafely and hinder the proliferate of private mode of governance. At the same time, a small signs of hope have also been identified at the supporters' and influencers' side of the chain. Successful environmental supply chain governance for safe pesticide distribution and use requires coordination and as well as training and information sharing (interaction) among pesticide supply chain actors, supporters and influencers at all levels-local, national and global as elements of one system of governance. Finally, the evidence presented in this paper suggests that due to limits in governmental capacity and concerns on commercial viability and on social and environmental impacts among private actors, there will be a role for private actors alongside public actors to ensure safe pesticide distribution and use. Public-private partnerships might constitute an attractive strategy for this aim.

Key words: Pesticides, distribution, use, supply chain actors, private environmental governance, Ethiopia.

3.1 Introduction

The importance of agricultural pesticides for developing countries is undeniable. However, the issue of human health and environmental risks has emerged as a key problem for these countries in a number of studies (Karlsson, 2004; Williamson et al., 2008; Williamson, 2011; Hoi et al., 2009, 2013; Stadlinger, 2013). Although the use of pesticides in Africa is relatively low (Reynold, 1997; Rojas, 2012; Kateregga, 2012) this should not be equated with low risk. The unsafe distribution and use of pesticides in many African countries such as in Ghana (Ntow et al., 2006) Tanzania (Ngowi et al., 2007), Uganda (Kateregga, 2012), Kenya (Macharia et al., 2013) has been widely documented. Other parts of Africa have shown similar problems with poorly implemented pesticide legislation, leading to widespread use of highly toxic and illegal pesticides (Ecobichon, 2001; Williamson et al., 2008; Handford et al., 2015). Also Ethiopia is confronted with a number of problems associated with unsafe handling of pesticide distribution and use. Over the last two decades, Ethiopia promoted a market economy and increased the involvement of private actors in many sectors, including in the importation and distribution of pesticides.

Most pesticides used in Ethiopia are imported by international manufacturing companies represented by local agents (registrants) (Amera & Abate, 2008; MoA, 2013; Mengistie et al., 2015a). Pesticides were first applied in Ethiopia in the mid-1940s, but expanded only when commercial farming expanded in the early 1960s. Recent economic development led to rapid growth in pesticides use (MoA, 2013; PRRP, 2014). Currently, pesticide use practices are changing as a result of the government plan to intensify and diversify agriculture by promoting high value export crops such as flowers and vegetables. For instance, more than 212 types of pesticides with different active ingredients are being used to cultivate roses in Ethiopia (Sahle & Potting, 2013). But also, smallholders growing vegetables are facing challenges because they are usually resource-poor but also risk averse and under these conditions it is challenging to decide when, how, how much and which pesticide to apply among the hundreds available on the market (Mengistie et al., 2015a, 2015b).

Ensuring the quality of the pesticides in the market and regulating the distribution and use of pesticides after registration is an important aspect of pesticide governance. In order to control the import of hazardous pesticides, prevent the contamination of the environment, and minimise the effects on human health, the government of Ethiopia has developed a pesticide policy. To support this policy, Ethiopia has also accepted and ratified different inter-national conventions and agreements including the Rotterdam, Stockholm, Basel, and Bamako conventions and the FAO code of conduct on pesticide distribution and use. The Ethiopian pesticide law covers the whole life cycle: from registration and procurement, via import/local manufacture and distribution to use by the growers (*Negarite Gazetta*, 2010). However, this state-based regulatory system has shown limitations because the implementation and enforcement proves not fully effective (FDRE/EPA, 2006; PRRP, 2012; Mengistie et al., 2015a).

State-based regulation seems not sufficient to secure sustainable pesticide distribution and use in Ethiopia. In order to fill this gap an important contribution could be made by involving private actors in pesticide governance and there is a growing number of analytical and empirical studies on the involvement of non-state actors in environmental governance (Pattberg, 2006; Driessen et al., 2012; Van Denbergh, 2013). However, there is little empirical and theoretical examination of how private actors might be involved in environmental governance in developing countries, such as Ethiopia. Therefore, this paper investigates why and how pesticide distribution and use might be un safe and assesses the potential contribution from supply chain actors in securing the quality, environmental safety and sustainability of pesticides distribution and use.

After introducing the theoretical background and research methodology, this paper analyses how and to what extent different private actors in the supply chain, support, influence and (un)successfully articulate their interest in safe pesticide distribution and use. In the concluding section, this paper looks for the potential of private actors to take up new roles in pesticide governance to overcome the limits of state-based regulations and to contribute to a more effective and sustainable pesticide supply chain.

3.2 Conceptualizing private environmental governance in pesticide supply chains

The emergence of private environmental governance in recent decades suggests that state-based regulation is insufficient and that involvement of non-state actors needed to implement effective environmentally sound and socially responsible management practices (Pattberg, 2006; Mueller et al., 2009; Driessen et al., 2012; Van Denbergh, 2013). Private environmental governance refers to actions taken by non-governmental entities such as reducing environmental and health risks and promoting a more equitable distribution of environmental amenities. Private pesticide governance arrangements are the formal and informal rules according to which humans and organisations interact and deal with pesticide distribution and use at different levels (Coglianese & Nash, 2002; Froger & Meral, 2012). These arrangements steer who has access to what information, shape the incentives for various courses of action, and affect who has the capacity to act.

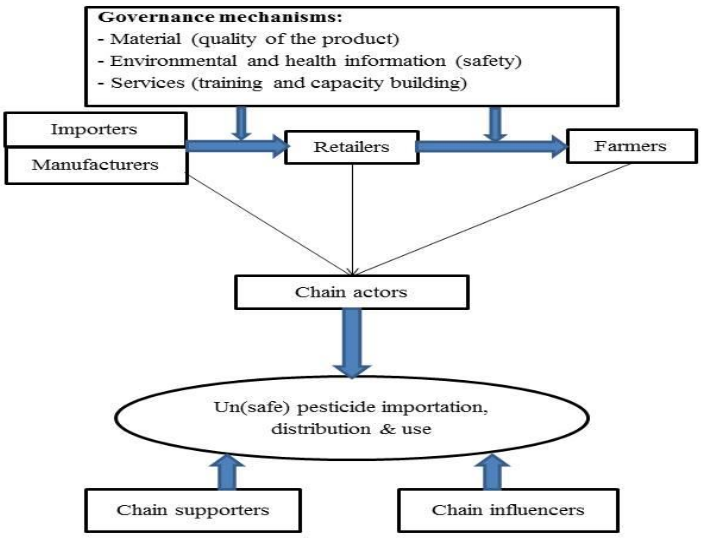

Figure 3.1 Governance mechanisms in the pesticides supply chain

Understanding pesticides provision and use as a supply chain allows considering the roles of different non-state actors and their relations. As Gereffi (1999) and Gereffi et al.(2005) made clear private companies do not operate as autonomous units but are part of larger supply chains. Within supply chains the provision of products, services, and information is organised through formal and informal institutions (Roduner, 2007; Vellema et al., 2013). Different actors at the various levels aim at improving the performance of the entire chain but this need not be limited to economic considerations but may also include social, ethical, and environmental ones (Hvolby et al., 2007; Van Wijk et al., 2009; Drost et al., 2010; Bush et al., 2015). Supply chain governance involves the ability of one firm to influence the activities of other firms in the chain.

Our focus is therefore on analysing how key actors in the pesticide supply chain participate directly or indirectly in pesticide governance mechanisms that exist in the chain. In line with Roduner (2007), Van Wijk et al., (2009) and Drost et al., (2010), we distinguish three categories of key actors, first chain actors (who deal directly with pesticides: importers, retailers and farmers), chain supporters (who do not deal directly with pesticides but provide services to chain actors: business service providers, associations and NGOs) and chain influencers (who influence the performance of the chain actors and chain supporters: the regulatory framework and government policies)(See Figure 3. 1).

Different private actors may apply different governance mechanisms when addressing economic, social, ethical, and environmental issues (Sharma & Ruud, 2003; Mueller et al., 2009; Trienekens, 2011; Gimenez & Sierra, 2013; Driessen et al., 2012). We distinguish three complementary mechanisms that may potentially steer environmental safety and sustainability in the Ethiopian pesticides supply chain. First, there is the governance of the material (pesticides) flow, involving decisions on the kind of pesticides that are traded and used while considering their health and environmental impacts. Second, the management of information about the environmental health and safety of pesticides and how this is be offered by upstream to downstream actors and vice versa. Third, the provisioning of services such as training and capacity building that may contribute to reduced environmental and health impacts from pesticides. It is also important to assess the roles of supply chain supporters and influencers (see Figure 3.1), whether public or private, in influencing the supply chain actors (Pattberg, 2006; Driessen et al., 2012; Van Denbergh, 2013). This framework supports a systematic analysis of how environmental safety and sustainability is dealt with in Ethiopian pesticide supply chains and may suggest new ways to promote the role of private actors in sustainable pesticide governance in Ethiopia.

The three governance mechanisms mentioned in Figure 3.1 under-line that the environmental and health effects of pesticides depend not only on the quality of the product, but crucially also on the characteristics of the actors involved, particularly their (access to)information, training and capacity to change their behavior. Particular attention should be given to information and training on the technical aspects of the pesticide and its use as well as on the information flow among the actors involved: who gets informed, when, about what, and with what consequences; what other actors are involved in safe distribution.

3.3 Research methods

To examine the potential areas of influence, the strengths and weaknesses of pesticide actors, face-to-face interviews were held between May and November 2013 using a semi-structured questionnaire. Key actors at different stages of the pesticide supply chain in Ethiopia were interviewed to find out how they deal with environmental sustainability and health. First, interviews were conducted with 32 importing companies, randomly selected from a total of 41 companies operating in Ethiopia. Second, 60 agro-pesticides retail shops in Addis Ababa, Ziway, and Meki were interviewed, selected through snowball sampling, since no official records were available. These three locations were selected because they have higher numbers of pesticides retailers than other regions in Ethiopia. The importers and the retailers were interviewed to determine their role in governing the pesticide supply chain, to assess their technical competence, their contribution to sharing information with other chain actors, and their involvement in providing training. During the interviews with retailers also direct observations were made on the condition of the shop and the storage rooms and on the presence of licences. Third, survey interviews were carried out with 120 smallholder vegetable growers, selected randomly in Ziway and Meki, important areas for vegetable growing in Ethiopia. Of these farmers, 45 were interviewed when buying pesticides in the shop and 75 at their farm. Fourth, in-depth interviews were conducted with key informants from the APHRD of Ministry of Agriculture (5), from Croplife Ethiopia (1), crop protection experts (4) and extension services (5) to examine their interaction with pesticide retailers and users. To assess the role and contribution of chain supporters and influencers in shaping pesticide distribution and use, existing literature was reviewed. The interview data were analysed qualitatively and some quantitative data were processed into descriptive statistics.

3. 4 Pesticide supply chain actors, supporters and influencers

This section presents the findings of the study, first on the pesticide supply chain actors (importers, retailers and farmers), second on the role of service providers (supporters), and finally on the role of influencers in relation to environmental sustainability and safety in pesticide distribution and use.

3.4.1 Pesticide supply chain actors: import, distribution and use

3.4.1.1 Pesticide importers

The involvement of pesticides importers in governing the pesticides supply chain is structured according to the three mechanisms identified: the governance of the product flow, the information and the services provided.

(i) Governing material flows: pesticides

The import of pesticides in Ethiopia is driven by the national desire for accelerated economic growth, with an orientation to the export of high value crops and to poverty alleviation. Ethiopia has only one local pesticides formulating company, Adami Tulu Pesticide Company, using imported active ingredients and solvents (MoA, 2013). This company formulates only a proportion of the pesticides required: between 2000-2012, this company produced 17,662 metric tons for agricultural and public health purposes. Of these, public health products for vector control accounted for a significant share of the production, 8858.30 while 32,230 metric tons of agricultural pesticides were imported (MoA, 2013) (see Table 3.1). The pesticide market is therefore heavily dependent on imports by local agents representing international manufacturing/formulating companies (MoA, 2013). Currently, 41 pesticide importers are legally registered with the Ministry of Agriculture (MoA). They act as distributors of pesticides to retailers and to end-users, but some companies combine imports with wholesale and retail. These companies mainly import pesticides from Germany, Switzerland, France, Belgium, USA, Israel, China and India. Some pesticides are imported from African countries such as Kenya and South Africa (MoA, 2013). Pesticide imports are free from import duties. The available data show large annual fluctuations, reflecting slowdowns in the registration process, private sector import capacity, seasonal demand in different cropping systems and shortages of foreign exchange. Pesticide donations are commonly not included in official import data nor are, not surprisingly, data about informal or uncontrolled cross border trade.

Table 3.1 Pesticides imports into Ethiopia between 2000 -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
Total	**6,840.6**	**20,046.0**	**2,224.3**	**3,120.0**	**32,230.9**
Share in%	**21.2%**	**62.2%**	**6.9%**	**9.7%**	**100%**

Source: APHRD, MoA, 2013

The increase in pesticides imports also meant an increase in the number of importing companies. Unfortunately, the correct way of administering and handling pesticides is not always strictly applied by them because of inadequate official trade regulations and poor control and enforcement. For instance, only 12 of the 32 interviewed importers have documented records of the product quantities they imported, stored and sold. None of the 32 importers was ever visited by MoA to inspect their stores unless they were invited to do so as a pre-condition for licence renewal by the Ministry of Trade and Industry. Informants from MoA and other experts revealed that shortage of human resources (inspectors) prevented them from random or regular inspection of pesticide stores. This situation creates opportunities to import and stock unregistered, illegal, outdated and hazardous pesticides.

Most pesticides used in Ethiopia are generic because they are cheaper and more familiar as they have been used for a long time. Although official registration is required, importers do not bother to register pesticides whose patents have expired; they only submit dossiers to MoA for patented pesticides. Even in these cases, the Pesticide Registration Directorate of MoA depends completely on evidence provided by the importer (registrant), who uses information received from the foreign manufacturer. The directorate is not equipped to actually verify the claims and to ensure that the results are relevant to the national situation. Experts from the registration office of MoA stated that they sometimes checked for additional information through the internet. Testing product samples is not possible for lack of laboratory facilities and this creates confusion on the market because product qualities are not assured and pesticides with similar active ingredients may vary in efficacy and toxicity owing to differences in the inert ingredients used. Often 'new' products do not really have new active ingredients but when they are successfully promoted they offer large benefits for the importer and retailers. Importers stated that double/triple registration of pesticides with the same active ingredient (ai) under different commercial names is a major problem. For example, Mancozeb 80% WP is available on the market under trade names, such as Unizeb, Fungozeb, Indom and Indofil, but they all contain the same active ingredient (80% WP). Old and broad spectrum pesticides still in use in Ethiopia contain hazardous substances and impurities that have been banned or severely restricted in other countries (e.g. Endosulfan and DDT). Importers criticize each other mainly on basis of the quality of their products. For instance, at present few new branded products are imported in Ethiopia because they are too expensive, while competition between importers on selling cheap pesticides intensifies. At the same time, companies who import cheap pesticides (mainly from China) are accused by others of taking unfair profits and cheating on quality.

Table 3.2 World Health Organization(WHO) Toxicity/hazard classification

WHO Toxicity class	Percentage
Extremely hazardous (class Ia &Ib	5.7
Moderately Hazardous (class II)	48.5
Slightly hazardous (class III)	15.3
Unlikely to present acute hazardous (class U)	14.5
Unknown (Unidentified & not classified by WHO)	(not available)

Source: PRRP-Ethiopia, 2012

According to PRRP (2012), there are 302 commercial pesticides registered in the country representing over 160 active ingredients. Among these the largest proportion falls under class II of the WHO risk classification system (see Table 3.2). Officially, "no person shall make any import order of any pesticide without obtaining an import permit issued by the Ministry of Agriculture'. However, some importers violate this provision and import pesticides without correct labels or without obtaining an import permit in advance. Importers also responded that customs officers allow the release of pesticides from the ports of Kaliti or Bole without inspections from qualified inspectors from MoA. Illegal pesticides are imported through porous borders and they are circulating through an informal supply network. These illegal imports result in banned pesticides still being available on the Ethiopian market, jeopardizing human and environmental safety. Examples of such hazardous products are organochlorines (such as Endosulfan) and pyrethroids (such as Deltamethrin and Cyperme-thrin).

(ii) Managing information: environmental health and safety

Information about environmental and health safety, efficacy, and safe use of pesticides is important and need to be available through-out the supply chain. Most (25 out of 32) interviewed importers provide no information about their products when distributed to customers. Although they offer pesticide safety data sheets (PSDS) to retailers and end users, many retail stores fail to follow the PSDS guidelines. Some brands, such as Syngenta, BASF and Bayer, insist on information dissemination on the performance of their products and services, as they guard their reputation. They provide importers with documentation on the price, the content and the correct application for each pesticide. Their importing agents also include criteria such as educational background, existence of a certificate of competence and a valid licence for selling pesticides when selecting retailers. For example, Chemtex PLC, agent of Syngenta agrochemical in Ethiopia employed technical personnel to offer information to retailers or farmers, to assess how their products are handled by retailers and to deal with complaints from farmers.

(iii) Providing services: training and capacity-building

Training can contribute to environmental safety and sustainability in pesticide distribution and use. Some international pesticides manufacturing and trading companies have set up a countrywide technical service with company representatives who provide technical assistance to their customers and offer knowledge and information on the best available techniques (BATs) and the best environmental practices (BEPs) in pesticides application. Some promote their pesticides by distributing colourful leaflets and posters and making presentations at farmers' gatherings. Especially, Syngenta provides pesticide packages to farmers with advice and extension. Staff from these large companies engage in person-to-person communication with large-scale users, major retailers and importers, but generally they do not serve smallholders. Moreover, only 5 of the 32 interviewed importers received support from these international companies, while the remaining 27 importers who have agreements with companies from China, India, and other countries, did not receive any training or other service. Neither has any of these importers provided training to either retailers or (smallholder) farmers. On the other hand, although all importers are licensed to sell pesticides, these licences are not considered relevant by retailers. Nearly half (47%) of the retailers had no valid licence to sell pesticides at all and none of the retailers had a certificate of competence. Similarly, 27 of the 32 importers never asked for a pesticide trading licence when selling their products to retailers. Training, capacity building and other services to promote sustainable and safe use of pesticides could also be provided through an association of importers. In Ethiopia, the association CropLife Ethiopia was established in 1998 by six pesticide importers and has 11 members at present. According to a key informant from the association, only thirteen sprayers and a few farmers have received training on safe pesticides handling and container management. Comparing to Croplife Kenya and Tanzania (WHO, 2011), CropLife Ethiopia has generated few concrete activities and is handicapped in terms of human (only 1 staff), financial and material resources.

3.4.1.2 Pesticide retailers

This section discusses the roles of retailers in the three pesticide governance mechanisms.

(i) Governing material flows: pesticides

Most pesticides found in retail shops are supplied from a limited number of importers; about 77% of the retailers from only one and only 23% buy from more than one importer. Retailers select importers on the basis of the availability of specific pesticides, long-term relationship and loyalty. Retailers mostly sell their products to farmers (74%),followed by sub-retailers (19%) and households (7%). Farmers' demand is the most determining factor in deciding which products are offered for sale. According to the interviewed retailers, the most frequently purchased products by vegetable farmers are *insecticides* (Agro-Thoate 40% EC, Selecron 720% EC, Karate 2.5% EC, Thionex 35% EC, Profit 72% EC, Ethiolathion 50% EC, Ethiozinon 60% EC, Ethiodemethrin 2.5% EC, Ethiothoate 40% EC, Radiant 120 SC, Coragen 200 SC, Tracer 480 SC) and *fungicides* (Mancolaxyl 72% WP, Agrolaxyl M2-63.5 WP, Victory 72% WP, Masco® 8-64, Ridomil 68 WG, Mancozeb 80% WP, Cruzate R, Matco 8-64). All retailers expected a continued increase in the sale of pesticides in the future because the number of vegetable growers is increasing as well as occurrence of pests while nowadays, pesticides are perceived as a necessity to obtain a good harvest, or any harvest at all.

No data on the amount of illegal pesticides sold were found but it was very common to find hazardous and unknown pesticides(e.g. Technical zinc phosphide, Aldicarb etc.) in retail shops and on open markets (own observation; see Photo. 3.1). In a few shops we observed farmers buying expired pesticides (e.g. Coragen 250 SC, Karate 2.5% EC, Mancolaxyl 72% WP) and pesticides without manufacturing and expiring dates (e.g. Ethiothoate 40% EC, Profit 72% EC). The officially permitted durability (shelf period) of pesticides is two years although some pesticides may be still effective after this. Extension of the shelf period is possible but only after an efficacy test which can no longer be done within the country while testing outside the country is expensive and takes very long. Retailers take advantage of farmers' inability to raise enough money to purchase not-expired pesticides and sold all classes of pesticides to farmers irrespective of their suitability and effectiveness. Pesticides are also sold illegally by unauthorised and untrained persons at local village markets and other non-designated sites. (Sometimes unauthorised) pesticides are common for sale on the streets repacked in small containers without appropriate label or product information. These issues are exacerbated by poorly regulated markets for pesticides. Crop protection experts considered the lack of inspection and quality control as the main reasons for hazardous pesticides being displayed and sold by non-professionals on the open markets without any permission or safety precaution.

Photo 3.1 Displaying and selling unknown chemicals and unlabelled pesticides at an open market.
(Photo by Belay Mengistie)

According to retailers, some farmers prefer to buy small quantities of pesticides and consider the original packaging too large. Hence, it is very common to observe pesticides repackaged into smaller containers. Nearly 52% of the pesticides are sold by retailers in their original packages, while the remaining 48% is re-packaged into smaller containers. These unconventional containers usually lack a correct and complete label with information about the content and on how to apply the pesticide, thereby making it complicated for the farmers to handle them correctly. It is therefore every likely that repackaged pesticides are not used according to their prescribed dosage.

(ii) Managing information: environmental health and safety

Pesticide retailers have an important role in communicating information on safe pesticide handling to farmers, since they are often the only actors with whom farmers are in contact with regarding pesticide use (except for their neighbours). Contact with official agricultural extension services does hardly exist and is often inadequate (Mengistie et al., 2015a, 2015b). However, the large majority of the retailers (87%) has little or no knowledge at all on the toxicity, efficacy and safety of the products they sell. They base their advice on their long experience in selling these products and communication is therefore focused on the type of pesticides, the disease that has to be handled and the price. Pesticides retail trade in Ethiopia is a “cash-and-carry” deal: retailers and farmers meet face-to-face to do business, visually inspect the pesticides on the spot and pay in cash. No orders are placed and there is no information exchange about brands, product specifications, handling prescriptions or quality guarantees. The only paperwork involved is the money that changes hands when the pesticide is paid for.

More extensive exchange of (environmental and safety) information is complicated by the presence of uneducated, untrained and unlicensed retailers. Our survey found that most retailers did not possess adequate knowledge and capacity to serve as a source of information on safe pesticide use for farmers. For instance, the interviewed pesticide retailers had no knowledge of sell-by-date, adequate storage facilities, guidelines for use, safety and toxicity of pesticides, handling of pesticides, and legal penalties. During the interviews, retailers were requested to read the labels of pesticides they had for sale. Of the 60 retailers, only 17 (28%) were able to give adequate explanations of most of the labels and could confidently indicate the meaning of indications on safe working procedures, such as “washing hands after use”, “keeping out of reach of children”, “dangerous pesticides”, “no smoking”, “no eating or drinking”. Nine retailers were unable to read and under-stand complex labels but had some idea on very simple ones. The remaining 34 retailers had no understanding even of the basic pesticides labels. The majority (59%) of the shops did not display the posters with health and safety information that are usually provided by importers or pesticides manufacturers. Besides, although 67% of the 60 retailers mentioned the possibility of health effects from pesticides use, none mentioned potential environ-mental impacts. While 58% of retailers knew that pesticides were poisonous none could mention a specific effect. Pesticide retailers themselves are at risk due to frequent exposure to pesticides(especially when repackaging pesticides), but none of the retailers was wearing protective gear, such as a mask and gloves, when repackaging and handling pesticides.

(iii) Providing services: training and capacity-building

None of the retailers had received training from manufacturers, importers, state agencies, NGOs or any other service provider on safe pesticide handling and storage, so they were unable to offer training to farmers. As 90% of the retailers had no agricultural background or less than one year of related work experience or training, their practical knowledge is severely limited. This is further enhance by the high incidence of unsafe pesticide retailing practices (see Table 3.3).

Table 3.3 Pesticide distribution practices by retailers (%; n=60)

Variables	**Yes**	**No**
Kept record of pesticides	13	87
Sold pesticides in their original packages	52	48
Gave adequate explanations of the labels	28	72
Displayed posters with health and safety information,	41	59
Mentioned the possibility of health effects	67	33
Had agricultural background or related work experience	10	90
Had valid licence to sell pesticides	53	47
Used family house to store and sell pesticides.	84	16
Had certificate of competency (CoC)	0	100
Received training on safe handling & storage	0	100
Inspected by federal or regional or local state actors	0	100

Source: this survey

Pesticide traders are legally required to be licensed and obtain a Certificate of Competence (CoC) from the appropriate regulatory body prior to engaging in pesticide business. None of the retailers in our study had a valid CoC, while 47% retailers had no valid licence at all and some of the 53% who had one, did not renew their licence in time (see Table 3.3). None of the included shops had ever been inspected by a local or federal state authority and there was not even a list of licensed retailers available for the agricultural authorities. This situation with unlicensed retailers and ineffective control enhances the risk for farmers of purchasing fake, substandard, unregistered or even prohibited pesticides. We observed that the condition of most stores, in particular their cleanliness, was very poor. Also, the majority (84%) of the retailers used their family house to store and sell pesticides. In all shops pesticides were stored together with other commodities, such as seeds, while 78% of the pesticides retail shops were located near to other shops selling food products and animal feed. Pesticides retailing is to a substantial extent in the hands of untrained, uninformed, unauthorized and/or fraudulent retailers. Their lack of professional knowledge and their orientation on short term profit means they do not engage in promoting safer and more environmentally sound pesticide use nor in providing adequate information on pesticides use to farmers.

3.4.1.3 Pesticide end users (farmers)

The final handlers of pesticides are farmers and in this section we discuss their role in pesticide governance based on information from a questionnaire among 120 Ethiopian smallholder vegetable growers.

(i) Governing material flows: pesticides

The majority (81%) of the farmers obtain pesticides from small retail shops and the others from either cooperative unions (13%) or via open markets (6%),where prices are lower compared with retail shops. The most common products vegetable growers used are Agro-Thoate 40% EC, Selecron 720% EC, Profit 72% EC, Ethiolathion 50% EC, Thionex 35% EC, Mancozeb 80% WP, Ridomil 68 WG, Mancolaxyl 72% WP, Agrolaxyl M2-63.5 WP. Also DDT (banned under the Stockholm convention) is still used in Ethiopia to control the mosquito malaria vector and by smallholder farmers to fight agricultural pests. Most of these have already been in use for many years and the same insecticides are applied for a wide range of crops (e.g. tomato, onion and cabbage). Continuous use of the same products throughout the different stages of growing vegetables may lead to increased resistance among pests and diseases (Williamson, 2011; Waibel, 2007; Hoi et al., 2016). Ineffectiveness of pesticides is a frequently reported problem in Ethiopia and also in our survey73% of the interviewed farmers claimed that retailers are not honest and only interested in profit because they fail to supply effective products. Informants from the extension service explained that due to their limited purchasing power some farmers buy pesticides that were stolen from large flower farms, or buy cheaper pesticides from the open market or retail shops. As retailers claim that cheaper pesticides are often more effective in controlling pests farmers can be encouraged to buy highly hazardous and unlabelled pesticides. Some cheap pesticides are broad spectrum pesticides and can only be substituted by four or five different crop- or pest-specific pesticides. Retailers also re-package pesticides because importers commonly supply pesticides in packages sized 1 kg or 1-5 litre, which price is too high for most farmers. However, pesticides packed in smaller containers (e.g. in empty penicillin bottles or plastic bags) may be sold at a lower price, they do not contain any information about the product and its use. We observed several improper practices in pesticide use: 77% of the farmers spray pesticides without protective devices; empty pesticide containers reuse and resale is common, which is risky when used for storing food or drinking water. All interviewed farmers mix two pesticide before application.

(ii) Managing information: environmental health and safety

Information is crucial for environmental health and safety in pesticide use but during our survey we found no information exchange between the retailer and farmers when purchasing pesticides. Farmers did not get advice on the quality of the products and how to store, apply and safely use them. Most retail shops did not even have competent personnel to provide such information. For most farmers, retailers proved not to be the most important source of information as they rely more on neighbouring farmers (47%), state extension service (31%) and cooperative unions (13%) (see Table 3.4).

Table 3.4 Support services available to smallholder farmers (%; N=120)

Actors	**Most important information source**	**Training on safe use and handling**
Importers	0%	0%
Retailers	9%	0%
State extension service	31%	11%
Neighbouring farmers	47%	0%
Cooperative (union)	13%	0%
None	0%	89%

Source: this survey

Even available information is not used as for instance, vegetable farmers sprayed their vegetable crops with Endosulfan which is registered an insecticide for cotton. Crop protectionists from *Ziway* and *Meki* districts also commented on the increased risk of pesticide poisoning in the area. For instance, the survey conducted by PRRP (2012) among twenty five respondents in *Meki (Dugeda*) district 11.8% of farmers indicated that they knew people who were poisoned but recovered and 14.7% knew people died of severe pesticide poisoning incidents. Regarding environmental risks, in 2009and 2010, the monitoring by Alterra shows that most surface water samples taken from the agricultural areas of rift valley contain residues of pesticides. The concentrations of these pesticides occasionally exceed

0.1 _g/l, which is the European and Dutch standard for drinking water (Jansen & Harmsen, 2011).

(iii) Providing services: training and capacity-building

Pesticide use is a complex agricultural technology and most of the information available from the formulation (manufacturing) and the registration phase is too technical for small holder farmers. Pesticide registration is the process whereby the responsible government authority approves the sale and use of a pesticide on the basis of an evaluation of comprehensive scientific data (chemical and physical properties, toxicology, residues, and environmental impacts from the active ingredient of a product) demonstrating that the product is effective for the intended purposes and does not pose an unacceptable risk to human or animal health or to the environment (Ecobichon, 2001; Strak, 2011; Damalas & Eleftherohorinos, 2011). Therefore, technical support translating this information into practical instruction is crucial for safe and sustainable pesticide use. However, only 11% of the farmers obtained training from state extension services while the majority (89%) of the farmers did not receive any training at all (Table 3.4). Extension services play a central role in the transfer of improved technologies and knowledge, skill development, and the provision of services through the Farmers Training Centres (FTCs). However, bottlenecks in this service are the top–down and non-participatory methods applied, the low morale among staff, and the limits in operational budget and facilities (Belay, 2002; Berhanu et al., 2006; Belay & Abebaw, 2004; Davis et al., 2010). Extension workers are not adequately trained to provide adequate services to farmers with regard to safe pesticide handling and use (Mengistie et al., 2015a). Even, as extension workers confirmed, government extension programs encourage the use of pesticides because they support the image that there is no alter-native for farmers other than the use of pesticides. As a senior expert from *Meki* District summarized: 'Currently crop protection for smallholder farmers means only pesticide application'. This may result in the misuse (overuse, abuse, wrong storage) of pesticides and a tendency to use (cheap and more toxic) pesticides.

3.4.2 Supply chain supporters: signs of hope

Several supply chain supporters take actions to promote environmental sustainability and safety and some of them have acquired prominence in Ethiopian pesticides governance.

(i) Ethiopia has developed a Pesticide Risk Reduction Programme (PRRP)–Ethiopia (2010-2014) in collaboration with MoA, Alterra (The Netherlands) and FAO. This program deals with all aspects of pesticide management in Ethiopia in order to regulate pesticide use by farmers and can be considered an important pilot for other African countries. Under this programme most experts of APHRD/MoA at federal level have pursued practical trainings abroad but none of the private actors (e.g. importer/registrant).

(ii) Ethiopia has one of the largest stockpiles of obsolete pesticides in Africa. Most of them are over 20 years old and pose serious threats to public health and the environment (Haylamicheal & Dalvie, 2009). To get rid of its remaining obsolete stocks of pesticides, Ethiopia is participating in the African Stockpiles Programme (ASP). Prior to Phase I of ASP,1500 tons were already disposed and Phase II also managed in 2011to ship 395 tons for disposal overseas (MoA, 2013). ASP also promotes the safe use of agricultural pesticides through courses for end-users, publication of pamphlets and posters on new chemical products.

(iii) Advocacy groups such as the Pesticide Action Network (PAN) Africa also shifted from their initial activist position(i.e., supporting agrochemical industry) to ban the export of hazardous pesticides and ensure that no chemicals were exported with-out import consent. They also promote safe and sustainable alternatives to pesticides in Ethiopian agriculture. Besides, PAN Africa and PAN-Ethiopia are involved in reporting problems caused by pesticide use, and advocates ecologically sound alternatives (PAN UK, 2008; Ameara & Abate, 2008, PAN-Ethiopia, 2014).

(iv) Croplife Ethiopia, which is an affiliate of Crop Life International, plays a major role in pesticide management through training and disposal of obsolete pesticides and empty pesticide containers. So far, only thirteen pesticide applicators obtained a training on safe pesticides handling and use from Croplife Ethiopia some years ago. However, although the contribution from importers is currently weak, some indications for change found. For instance, Chemtex PLC (representing Syngenta agrochemical company) employs technical personnel to provide supportive services, to assess how their products are handled by retailers and to deal with farmers' complaints.

(v) Agricultural research institutes are important in assessing the efficacy of pesticides before registration and importation and over the last 10 years they generated local efficacy data for more than 256 pesticides in Ethiopia (MoA, 2013).

3.4.3 Supply chain influencers: international treaties and codes on pesticide import, distribution and use

Pesticides governance also requires laws, regulations, and standards on administration, quality, safety and inspection of pesticides. The government of Ethiopia has developed a pesticides legislation ('Pesticide Registration and Control Proclamation No. 674/2010'), regulation and guidelines (MoA, 2013). The effects of chemical misuse on human health and the environment provide also a strong incentive for international commitment to achieve an effective and comprehensive pesticide governance system (Reynold, 1997; Rojas, 2012; Handford et al., 2015). Ethiopia has therefore signed and ratified different international conventions and agreements: the Rotterdam Convention on Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, the Stockholm Convention on Persistent Organic Pollutants (POPs). POPs include organochlorine pesticides: DDT, endrin, dieldrin, aldrin, chlordane, toxaphene, heptachlor, mirex, hexchlorobenzene; and industrial chemicals and by-products: PCBs, dioxins and furans. These initial twelve chemicals, the 'poisons without passports' were selected because they share the hazardous characteristics of toxicity, persistence and bioaccumulation, and are capable of travelling vast distances via water and air. Out of these 12 chemicals 9 are pesticides, the Basel Convention on the trans-boundary movement of hazardous wastes and their disposal, the Bamako Convention on the ban of the import into Africa and the control of transboundary movement and management of hazardous wastes within Africa, the FAO Code of Conduct on the Distribution and Use of Pesticides.

The Stockholm Convention is far more influential through its immediate impact on trade than the Rotterdam Convention, given that the latter's focus is on informing about, rather than on banning, a chemical (Jansen & Dubois, 2014). The Stockholm Convention can be seen as an effort to match the global scope of the problem with global governance. Banning a pesticide in Ethiopia while it is allowed in a neighbouring country invites smuggling, black market sales and potential for cross-border pollution via rivers. Ethiopia has taken several steps after ratifying these conventions, including forming a Designated National Authority (DNA) for pesticides, to prepare the national implementation plan, launch a workshop on chemicals and carry out a preliminary inventory of POPs. They found four types of obsolete POPs pesticides: Aldrin, Dieldrin, Heptachlor and Chlordane. However, the ultimate goal of the Stockholm Convention is to eliminate DDT but in Ethiopia Endosulfan and DDT are produced domestically and allowed for use in cotton and for malaria control but still frequently used on vegetables as well. Ethiopia has also implemented Article 10 of the Rotterdam Convection and sent a report to the secretariat signalling that 8 pesticides received their consent to import, 3 pesticides did not and that for 8 pesticides import was subject to specific conditions (FDRE/EPA, 2006).

Even where legislation is sufficient information about distribution and use, enforcement is often inadequate. Like in many developing countries (Ecobichon, 2001; Kateregga, 2012; Macharia et al., 2013; Stadlinger, 2013), also Ethiopia does not have the skilled human resources nor the infrastructure to secure environmental and human health in local pesticide trade and use (PAN-UK, 2006; Williamson, 2008; Mengistie et al., 2014) and support from international parties has been too limited to make a difference (Stark, 2011; Handford et al., 2015). For instance, the WHO (2011) reported that 67% of countries in Africa knew only limited enforcement of pesticide regulations. This reports showed that this may lead to the presence of substandard, illegal, adulterated and counterfeit pesticides on the market. Some of the pesticides traded between developing countries contain substances that are banned in many developed countries. Global differences in regulated pesticides cause further problems in the course of international trade, especially in the developing countries, which still may use hazardous pesticides that are not authorized in developed nations. The PIC is used to control the export of certain hazardous pesticides through notifying and providing adequate data to the importing nation. Nevertheless, the system fails to support developing countries in the establishment of a regulatory framework to help them assess pesticides for import. Furthermore, no obligatory mechanism exists for compliance with the PIC; therefore, manufacturers may regularly violate the PIC provisions in the channel of pesticide trade (Handford et al., 2015; Jansen & Dubois, 2014; Hough, 1998, 2003). Even, when authorised, in Ethiopia several pesticides have not been re-evaluated for many years and they do therefore not necessarily meet the current stricter criteria of risk assessment.

There is no international regulation that requires the pesticide industry to share responsibility for the safety and efficiency in the distribution and use of their pesticides.

3.5 Discussion and conclusions

Considering the problems in state-based regulation of agro-pesticides in Ethiopia, this study has analysed the roles of private actors in the environmental and safety governance. For this, three categories of supply chain actors (importers, retailers and farmers)were analysed on their engagement in three private governance mechanisms (on product, information and services). We found that private actors focus mainly on facilitating sales and gaining profits, while safety, quality and environmental sustainability play hardly any role. We found also little collaboration between the chain actors, so the structure of the pesticide supply chain in Ethiopia can be considered atomistic and dominated by market relations. Two interdependent factors have, according to our analysis, contributed to this situation contributing to unsafe pesticide distribution and use: (i) the failure (of state authorities) to actively engage private actors in pesticide governance. Private actors could play important roles in pesticide governance, to overcome state failures in pesticides governances. However, the roles currently played by these actors in Ethiopian pesticide governance is weak: as non-state actors in a state-centric system they are faced with, among others, a lack of information and involvement. This paper suggests that due to commercial viability, social and environmental concerns there will increasingly be a role for private actors alongside public actors to ensure safe pesticide distribution and use. In conclusion we argue that the type of relationship between the public and the private actors has a significant influence on safe distribution and use. The question is not purely about involving private actors as such, which is how this is currently framed within pesticide trading and retailing, but primarily how these private actors are engaged. Governments could seek to engage with private actors to build those partnerships. And, (ii) the poor capacity of the state regulatory sys-tem. Importers and retailers are encouraged to market aggressively and some companies benefit by distributing banned/restricted pesticides, putting smallholder farmers in a disadvantageous position. The state regulatory system has proved an inability in controlling proper registration, distribution and safe use, inspection and quality control (MoA, 2015; Mengistie et al., 2015a, 2015b). Currently, in Ethiopia pesticides distribution and sales is done by trained but also by untrained retailers who have no proper permit/licence. Neither is there a tracking and tracing system once a pesticide is imported or cleared from customs.

Ethiopia has by no means an effective pesticide governance sys-tem. The country has not been able to commit the relevant state authorities and private actors in setting up a well-functioning, legitimate, transparent and accountable system for pesticide distribution and use. This failure is not only due to Ethiopia’s limited economic resources as a developing country but also to its political system. Involving private actors in governing collective goods such as environmental protection requires well-functioning, legitimate and accountable regulatory systems and an independent civil society to counter-balance and disclose failing public and private actors and institutions. The absence of these conditions in Ethiopia constrains effective private actor involvement in pesticide governance.

State action alone is not necessarily the most effective way to achieve sustainable pesticide management and therefore the question should be what mix of public and private governance arrangements will produce the desired outcome. This paper argues that private arrangements are not a substitute for public governance in the pesticide supply chain in Ethiopia but that private actors may nevertheless be important when addressing some of the most intractable environmental problems. Private actors determine to a significant extent the quality of pesticide products and the related information while they also may provide supportive services. In addition, from an ethical perspective, it is preferable to include those who are explicitly responsible for a problem also in governing it (Mueller et al., 2009). For instance, importers may contribute to the implementation of better environmental governance measures because they are dominating the pesticides supply chain from pesticide registration (as registrant), import, sale to retailers, to even distribution by supplying large scale farmers directly. Moreover, importers have agreements with international manufacturers and therefore access to information about the risks involved and they strong financial resources compared with the other actors in the supply chain. To prevent damaging their reputation they might encourage safe handling and use practices and improve the capabilities of downstream actors (see the example of Chemtex PLC).To identify gaps in the current pesticides governance system, itis useful to identify which negative effect occurs where, determine the driving force behind it and select matching effective institutions.

The strongest driving forces promoting pesticides use can be found at the global level where the agrochemical industry, along with some multi-lateral governments, promote modern intensive, high-input agriculture. Multinational corporations are a strong driving forces determining the types of pesticides that are available on the market also in developing countries. Involving these corporations is therefore needed, as developing countries' governments have little control over them. Also at the global level, the presence of transboundary pollutants push countries to form international agreements. As the Stockholm and Rotterdam Conventions illustrate specific chemicals, including pesticides, can be targeted for regulation or a ban; if implemented, these rules can reduce risks in developing countries (Ecobichon, 2001; Jansen & Dubois, 2014; Handford et al., 2015). However, the number of chemicals included remains very small, making these agreements a weak governance institution. At the national level, agricultural policy, research, and extension advice and marketing strategies of the pesticide companies create similar incentives to promote pesticide use. In Ethiopia, the government controls which pesticides may be allowed to use but they depend on which products the pesticide industry chooses to market. Collaboration and interaction is needed here as well, also considering the limited government capacity to monitor quality and safety. The interactions shape the actors and the actors shape the interaction. Governance issues arises in inter-action among the *supply chain actors, supporters and influencers* (Drost et al., 2010; Vellema et al., 2013). Therefore, all interaction between or among governing actors is governing safety and sustainability in pesticide distribution and use. Ultimately, individual farmers determine how pesticides are used and effects on health and the environment may thus be very local and context dependent. Most farmers are not aware of the risks or because they believe it is impossible to farm without pesticides, while they have no knowledge of alternative pest control strategies. At the local level, there is often little capacity to act and to decide on which pesticides are allowed for use under what conditions.

Private governance institutions can contribute to governing the behaviour of chain actors in pesticide distribution and use. They may consider pesticide governance issues in a more general context along the supply chain, and provide possible options for tackling the factors which drive pesticide misuse and dependency and that under-resourced regulatory authorities have been unable to address. Still, state involvement is both necessary and inevitable in a developing country like Ethiopia. Restructuring the current pesticide market should be the first priority of the Ethiopia to reduce unnecessary pesticides and improper practices. Also an active industry association should be built by importers and cooperatives to provide safer (bio-)pesticides and to promote alternative strategies (such as IPM). The serious health impacts from hazardous products and practices requires awareness-raising and education to go beyond conventional extension activities. Monitoring the correct use of pesticides and exchanging of information on the economic, scientific, legal, and technical aspects of pesticides is important. These interventions require strong political commitment and private actor participation in decision making and implementation to enhance their effectiveness.

Governing sustainability in the pesticides supply chain cannot be based on governance in the supply chain but should be some form of governance of the supply chain (Trienekens et al., 2012; Bush et al., 2015). When companies only develop and apply internal sustainability management systems and do not create connections with other firms and actors within the supply chain, information flows and training will remain in effective. Sustainability governance of the pesticides supply chain requires the active involvement of lead firms, such as the importers and the government to organise the chain and impose particular quality and performance standards upon other chain actors. To sum up, this study has identified the absence of coordination among private actors as a major impediment of safe pesticide distribution and use in Ethiopia. This paper also provides evidence for the potential role of private environmental governance in Africa. Also here, private actors are capable of generating new insights about pesticide problems, re-framing the systems used for pesticide distribution, and suggesting innovative ways to address environ-mental and health problems. Coordination among private actors, such as importers, retailers and users could incite importation, distribution and use systems and practices to incorporate sustainability concerns more effectively.

Chapter 4

Pesticide use practices among smallholder vegetable farmers in Ethiopian Central Rift Valley[6]

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Abstract

Pesticide use is a common practice to control pests and diseases in vegetable cultivation, but often at the expense of the environment and human health. This article studies pesticide-buying and use practices among smallholder vegetable farmers in the Central Rift Valley of Ethiopia, using a practice perspective. Through in-depth interviews and observations, data were collected from a sample of farmers, suppliers and key governmental actors. The results reveal that farmers apply pesticides in violation of the recommendations: they use unsafe storage facilities, ignore risks and safety instructions, do not use protective devices when applying pesticides, and dispose containers unsafely. By applying a social practice approach, we show that these pesticide-handling practices are steered by the combination of the system of provision, the farmers' lifestyle and the everyday context in which pesticides are being bought and used. Bringing in new actors such as environmental authorities, suppliers, NGOs and private actors, as well as social and technological innovations, may contribute to changes in the actual performance of these pesticides buying and using practices. This article argues that a practice approach represents a promising perspective to analyse pesticide handling and use and to systematically identify ways to change these.

Keywords: Pesticide buying & using, social practice approach, sustainable consumption, smallholder farmers, vegetable, Ethiopia

4.1 Introduction

Promoting sustainability in agricultural production requires critical consideration of agricultural technologies and identification of best practices. Pesticides are agricultural technologies that enable farmers to control pests and weeds and constitute an important input when producing a crop (Kateregga, 2012; Skevas et al., 2013; Jansen and Dubois, 2014). Even today, despite the advances in agricultural sciences, losses due to pests and diseases range from 10-90%, with an average of 35-40%, for all potential food and fibre crops (Abang et al., 2014). Agro-pesticide technologies, including insecticides, fungicides and herbicides, formed one of the driving forces behind the Green Revolution. Coupled with high-yielding crop varieties and increased land for crop production, significant yield improvements were achieved. However, this was realized at the expense of the natural environment and the health of farmers (UNU, 2003; Pimentel, 2005; Panuwet et al., 2012; Hoi et al., 2009, 2013; Ahouangninou et al., 2012). Since Rachel Carson's Silent Spring attention has been given to the hazards of extensive pesticides use in developed and developing countries (e.g. Karlsson, 2004; Hoi et al., 2013; Ríos-González et al., 2013; Jansen and Dubois, 2014), including sub-Saharan Africa (Ngowi et al., 2007; Jansen & Harmsen, 2011; Stadlinger et al., 2011; Kateregga, 2012; Macharia et al., 2013; Mengistie et al., 2015a).

Recent agricultural growth in Ethiopia resulted in higher demand for pesticides. More shops are selling pesticides, and farmers have easy access to them. However, there is no proper record of the actual volume of pesticides used in vegetable production in Ethiopia (Mengistie et al., 2014, 2015). According to a survey by the Irrigation Development Authority Office of Ziway and Meki districts in the Central Rift Valley (CRV) during the 2013/14 crop seasons, about 53,044 l of insecticide and 50,957 kg of fungicide were applied by 13,889 smallholder vegetable farmers. These farmers grew tomato, onion, green pepper, cabbage, potato, among others, throughout the year under rain-fed and irrigated conditions. As farmers have little tolerance for pest infestation, they rely heavily on the use of pesticides. Also, government extension programs encourage the use of pesticides arguing that farmers have no alternative (MoA, 2013; Mengistie et al., 2015a; Damte & Tabor, 2015). Pesticide use patterns of smallholder farmers are more complicated compared with large-scale farmers, as they are usually resource-poor as well as risk-averse. In addition, due to high exposure and unsafe application techniques, smallholders experience more pesticides health risks than larger-scale farmers (Ngowi et al., 2007; Williamson et al., 2008).

Different studies conducted on knowledge, attitude and behaviour among smallholders (Mekonnen & Agonafir, 2002; Obopile et al., 2008; Macharia et al., 2013; Abang et al., 2014; Damte & Tabor, 2015) have shown that unsafe use of pesticides is common in developing countries including in Ethiopia. However, little research has explored farmers' actual practices, while applying an approach based on practice theory could improve our understanding of these practices and the changes therein. The central claim in a practice approach is that the transition to sustainability needs to go beyond individual attitude and behavioural change and that actual practices should be the main unit of analysis. In this study, we try to 'open up the black box' of pesticide use practices by investigating the lifestyle factors and specific systems of provision among Ethiopian smallholder farmers to examine the potential for safer use and handling of pesticides. In order to achieve this, the following research questions were formulated: (1) how do existing pesticide selection and use practices look like in Ethiopia; (2) how can lifestyles and systems of provision be reoriented to create sustainable/safe pesticide use practices among Ethiopian smallholder farmers?.

The paper starts with elaborating the social practice approach and presenting the methodology. The main part of the paper presents the results of an analysis of the farmers' lifestyle, system of provision and actual use practices, followed by a discussion on the intervention potentials for sustainable pesticide consumption practices. The final section provides conclusions.

4.2 A social practices approach for studying pesticide use

In bringing social theory to the study of pesticides, we have used Giddens'(1979, 1984, 1991) conceptualisations of 'social practice' to understand the dynamics between agency and structure. In the domains of consumption and sustainability studies (Schatzki, 2002; Reckwitz, 2002; Shove et al., 2007; Warde, 2005; Spaargaren & Oosterveer, 2010;

Spaargaren, 2003, 2011) and others have used social practice theories to broaden and enrich understandings of why people do, what they do and to offer alternative explanations of human 'action' other than behavioural understandings.

Social practice theories divert attention away from individual decision making, towards the actual doings and sayings of social actors in everyday life (Reckwitz, 2002; Shove et al., 2007; Hargreaves, 2011). Analysing pesticide use as a social practice (Warde, 2005; Spaargaren & Oosterveer, 2010) allows for bridging the farmers' lifestyles and socio-technical systems of provision. The concept of lifestyle refers to an individual's participation in different social practices in combination with the storytelling that goes along with this. A lifestyle is both individually and collectively constructed as it is a unique combination of shared social practices (Stones, 2005; Nijhuis, 2013). The system of provision points at the relevance of domain-specific socio-technical innovations for increasing sustainability in a social practices (Oosterveer, 2007; Spaargaren & Oosterveer, 2010; Spaargaren, 2003, 2011; Nijhuis, 2013). This social practices approach is applied here to clarify how actors and the structural conditions effectively co-construct pesticide use practices or change them.

At the right-hand side of the model (Figure 4.1), the system for pesticide provision indicates the relevance of social structures in determining pesticide practices. The system of provision is the domain-specific socio-technical regime under which particular sets of practices are performed. It is important to determine what choices farmers have when accessing and using pesticides. The kinds of choices that are made available to farmers, as well as the role played by quality and price of products and services, have to be investigated (Spaargaren & Van Koppen, 2009; Nijhuis, 2013).

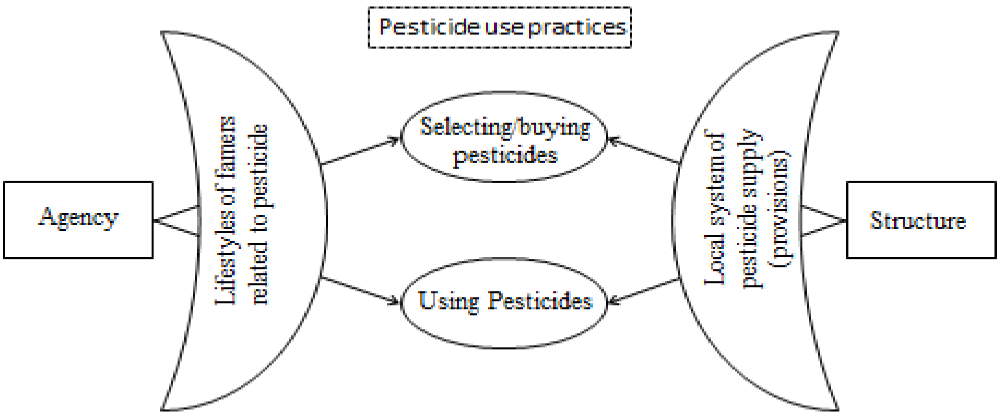


Figure 4.1 Social practices model for studying pesticide use

In the centre of the model, one finds the actual behavioural practices situated in time and space and share with other farmers. There are different pesticide practices exemplified as the organized and routinized activities of vegetable farmers: buying and using pesticides. They result from decisions made by farmers against the background of the configuration of choices made available to them by the (local) systems of provision.

The left-hand side of the model mentions the lifestyles of farmers. Lifestyles (following Giddens, 1984) are not limited to attitudes and values, but include general as well as practice specific knowledge and skills. Lifestyles are composed of the routinized activities performed by farmers, while also reflecting their perceptions, knowledge, values and worldviews (Spaargaren & Oosterveer, 2010). In this study, we treat knowledge, experiences and perception as the general dispositional dimension of lifestyles (Stones, 2005; Spaargaren & Oosterveer, 2010), the foundational principles that specific actors adhere to and use throughout a number of behavioural contexts, while on the other hand lifestyle experiences are always shared experiences (Shove et al., 2007; Nijhuis, 2013). The lifestyle characteristics of farmers are important for understanding the diversity within a social practice (why do some purchase and use sustainable innovations while others reject these innovations?) and to understand how at individual level different social practices are integrated.

By connecting socio-economic factors, what farmers know (knowledge), how they feel (perceive) risks as dispositional lifestyles (agency), what they do (practice) and the system of provision (structural perspectives), we argue that practice theory provides a holistic and grounded perspective on pesticide governance. In doing so, it offers an original perspective on options for behavioural change towards more sustainable patterns in how smallholder vegetable farmers in Ethiopia buy (select) and use pesticides.

4.3 Research methods

The farmers' pesticide use profiles is specified in terms of what practices are enacted, how much pesticides are applied, how farmers select, store, mix and spray pesticides and how they dispose of empty containers. Subsequently, we analyse the farmers' lifestyle which has an individual aspect because each person has his own unique ideas, beliefs, competences and identity, but also a collective aspect because social practices are always shared resulting in a common storyline. The system of provision provides insights in which pesticides are available and proposed in what quantities, according to what time schedule, for which pests and on which crop by traders, retailers, state extension workers and the farmers' union.

After pretesting, a cross-sectional study was conducted during the wet and dry seasons of the year 2014 (between 12 June and 30 December 2014) in 12 out of 31 irrigated *kebeles* (the smallest rural administrative unit) of *Adami-Tulu-Jido-Kombolcha (Ziway) and Dugda (Meki*) districts in the Central Rift Valley. These districts were selected because the majority of small farmers use their land for vegetables production while pesticide shops are widely available. A total of 220 smallholders were randomly selected during pesticide application from purposively selected irrigation-using *kebeles.* The sample size was determined using the Leslie Kish (1965) formula and proportionally selected from these clusters. A questionnaire containing structured and semi-structured questions was designed based on relevant literature and previous experiences. Data were collected through a farm survey by face-to-face interviews with farmers/sprayers. Eight pictograms used on pesticides labels were shown to farmers to verify their understanding. The data collected include socio-economic and lifestyle factors (age, sex, education, farm size, income, land tenure situation), pesticides used and their sources, characteristics of the pesticide stores, locations and ways of mixing, frequencies and dosages of pesticides applied, protective devices, disposal of pesticide containers, knowledge on environmental impacts from pesticides and observed symptoms due to exposure to pesticides. In addition, interviews were conducted with 78 randomly selected sprayers during application hired by farmers to investigate data on training on safety measures and on showering and change of clothes after spraying. To check the validity of responses, observations on 12 items in pesticide buying practices were made using a structured checklist.

Information about pesticide use practices include the types of pesticides used, how pesticides are selected, factors that influence pesticide selection and use, ability to read information available on the label and technical training. The system of provision was investigated through interviewing 12 retailers, two representatives of *Meki-Batu* farmers' union, five state extension workers and four plant protection experts. These key informants were interviewed for information on training and support to farmers either by suppliers (retailers), or state extension workers and farmers' union staff. Additional interviews were conducted with an environmentalist and a health practitioner. Existing documents and pictures of important observations were included as supportive qualitative information. The dynamics between farmers' lifestyles and the system of provision were analysed qualitatively when considering two practices: selecting/buying pesticides and actually using pesticides. Descriptive statistics (percentages, cross-tabulations, chi-square test (X^2) tests were used for quantitative data analysis applying SPSS.

4.4 Results

Following our conceptual model as presented in Figure 4.1, this section discusses the interaction between lifestyles (4.1) and the system of provision (4.2) in the pesticide selection and use practices (4.3).

4.4.1 Lifestyle characteristics and their contribution to (un)safe pesticide practices

The lifestyles of farmers include general lifestyle elements (general socio-economic background characteristics) and practice-specific elements (knowledge and understanding of pesticides).

4.4.1.1 Lifestyle characteristics of farmers

Pesticide use is a highly routinized social practice. Diverse lifestyles should be considered for their different potential to contribute to (un)safe practices. Behaviour of the farmers classified on the basis of gender, age, income and farm size as various factors and courses of action intervene in it, may reflect different lifestyles. Gender is also relevant, since each sex has hormonally controlled hyper sensitivities (Duah, 2002). Of the 220 farmers included in this study, the majority (97%) were male, while none of the female farmers sprayed pesticides. Besides, males decide on which pesticides to use on the farm. Most farmers (81%) interviewed were between 25 and 49 years old, while the average age was 37 years. Age is an important variable in the decision process (de Acedo Lizárraga et al., 2007) because younger farmers tend to be more flexible in their decisions to adopt new ideas and adopt proper and safe handling methods. Moreover, old age farmers did not trust new agricultural technology. Pesticides use practices that farmers applied already for a long period did not easily change and these farmers held on to their own conventional practices. An informant explained, 'many older farmers still admire DDT because they associate it with their first significant agricultural gains or those of their fathers before them'. Age also relates to distribution of possible pesticide poisoning symptoms (since the elderly and children are more susceptible to toxins) (Duah, 2002).

Education plays a significant role in changing farmers' lifestyles (Ríos-González et al., 2013). In this study, 55% of the farmers are illiterate, while only 34% studied up to elementary (primary school) level, and could be classified as semi-literate with poor reading skills. Few (10%) farmers had attended secondary school, while the remaining (1%) had tertiary level education (Table 4.1). Literate farmers have a better understanding of the effects pesticides have on human health and the environment compared to less literate farmers (Karlsson, 2004; Ríos-González et al., 2013). For instance, farmers with secondary and tertiary level reported the occurrence of pests as a major criterion for pesticide application. The majority of the less literate farmers apply pesticides haphazardly, without identifying diseases and pests. Many farmers reported insects as diseases when they were asked to name the diseases that attacked their crops. One of the vegetable farmers stated the intensity of the problem as follows. 'The pests and diseases are the worst, as they are probably every farmers' problems. My major problem is, every single year a new pest appears and attacks my vegetables. For instance, in 2013/14 the *Tuta absoluta* devastated large amount of potato'. Size of land is another important factor positively associated (χ^2 = 15.5, p = 0.001) with the amount of pesticides used. The farmers interviewed were typically smallholders with farm sizes averaging 0.75 ha, the majority (65%) of the farmers having land holdings ≤1.0 ha and 35% above 1.0 ha. Most of the land used by vegetable farmers was rented from local farmers with 2-5 year contracts (59% of the farmers) (Table 4.1). The majority of the farmers (88%) witnessed an increasing trend in pesticide use during the past five years, while 12% considered the situation as constant and no one stated that pesticide use is decreasing (Table 4.1). According to the crop protection experts of the district, farmers from higher income groups are more likely to buy appropriate pesticides from official retailers or suppliers, while farmers from lower-income groups use less expensive, broad-spectrum products that are available on the open market. Similarly, lack of capital was the main reason why all farmers use knapsack sprayers rather than motorized sprayers, despite their higher chance of leaking.

4.4.1.2 Pesticide knowledge and perception as general dispositions of lifestyles

Lifestyle occupies a key position in practice theory, since human agents are carriers of practices who are seen as knowledgeable and competent practitioners, able to link and integrate the elements of meaning, material, and competence to perform a practice (Ropke, 2009). Practical knowledge is part of the lifestyle as acquired social know-how which is accumulated through everyday experience. Practice theorists refer to practical knowledge as practical consciousness (Giddens, 1984), as knowing 'how to go on' in everyday life. It is obvious that that pesticide knowledge and understanding of vegetable farmers on pesticide use is co-determining pesticide practices. In this respect, most (92%) of the farmers knew the names of the pesticides they were using. The most commonly used pesticides were Mancozeb, Selecron, Redomil, Malathion, Karate, Thionex and Profit. Most farmers reported the use of more than four types of pesticides during one cropping season. Almost all farmers lacked extensive knowledge on the environmental and health effects from using pesticides.

Table 4.1 Socio- economic background of smallholder vegetable farmers (n=220)

Background	Respondents (n)	Percentage (%)
Sex		
Male	213	97
Female	7	3
Age		
<24	24	11
25 -49	178	81
50 -79	18	8
>79	0	0
Education level		
Illiterate (unable to read and write)	121	55
Elementary (grade 1-8)	75	34
Secondary (grade 9-12)	21	10
Tertiary level	3	1
Farm sizes (ha)		
≤1.0	144	65
>1.0	76	35
Land tenure situation		
Landowners	90	41
Land holders	130	59
Trend pesticide use past 5 years		
Increasing	194	88
Constant	26	12

Source: Field survey, 2014.

Although 76% of the farmers indicated that pesticides cause damage to human health, the majority also indicated that pesticides do not cause damage to animal health (75%) or waterbodies (91%) (Table 4.2). In line with Jansen and Harmsen (2011) and Teklu et al., (2015, 2016) the environmental impacts of pesticides are not well understood by farmers in Ethiopia. Laboratory facilities to monitor environmental residues are lacking, and there is no assessment of contamination of surface waters through pesticides. Over 70% of the farmers never read pesticide labels, because they were unable to read and understand the meaning of the label (56%), because the labels were written in a foreign language (English, Swahili), the letter fonts too small or the language too technical (19%). We found that only 8% read and understood pesticide labels correctly.

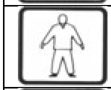
Table 4.2 Farmers' knowledge and understanding about pesticide

Items	Yes		No	
	n	%	n	%
Do you know the names of pesticides?	203	92	17	8
Do you think that pesticides affect human health?	168	76	52	24
Do you think that pesticides affect livestock?	32	15	188	75
Do you think that pesticides affect environment (water bodies)?	20	9	200	91
Do you ever read pesticides labels?	63	29	157	71

Source: Field survey, 2014.

Pesticide labels also contain self-explanatory pictures (for users with limited reading abilities) on safe use, safe handling and potential hazards. Table 4.3 shows eight pictograms normally found on pesticide labels on the Ethiopian market. Our survey shows that the majority of the farmers could not indicate the correct meaning of these pictograms, except for the pictogram ''wear gloves'', only 13 farmers understood all pictograms.

Table 4.3 Pictograms presented to farmers and level of understanding.

Pictogram	Meaning	Understand meaning	
		Yes (%)	No (%)
	Keep in a safe place out of reach of children	17	83
	Protect your feet/wear boots	34	76
	Wear protective clothing/apron	28	72
	Wear gloves	72	28
	Harmful to farm animals	14	86
	Harmful to aquatic animals like fish	9	91
	Cover face/use a face shield	6	94
	Wash hand after use	7	93

Source: Field survey, 2014.

About half of the farmers (53%) considered pesticides to be always harmful, 30% sometimes harmful and 17% harmless. Despite the fact that pesticides are toxic products, most farmers referred to them in the local language as '*medhanit'* (medicine). This influenced pesticides use. For example, in some rural areas farmers use highly toxic pesticides such as malathion or DDT to treat head lice, fleas and bedbugs, and even to cure open wounds. Overall, most farmers lack adequate knowledge on the potential hazards that pesticides may cause for themselves, the consumer and the environment.

4.4.2 Local pesticide provision system

This section deals with local provision systems and their contribution to (un)safe pesticide practices.

4.4.2.1 Types of pesticides used by farmers and system of provision

Pesticides are readily available at wholesale stores (importers), the farmers' union and pesticides retailers. Pesticides are supplied in containers ranging from 0.25 to 5 l (sometimes even 200 l) or in packets ranging from 0.5 to 25 kg. One litre and 1 kg are the most common packages sold at retailers. In our study, 41 different types of commercial pesticides with different chemical composition (organophosphates, organochlorines, pyrethroids and carbamates) were commonly used. Organophosphates and pyrethroids, with high levels of toxicity (in WHO class II, moderately hazardous), are applied at different growing stages (see Table 4.4).

In vegetable farming, insecticides (58%) are the most used pesticides because of serious insect pests in vegetable production in CRV. This is followed by fungicides (42%) usage, while herbicides are not used probably because hired labourers manually carry out weeding. This is contrary to cereal (maize and wheat) farmers, where herbicides are the predominant pesticides in use.

Table 4.4 Pesticides used by vegetable farmers in the CRV of Ethiopia, 2013/14 crop seasons

Trade name	Type of crop	Type of pest and disease	WHO's toxic class
Insecticides			
Agro-Thoate40%EC	Cabbage	Aphids, African ball worm	II
Selecron 720%EC	Onion	Thrips, (broad spectrum)	II
Karate 2.5% EC	Tomato, cabbage	Thrips, Sucking Insects/wide range of insects	II
Polytrin315EC	Onion	Insects(thrips)	II
Thionex 35EC	Tomato, onion	Ball worm, thrips,	II
Profit 720EC	Tomato, cabbage	Onion thrips ,leaf hoppers	II
Ethiolathion 50EC	Tomato, onion, cabbage	Any worms	II
Ethiozinon 60EC	Tomato, pepper	Boll worm, termite	II
Polytrin®KA315EC	Onion	African bollworm, thrips	II
Ethiodemethrin 2.5EC	Onion	Thrips	II
Ethiothoate 40%EC	Tomato	White flies, spider mites	II
Pyrinex 48%EC	Onion	Thrips	II
Roger	Onion	Thrips ,Stalkborer	II
Radiant 120SC	Tomato, onion	Onion Thrips, tutaabsolutaon, broad spectrum	II
Coragen 200 SC	Tomato	African ball worm, tutaabsoluta	III
Tracer 480SC	Tomato	Boll worm, tutabasoluta	IV
Helerat 50EC	Onion	Thrips ,ball worm	II
Dimeto40%EC	Tomato, cabbage	Ball worm and cabbage Aphids	II
Lamdex 5% EC	Onion, cabbage	Ball worm, Aphids	II
Decis 2.5%EC	Cabbage	Ball worm, aphid, fruit-borer	II
Ethiosulfan	Tomato, onion	Ball worm	Ib
Dursban 48%EC	Tomato, onion, cabbage,	Stalk borer, termites, soil born insects	II
Fastac10EC	Tomato	Ball worm, thrips & whitefly.	III
Hanclopa 48% EC	Pepper	Termites	II
Fungicides			
Mancolaxyl 72WP	Tomato	Late blight, powdery mildew	II
Agrolaxyl M2-63.5 wp	Tomato	Late blight, leafspot	II
Victory 72WP	Tomato	Late blight	II
Masco® 8-64	Onion, cabbage	Downey mildew, Late blight	II
Ridomil 68WG	Onion, tomato	Purple blotch, Late blight and downy mildew	III
Unizeb (Mancozeb 80%WP)	Onion	Thrips	II
Indom (Mancozeb 80%WP)	Tomato	Late blight, leaf spot	II
Fungozeb (Mancozeb 80%WP)	Tomato	Fungus	II
Indofil M-45 (Mancozeb 80%WP)	Tomato	Fungus	II
Ethiozeb(Mancozeb 80WP)	Tomato	late blight.	II
Cruzate R	Cabbage, Onion	Purple blotch, downy mildew and late blight	III
Bayleton 25 WP	Tomato	Powdery mildew, late blight	III
Matco 8-64	Tomato, onion, cabbage	late blight ,Downy mildew.	II
Kocide 101	Tomato, onion, cabbage	Early and late blight	III
Revus 250SC	Tomato, onion	Late blight, Downy Mildew	III
Natura 250 EW	Tomato, onion	Early blight, purple blotch	II
Nimrod 25 EC	Pepper, tomato	Powdery mildew	III

Source: Field survey, 2014

Table 4.4 shows that, while newer pesticide formulation are gradually being adopted, Ethiopia still relies largely on less expensive, 'older' (established), non-patented (generic), more acutely toxic and environmentally persistent agents. These latter ones are manufactured domestically or formulated from imported active ingredients. Besides, there is repeated use of the same class of pesticides (mainly class II) to control pests and diseases, while repeated use may cause pest resistance (UNU, 2003; Williamson et al., 2008).

According to key informants, interviewed farmers and field observations, a considerable proportion of the pesticides applied in the study area originate from unauthorised, sometimes illicit, sources and sometimes brought in Ethiopia through illegal trading from Kenya and Sudan to local retailers. Some examples can clarify this. Endosulfan products (proposed for cotton) are frequently used on vegetables. One retailer reported that he knew the products are forbidden for vegetable production, but farmers find them very effective. By using Endosulfan, farmers effectively combat insects, especially in cabbages, and thereby reduce harvest losses. Low prices set on these pesticides by informal traders imply that they source these products from outside the official distribution channels. Also DDT (banned globally for all agricultural purposes under the Stockholm Convention but widely used in Ethiopia for malaria control) is still available and used by vegetable farmers in the CRV. In addition, double/triple registration of pesticides with the same active ingredient under different commercial or brand names is causing confusion in pesticide provisioning.

For example, Mancozeb 80% WP is available in the market under different trade names, such as Unizeb, Fungozeb, Indom and Indofil, but they all contain the same active ingredients (80% WP). Finally, nationally unregistered pesticides (Champion 50% WP and Aldicarb, class Ia (extremely hazardous), imported only for the flower industry, are found on tomato farms. A district state agricultural officer disclosed that flower growers sometimes import large amounts of unregistered pesticide for their large farms. Some of these products are stored for a long time, and when the expiration date comes close, they are sold for a low price to small vegetable farmers.

4.4.2.2 Provision of technical support

Pesticides are a complex, toxic and hazardous technology and most information developed during preregistration and registration is too technical for smallholder farmers. Smallholder farmers need adequate technical support from state and/or non-state actors to apply pesticides correctly. Only 23% of the vegetable farmers and 13 out of 78 applicators obtained training from Croplife Ethiopia, in collaboration with Ethiopian Horticulture Producer Exporter Association (EHPEA). None of the hired sprayers had a pesticide applicator certificate. The majority (87%) of the farmers did not receive any training/technical support on how to use and handle pesticides while fostering safety and sustainability. All vegetable farmers are using pesticides as the main means to control their vegetable pest problems since they are easily available and 'highly' effective. Other means of crop protection, e.g. integrated pest management (IPM) and biological control, are not practiced nor fully understood by the farmers. None of the trainers/advisors suggested IPM or biological control as a possible option.

Extension services could transfer 'best pesticide practices' from one farmer to another. However, extension workers in the region are not adequately trained in pesticide management and hence unable to provide adequate services to farmers with regard to safe use and handling of pesticides. Extension services on safe pesticide use are largely missing in the CRV and local agricultural offices provide only very general agricultural support. Moreover, the pesticide distribution system falls short due to multiple market actors, like distributors and retailers, who lack the necessary qualifications. For instance, none of the retailers had a certificate of competence, nor were any of the interviewed shops ever inspected by an inspector from the local or federal state authority. There is also no tracking system on pesticides once they are distributed. In addition, farmers complained that the government through the farmers' union provides pesticides on higher priced credit basis than the market. Thus in order to pay back the loan, farmers are forced to sell their vegetables to the union.

Besides, in Ethiopia there are also several NGOs with activities related to pesticides, namely Pesticide Action Nexus (PAN), Ethiopia Institute for Sustainable Development, Social Welfare Development, Association Forum for Environment, Chemical Society of Ethiopia among others. One of the main objectives of these NGOs is to oppose the misuse of pesticides and support safe and sustainable pest control methods and articulate problems related to conditions of pesticide storage and safe handling. However, the overall performance of these actors is weak in supporting smallholder farmers regarding pesticide governance. Interestingly, there are some reports (PAN-Ethiopia, 2014; Amera, 2008) by these NGOs on pesticide use in Ethiopia's and its impact on human health, agricultural yield and biodiversity. Despite this, much works remain to be done.

In general, all key informants at district level expressed concerns over unsafe distribution an use of pesticides resulting from heavy workloads extension workers, poor service of plant health clinics and farmers training centres (FTCs), inadequate material and infrastructural support for the extension service, lack of sufficiently trained extension agent in horticulture contexts and absence of linkages between/among farmers, extension agents, and pesticide suppliers and civil society actors.

4.4.3 Pesticide use and selection practices

Practice based analysis takes practices as the unit of analysis. This means that individuals are considered as the carriers of practices. Smallholder farmers relate to two practices when dealing with pesticides; pesticide use (handling) practices and pesticide-buying (selecting) practices.

4.4.3.1 Using practices

To evaluate farmers' (un)safe pesticide practices, farmers were interviewed on their application practices during the past year (including storage, application rate, quantity, method, product mixing, and frequency of applications), disposal of empty containers, use of protective gears and precautions taken after application. We found that about 32% of the farmers stored pesticides in the house, often under their bed or hanging from the roof or the wall. Such storage can easily be accessed by children, creating the risk of accidental poisoning of family members. The majority (57%) of the farmers stored their pesticides in a small hut made from wood and grass at farm fields (called camp), where sprayers also sleep. Hired sprayers reported that they used these small huts for living and cooking, and stored pesticides together with agricultural tools (seeds, knapsack and water pumping machine).

The remaining 11% stored their pesticides in a separate place; sometimes pesticides are buried in the ground, safe from thieves, children and other unauthorized people.

Most farmers (87%) mix two pesticides before application, while 13% use both single and cocktail sprays. Cocktails help farmers to save time and labour and are considered to have a higher efficacy in pests and diseases control. Label instructions do not cover mixtures of two or more pesticides and provide no information on the compatibility of inert ingredients such as emulsifiers and wetting agents. However, unspecified tank of mixing of insecticide and fungicide are common practices with the vegetable farmers (Table 4.5).

Table 4.5 Pesticide mixtures by smallholder farmers in the CRV of Ethiopia

Pesticides combination	**Types of pesticides**	**Description of the mixture**
Ridomil + Selecron	fungicide + insecticide	15 cc each/10 knapsacks* of water, on tomato onion, and cabbage
Selecron + Malathion	two insecticides	1 blue copper drum of water*, on onions and cabbages
Thionex + karate	two insecticides	1 blue copper drum of water, on onions & cabbages
Selecron + karate	two insecticides	20cc each /30 knapsack, on onions and cabbages
Mancozeb + Malatine	fungicide + insecticide	15cc each /20 knapsack of water, on tomato, onion
Coragen + Mancozeb	Insecticide + fungicide	1 drum of water, on Tomato, onion
Ethiotate + Cruzate	insecticide + fungicide	2 blue copper drum of water, on tomato, onion, cabbage
Profit + Ridomil	insecticide + fungicide	1 drum of water, on tomato, onion, pepper
Profit + Mancozeb	insecticide + fungicide	1blue copper drum of water, on tomato, onion

*1 Blue copper drum contains 200 litter; a knapsack varies between 15 and 25 liter of water.

Source: Field survey, 2014.

Besides, farmers did not consider that these kind of mixing of products could be less effective and cause adverse effects to their health or the environment. Mixtures follow either retailer recommendations or common practices in the area. It is risky to mix two different types of formulations, for example wettable powders (WP) with emulsified concentrates (EC). Ngowi et al. (2007) reported that interactions between insecticides, fungicides and water mineral content can influence the efficacy (more toxic, less efficient, neutralized or resistant) of pesticides against fungal pathogens and insect mortality, while some mixtures induced phytotoxicity on tomato, onion and cabbage.

Most farmers (74%) mix their pesticides close to a river, canal or community water source (Table 4.6), which are used by local residents for drinking, cooking and other domestic purposes. Mixing takes place in a knapsack or container, often using a long stick but sometimes with bare hands (Table 4.6). None of the farmers wears gloves and/or closed boots, enhancing direct contact of hands and feet with pesticides. The mixing containers are reused by 48% of the farmers for other activities, such as carrying vegetables from the field or washing clothes. In the CRV, farmers generally use a higher dosage of pesticides than recommended, under the misconception that a higher dose means better eradication of pests. Assessing the exact overdoses proved difficult, because unlabelled units (such as tins) and different combinations of pesticides were used.

Although farmers keep no records of the amount of pesticides sprayed, they explained that their spraying frequency varied, depending on climatic conditions (rainy and dry season) and crops. During rainy seasons, when pests and diseases proliferate, farmers spray more. Then most farmers apply increased dosages as from experience the recommended amount proved ineffective; they use the term *mooq* (a bit higher than the dose). They intend to eliminate pests at once and/or reduce spraying frequency. A wide range of dose rates (both excessive and reduced) were applied. For example, the recommended dose of CruzateR WP on tomato was 200-300 g per 100 l of water per hectare to manage downy mildew and early blight. However, a farmer in Ziway diluted this amount of pesticide in 200 l of water, mixed it with Ethiotate 40% EC and sprayed the mixture on 0.75 ha farm land. In Meki, a farmer used Matco 8-64 with profit 72 in a dose of 1 kg/200 l water/ha, instead of the recommended 1 kg/500 l water/ha to manage Downy mildew on onion. If pests are not sufficiently reduced after pesticides application, farmers increased the concentration, the frequency and/or changed the types of pesticides without any instruction.

Some tomato farmers mix insecticides and fungicides and spray as many as 17 times in a wet season and eight times in a dry season, while a maximum of five is recommended when the worst infestation occurs. The longer growing season of crops like tomato entails a higher frequency of sprays per season. No farmer follows the recommended spraying intervals. For instance, for spraying 1.75 kg Indom per ha mixed per 100 l of water to control late blight in tomato, the recommended interval is 10 days. However, a farmer mixed this pesticide with Agro Thoate 40% EC in 200 l of water and repeated this every five days.

Landholders (i.e. farmers who have land use rights but no land title) generally apply significantly more pesticides per hectare than landowners (with land titles) (χ^2= 42.5, p\0.001). Landholders minimize subjective (uncertainty) and objective (disease, weather variation, pest infestation etc.) risks in order to obtain the income necessary to pay the rent for the land. Farmers give three reasons for the current (high) pesticide use: low efficacy of pesticides compared to the standards, pressure from retailers and their technical guidance and high incidence of diseases/pests (Table 4.6). However, in maintaining long-run relationships with farmers, some retailers do not deliberately misguide farmers towards overdoses for short-term profits. The most common pesticide spraying equipment was the manual (hand pump) knapsack sprayer of 15, 20 or 25 l. The use of a knapsack sprayer exposes the sprayers to health dangers.

Knapsacks often leak, especially in a hot climate. Water drawn from the river, well or pond is often not filtered, and the debris in the tank frequently leads to nozzle blockages. We observed that many nozzles were in poor condition, either worn out or damaged because knives or wires were used to clear blockages. Consequently, the nozzles were atomising poorly. This comes with limited use of personal protective equipment while spraying pesticides. Ethiopian farmers usually spray pesticides dressed only in T-shirts, shorts and slippers that offer little protection (see Photo 4.1). The majority of the farmers (81%) wore their normal clothes during spraying, whereas 19% wore inadequate overalls that did not cover most parts of the body.

Table 4.6 Some aspects pesticide use practices

Place of Place of pesticide mixing	N(%)
Near a river canal/community water sources	163 (74%)
In the field (farm)	37 (17%)
At home	20 (9%)
How farmers mix pesticides	
With a stick, but bare hands	207 (94%)
With bare hands	13 (6%)
With hands and wearing gloves	0 (0%)
With a stick and wearing gloves	0 (0%)
Devices used for mixing pesticides	
Knapsacks	139 (63%)
Various types of mixing containers (drum)	81 (37%)
Reasons reported by farmers behind using current level of pesticides (multiple answers possible)	
Low efficacy of pesticides	183 (83%)
Influence from retailers and their guidance	150 (68%)
High incidence of diseases/pests	125 (57%)
Use of personal protective equipment PPE during application (multiple answers possible)	
Wearing normal clothes	178 (81%)
Using hat	156 (71%)
Spraying with bare feet	125 (57%)
Using boots	95 (43%)
Using cotton overalls (tuta)	64 (29%)
Bath after application	15 (7%)
Fate of empty pesticide container (multiple answers possible)	
Dump them by the field (throw away on farm)	213 (97%)
Throw into irrigation canals or rivers	180 (82%)
Collect and bury in ground on farm	138 (63%)
Collect and burn on farm	103 (47%)
Keep for domestic uses	84 (38%)
Collect and sell them	59 (27%)

Source: Field study, 2014

During our observation, no one was using gloves, glasses, masks or goggles. The large majority of the sprayers did not shower after pesticide spraying and carried on working in the field. Our close observation of spraying practices at the site revealed some unsafe practices. As a sprayer in Ziway district explained, ‘I do not wear PPE when I apply (spray) pesticides since I feel uncomfortable and I work cumbersomely. This makes me work very slowly and I cannot finish my job on time’. Another informant in Meki said, ‘When I once wore PPE, I could not breath comfortably because of hot weather and I sweated, then my PPE got wet.

Photo 4.1 Sprayers without protective devices, a manual knapsack and drum for mixing
(Photo by Belay Mengistie (left) and by Suzan van der Schenk (right))

After that I did not wear it'. None of pesticides companies makes efforts to provide protective gears and equipment free of charge or at a cheaper price to enable farmers to buy them. Even when a farmer is aware of the risks associated with pesticide use and wants to wear protective gear, he often cannot access it; protective clothing is very expensive. The main reasons mentioned for not using protective equipment were lack of availability (not provided) and affordability, while some considered it uncomfortable under local hot and humid climates. As sprayers are not trained in safe handling of pesticides, they did not ascribe any health problem encountered to pesticide exposure. Nevertheless, over 55% of the sprayers reported at least one of a number of symptoms of acute pesticide poisoning within 24 h after spraying pesticides. Half of them also indicated that they witnessed a fellow farmer being intoxicated by pesticides. The most frequently reported symptoms were eye irritation (25%), backache (22%), vomiting (21%), burning skin/rash (15%), shortness of breath (11%) and headache/ dizziness (6%). Young farmers more often reported possible poisoning cases than the old farmers. For example, 23% of young farmers said they never had any symptom of pesticide poisoning, compared to 38% of the old farmers. There are important differences between landholders and hired labourers on pesticide use practices. Hired labour (87%)was the dominant work force for landholders, but most landowners used family labour (73%). Landholders who contract hired labour for pesticide spraying tend to explain (1) pesticide poisoning as a result of sloppiness during pesticide application and (2) voluntary pesticide intake as mental craziness. In contrast, hired workers tend to explain (1) pesticide poisoning as occupational risk and (2) voluntary pesticide intake as a *desperate decision*. Moreover, according to a landholder: *if workers get sick due to pesticide* *application, it is because these people do not take proper care at home and in the field. On the other hand, a hired labourer's opinion was: we got sick because we are forced to live in continuous exposure to pesticide, this is the only way to survive here. At least here, I can survive even if I have to respire pesticides every day*.

The common way of disposing empty pesticide containers was throwing them in the field (97%), irrigation canals or rivers (82%). Alternatively, they were buried, burned, reused for water or food storage, and sold (Table 4.6). Pesticide containers were also placed on sticks to protect the crop from birds. Most of these disposal measures for pesticides packaging come with significant environment and health risks, as usually around 2% of the pesticides still remains in the empty packaging (Briassoulis et al., 2014). Suppliers (importers, unions and retailers) and even local authorities often recommend burning or burying empty packages, which is also potentially hazardous to human health and the environment.

Generally, Table 4.6 shows the actual behavioural practices situated in time and space that an individual farmer shares with other farmers. Similar lifestyles should be considered for their similar practices to contribute to unsafe pesticide handling. On the other hand, social practices are always shared resulting in common storylines and experiences. Each farmer may have some freedom to act, but their actions are nevertheless constrained by the accepted rules of behaviour which characterize particular pesticide use practices. Up to a certain level, the farmers share an understanding of the use of pesticides: what it means and how it should be performed. Pesticides were considered important in trying to get a good yield and reduce risks of pests and diseases. On the other hand, while at least partly bounded by the practices they practiced, farmers' personal characteristics also had an influence. Under the same conditions of rising pesticide prices and low vegetable prices, some farmers pushed towards 'cost minimization'. Some landholders were not keen on testing a new product, but rather waited until others had proved them to work. Other farmers (landowners) used their own long year experience to decide on pesticide application.

4.4.3.2 Buying (selection) practices

Consumption behaviour is embedded in social, cultural, economic and institutional infrastructures over which consumers have little influence (Barnett et al., 2011). This argument is also valid with respect to farmers' pesticide selection as discussed in this research. Vegetable farmers can be conceptualized as passive or 'captive' users to a great extent. For the supply of pesticides, they are largely dependent on the local, uncertified and unlicensed pesticide retailers. This clearly shows that the choice of pesticides to be used by farmers is directly influenced by the provision side. Pesticide selection can therefore to a considerable extent be explained by focusing on some of the structural characteristics of the current systems of pesticides provision in Ethiopia. For vegetable farmers pesticide selection is done on the basis of availability. Most farmers (79%) reported that for them efficacy was the most important criterion when selecting pesticides, while 21% regarded price (affordability) the most important selection consideration. All farmers reported that pesticides constitute their most expensive input in tomato and onion production compared to other inputs, such as fertilizers, labour, water pumps or seeds.

Concerns about the toxicity, residue effects, environmental impacts or risk/benefits for themselves or consumers were not important considerations in pesticide selection. Farmers also purchased less expensive but broad-spectrum (and thus toxic) products (e.g. DDT), which are suitable for all kind of pests that require control. Twelve observations in shops learned that farmers usually buy pesticides in small quantities whereby they rarely read the instructions. For instance, 67% of farmers did not check the expiry date of the pesticides they purchased, and most farmers (55%), are illiterate (Table 4.1). Farmers trust their pesticide providers and lack knowledge on the importance of the expiry date. In quite a few shops, we observed farmers buying expired pesticides (e.g. Coragen 250 SC, Karate 2.5% EC, Mancolaxyl 72% WP), and pesticides without manufacturing and expiring dates (e.g. Ethiothoate 40% EC, Profit 72% EC).

Information from suppliers can have a strong influence on the correct and efficient selection of pesticides, especially for small-scale farmers who have no other source of information to rely on. However, none of the pesticide importers employed technical personnel at district or farm level to disseminate information, to assess product handling of retailers or to deal with farmers' complaints. Similarly, all 12 pesticide shops visited did not provide customer advice on pesticides. Table 4.7 shows that farmers mainly depend on neighbours and their own past experiences in the selection and use of pesticides. As the majority of farmers select (60%) and use (61%) pesticides on the basis of their own personal experience, farmers (especially those farming for more than 5 years) are likely to know the name and quality of the pesticides available in the market. Pesticides like Selecron, Mancozeb, Malathion and Ridomil indeed proved to be well known by the majority of the interviewed farmers.

Table 4.7 Information sources farmers rely on for pesticide selection and use

Information source	Neighbour farmers	Own past experience	Retailers	Extension workers
Selection (buying)	141 (64%)	133 (60%)	108 (49%)	38 (17%)
Use	158 (72%)	134 (61%)	77 (35%)	71 (32%)

Multiple responses were possible.

Source: Field survey, 2014

According to extension workers, pesticide advertisements continue to encourage farmers to buy cheap and generic, but toxic and persistent pesticides. All retailers expected pesticide sales to increase in the near future because of the growing number of vegetable farmers, the higher occurrence of pests and diseases and the current perception that pesticides are required to obtain a good harvest (or any harvest at all). Farmers hardly relied on information and recommendations from extension agents, which confirms the limited role of government authorities in pesticide management in Ethiopia (Mengistie et al., 2015a). In general, since farmers purchase pesticides from the local retailers, they cannot decide what kind of pesticide will be used. Farmers are not offered a choice for bio- and safe pesticide in a similar way as is the case in some developed countries. They also depend on the experience of neighbouring farmers to know how 'effective' a pesticide is.

4.5 Discussion

Vegetable farmers in Ethiopia clearly show improper use of pesticides in their cropping practices. This observation confirms that the problem is not the pesticide itself but how farmers handle pesticides, shaped by lifestyle factors and the system of provision. Farmers apply pesticides indiscriminately in violation of the recommendations. These practices of pesticides' use have implications for agricultural sustainability, the health of growers and consumers and the environment. This situation calls for a transformation of these practices. The central argument in this paper is that pesticide practices are the outcome of interaction between agency and structure. The empirical findings confirmed the relevance of both agency and structure on the farmers' (buying and using) pesticide practices. The individual choice of farmers is guided and influenced by structures and the existing patterned arrangements. This raises the question how lifestyles (agency) and systems of provision (structure) determine pesticide practices and how more sustainable patterns can be created.

Theoretically*,* although the practice approach has been developed particularly in Europe and the USA, it proves also relevant beyond these regions. The globalization of lifestyles, practices and systems of provision adds a new dimension to the efforts to develop sustainable patterns in different parts of the world. A growing number of organisations and institutions are beginning to affect developing countries and new institutional settings open up avenues to influence actors from the South including Ethiopia.

Empirically, specific studies have shown the high human and environmental risks of unsafe use of pesticides in many African countries such as Ghana (Ntow et al., 2006), Tanzania (Ngowi et al., 2007), Botswana (Obopile et al., 2008), Ethiopia (Jansen & Harmsen, 2011), Benin (Ahouangninou et al., 2012; Vidogbéna et al., 2015), Uganda (Kateregga, 2012), Kenya (Macharia et al., 2013). Other parts of sub-Saharan Africa have similar problems with the widespread use of highly toxic and illegal pesticides (Ecobichon, 2001; Williamson et al., 2008; Handford et al., 2015). Like in many African countries, also in Ethiopia, different studies conducted on knowledge, attitude and perception (KAP) among smallholders (Mekonnen & Agonafir, 2002; Amera & Abate, 2008; Mengistie et al., 2015a; Damte & Tabor, 2015) have shown that farmers have low knowledge, attitude and perception on pesticides use. Other interesting studies done in sub-Saharan Africa (Gogo et al., 2014; Simon et al., 2014) can be seen as an attempt to combine some elements of the system of provision into an integrated strategy, emphasizing the need to provide low or nontoxic insecticides (i.e. spinosad, indoxacarb, metarhizium) and netting technology (eco-friendly nets). However, none of these studies applied a practice approach and farmers' actual practices have hardly been explored, and therefore, there is a need for further research, on how to transform these practices to more sustainable and safer ones. The possibilities for sustainable pesticide use practices by vegetable farmers depend to a large extent on the availability of socio-technical innovations in the system of provision. Key actors in this system of provision, state authorities and pesticide providers are critical in this change practices as smallholders have poor access to markets, weak purchasing power and limited knowledge about pesticides. Intervention strategies for better pesticides practices can be developed along three lines: legislation, control, and education, but an interplay between these three strategies is key for its effectiveness.

4.5.1 Using practices

This study has shown that much misuse (abuse and overuse) of pesticides by farmers occurs, particularly when storing, mixing (dosage) and applying them, and also with regard to wearing protective gears and disposing of empty containers. These problems can be attributed to farmers' lack of technical knowledge, the absence of extension services and lack of training on safe pesticide use. Neighbouring farmers play a crucial role in information dissemination, while official institutions are absent. Addressing the problem of pesticide misuse requires the active involvement of important stakeholders such environmental NGOs, health practitioners, private entrepreneurs and agrochemical companies to provide training and technical support for farmers, hired sprayers, retailers and extension workers. Specifically, (1) training and technical support for extension workers is necessary to address incompetence and gaps in technical knowledge; (2) training programs to raise awareness among farmers about the potential hazards of pesticide use and particularly about the importance of proper pesticide management during all phases of handling them. Farmers' Training Centres (FTC), Farmers Field Schools (FFS) and Plant Health Clinics may be effective in implementing this objective, but local social networks should also be included; (3) health practitioners should inform farm workers on how to avoid pesticide exposure that may lead to short-term (acute) and/or long-term (chronic) pesticide health effects; (4) the government should appoint agencies that are responsible for collecting empty pesticide containers. They could follow the example of the industry association, CropLife, that takes a vigorous approach with stewardship programs around the world for a safe environment.

In African countries, many government extension programs encourage the use of pesticides (Ngowi et al., 2007; Kateregga, 2012). Also Ethiopian farmers have been stimulated to use pesticides as the only option for crop protection, mainly through advertising pesticide use by retailers and extension officers. Rethinking this approach is needed to identify alternatives, for instance in terms of good agricultural practices, integrated pest management (IPM) or organic farming. Currently, IPM seems the most promising strategy for widespread application by vegetable farmers, as it can change farmers' perceptions, attitudes and practices in using pesticides without requiring large investments or radical transformations in management systems (PAN-UK, 2007; Williamson et al., 2008). There is no policy promoting organic agriculture in Ethiopia although there are some local initiatives to produce and export organic crops, for instance coffee (PAN-UK, 2007; Vidogbéna et al., 2015). In particular, further consideration should be given to build a dynamic private sector where commercial importers or cooperatives provide safer and newer (bio-)pesticides that can replace highly hazardous pesticides.

4.5.2 Buying (selection) practices

Pesticide-buying practices in Ethiopia are not merely driven by farmers' rational considerations on pest occurrence but involve other elements of their lifestyle, such as low knowledge about pesticides and their possible impacts, incorrect perceptions about their effectiveness and unhealthy routines. These practices are also shaped by specific features of the system of provision. The system of pesticide retailing in Ethiopia is structured rather informally and characterized by unlicensed and unregistered business operations without inspections from local or national government offices (Mengistie et al., 2015a). Farmers are allowed to buy pesticides without any restriction and without any requirement on knowledge about their proper use. Although pesticide trade is a commercial activity dominated by private actors, the state should enhance sustainability in this sector and strictly regulate it (Ecobichon, 2001). Import, sale, distribution and use of pesticides should be controlled and post-registration activities such as marketing, training, licensing and certification, enhanced. The International Code of Conduct on the Distribution and Use of Pesticides provides governments in developing countries with the tools to select the appropriate legislative requirements for pesticides' trade and use (Ecobichon, 2001; Dinham, 2004; Karlsson, 2004; Jansen & Dubois, 2014). A national pesticides law could for instance give instructions for writing labels to minimize risks and define the correct use of the product. A law could also require that pesticide products can only be bought when a prescription is provided by an agronomist for a particular pest and crop (Dinham, 2004; Jansen, 2008). Farmers are then expected to report problems (pests, diseases and weeds) to local extension services and receive a prescription from plant protection experts. Mandatory prescription for pesticide sales could be a mechanism for safe selection, handling and use of pesticides and reduce pest resistance, environmental risks and human exposure.

The pesticide retail shop remains the most important location for vegetable farmers to access pesticides because here a particular pesticide is selected and bought. Retailers can either emphasize or downplay environmental and health effects of pesticides, in addition to the classical properties of quality, price and service. This complex process should be guided by adequate knowledge, but most of the available information is too technical for farmers and unlicensed retailers (Panuwet et al., 2012). Therefore, supporting and training farmers and retailers by importers, state or non-state actors is crucial. Pesticide importers should conduct workshops when they introduce new pesticides on the market in order to provide more information to retailers. All retailers should possess sufficient technical knowledge to offer complete, accurate and valid information about the products, such as recommended doses, recommended frequency of application, and safe pre-harvest intervals. They should hold a certificate to demonstrate this. They should also make available posters and other media to farmers to give them the opportunity to learn more about pesticides when actually buying them.

4.6 Conclusions

We showed that vegetable farmers in CRV of Ethiopia overuse, misuse and abuse pesticides by applying pesticides indiscriminately in violation of the scientific recommendations, store them unsafely and ignore risks, safety instructions, and protective devices when applying pesticides and disposing containers.

Applying a social practices perspective to study Ethiopian farmers' selection and use of pesticides provides an interesting account on the prospects for improving agricultural sustainability and environmental safety. Pesticide (buying and using) practices are the outcome of interactions between actors and social structures and our empirical findings confirm the relevance of these interactions for farmers' decisions on buying and using pesticides. Farmers' agency and the system of pesticide provision influence the practice as they mediate and connect the available elements in a particular performance. Transforming pesticide practices towards sustainability requires reconsideration of existing patterns of use and transforming them. Therefore, to be sustainable, they will have to change from a reliance on traditional knowledge and perception (as general dispositional dimensions of lifestyles) and the existing system of provision via the introduction of new and safe products and the new systems of provisions to the creation of new linkages in the performance of the practices.

One way to create this change is to focus on the agency of farmers. Farmer agency is restricted by the availability of products, their understandings and competences and the routinized ways of performing the practice. In the context of agency, farmers' knowledge and perception of pesticides and management strategies play a significant role. Decisions made by farmers to buy and use pesticides are mediated by their knowledge of the farming system based upon their training and their experience. Changes in practices cannot be explained from individual characteristics alone: the practitioner is always embedded in the practice. Performing a practice, however, still includes agency as a possibility to perform differently, and thus there remains space for humans to take action. By rejecting to view farmers as isolated decision-makers, our practice analysis places the actors' motives and personal qualities in context as one of the elements of a practice and not as the decisive factor. The farmers' motives and qualities may shape practices through the introduction of different forms of knowledge and by making new skills available. This could be achieved through providing further information and training services on the economic, scientific, legal and technical aspects of pesticides. At the same time, agency is not only found in combining the different elements and routinely performing a practice but also in actively developing a vision for change and create new ways to perform a practice. The process of change may be facilitated by the recruitment of new actors with capacities to perform a practice differently.

For example, some large-scale farmers decided individually to stop using particularly hazardous pesticides and to implement IPM programmes which reduce their reliance on chemical control as the main pest management strategy. These farmers are likely to obtain better prices or preferential purchase from European importers who are fearful of pesticide residues in food products and engaged in promoting ethical standards related to human and environmental safety.

Another way is to aim for changes in the system of pesticide provision. The provision side influences what products are available, which actor has access to what information, and who has the capacity to act and change the current practices. Hence, promoting safe pesticide use also depends on changing the systems of provision and this relates to reconsidering the activities of the providers and regulators and to the improved availability and of quality services and products (such as safe and less toxic pesticide). Taking this into account, the government should provide capacity-building measures, such as training, education, awareness raising, facilitating access to information and conducting regular surveillance and monitoring activities (establishing a system to track and trace the fate of pesticides after registration). Pesticide companies and especially importers and retailers should adhere to the requirements of the national law when distributing and promoting pesticides. The small-scale farmers included in this study do not target the export market, but imposing stricter rules and safer pest management measures should be considered also important for the domestic market. Changes in the system of provision may also come from new methods (such as IPM), less harmful pesticides, new competences (such as the ability to buy the appropriate pesticide for a particular pest and its safe application) and new meanings (such as organic agriculture and legal changes)), their connections and the relations with other practices.

From a practice perspective, it is a sensible policy to impose restrictions and demands for an activity as long as attention is paid to the ways in which these can contribute to changing the practice. Despite potential initial resistance, restrictions and demands may contribute to slowly changing these practices and to introducing new practices. However, without profound knowledge of the constitution of the practices that need change and the kinds of new practices that need to be created, the direction of change that results from certain policy measures might be difficult to predict: will a farmer start searching for new ways to pest management like IPM; will a farmer reduce his reliance on pesticide as the only option against pests; will the introduced biological agents, low or nontoxic insecticide (i.e. spinosad, indoxacarb, metarhizium), netting technology (eco-friendly nets) create sustainable practices or practices that are not based on the best available scientific knowledge and that again may be difficult to alter in the future. Controlled experiments with the application of certain policy options in actual practices may be a strategy to acquire the knowledge needed to effectively promote sustainable pesticide use through such incremental change.

Promoting sustainable pesticides' practices among smallholder vegetable farmers means reconsidering how they buy and use pesticides and transforming them to create a safe environment at shop/home and at the farm. Transitions in farming systems have been identified to occur as a result of changes in policy, technology, markets and environment (Grin, 2010). In line with this, we argue that sustainable pesticides use can be achieved best by focusing on the promotion of constant incremental change in buying and using practices. The accumulation of incremental changes provides an opportunity for wider transformations. This leads to three recommendations for improving environmental safety and agricultural sustainability. First, the elements and their linkages in buying and using practices need to be identified in order to find the potential areas for intervention. Second, based on this information, policies should be designed in such a manner that access to new systems of provision and lifestyles is facilitated and new connections between these components are being created and reinforced while old ones are weakened. Third, as performance is central in the creation of best practices for buying and using pesticides, socio-technical innovations in the form of different kinds of performance, also by involving new actors, should be encouraged.

Chapter 5

Pesticide governance through private environmental and social standards in the global cut flower chain from Ethiopia[7]

[7] This paper has been revised and resubmitted based on three positive reviews to *Ambio, A Journal of the Human Environment* as: **Belay T. Mengistie**, Arthur P.J. Mol, Peter Oosterveer. Pesticide Governance Through Private Environmental and Social Standards in the Global Cut Flower Chain from Ethiopia.

Abstract

The international cut flower industry is highly criticized because of its environmental impacts and unsafe working conditions. Certification of cut flowers is increasingly used to improve the growers' environmental and social performance. But what is the impact of this private governance instrument in regulating pesticide use? This paper assesses the potential of private certification on governing the environmental and social problems of pesticides use along the global flower supply chain. We use detailed farm-level data to analyse the environmental and social impacts of flower certification in Ethiopia by comparing different national and international certification schemes. Our analysis does not show significant differences between these different private standards for most environmental and health and safety variables. The Ethiopian cut flower industry remains far from improving its sustainability through private certification. But certification schemes do allow farms to have access to international markets and keep up their reputation.

Key words: Pesticide, Ethiopia, Cut flower, Private certification.

5.1 Introduction

The global cut flower commodity has grown consistently since the early 1980s especially in developing countries. The global demand for cut flowers is still growing. In 2013, global exports of cut flowers, cut foliage, living plants and flower bulbs mounted to USD 20.6 billion as against USD 21.1 billion in 2011 and nearly USD 8.5 billion in 2001 (Reynolds, 2012). Following regional trade patterns, Africa is the major supplier for European market while Latin America ships largely to North America. Although the Netherlands is the historic center of flower cultivation, production has shifted over recent decades and is now concentrated in Africa, particularly Kenya and Ethiopia (Riisgaard, 2009; Rikken, 2011).

The floriculture sector is booming in Ethiopia making the country the second largest flower exporter in Africa and the fourth largest supplier of flowers globally. The expansion of floriculture in Ethiopia over the last ten years has been remarkable. It was only in 1997 that the first private floriculture farms, Meskel Flower and Ethio-Flora, started their activities on a few hectares of land. By 2007, the number of companies involved in flower production and exporting reached 67 (Mano & Suzuki, 2011). Today there are around 84 companies growing cut flowers, mostly roses followed by summer flowers and cuttings. Out of these 52 are funded through foreign direct investment (FDI), while 26 are local companies and 6 are joint ventures (EHPEA, 2015). The rapid growth of floriculture in Ethiopia is due to the country's favourable climate and natural resources, wide support from the government and abundant availability of labour. The floriculture industry occupies about 2000 hectares of greenhouses and open fields. Cut flowers have become the country's second largest source of foreign exchange in agriculture (next to coffee). The value increased from USD 660,000 in 2001 to USD 211.89 million in 2012/13. In 2013, the sector generated earnings of about USD 265.7 million and is expected to reach $550 million USD by the end of 2016 (The Reporter, 2014;EHPEA, 2016). For Ethiopian flowers, the EU is the main export destination. Currently, more than 70 percent of Ethiopia's floriculture produce goes to the Dutch market and from there the flowers are re-exported to other EU countries. Other markets are Germany, Britain, Russia and, the Middle East (Getu, 2009; EHPEA, 2015). The sector provides employment for 180,000 workers, of whom about 80 percent is female (Mano & Suzuki, 2011).

At the same time the environmental and social impacts of the Ethiopian flower industry are also growing. There is increasing evidence that the economic benefits of the flower industry come at the expense of farmworkers' health and the environment (Sisay, 2007; Tilahun, 2013; Getu, 2009; Tamirat, 2011). Flower growers are among the heaviest users of agrochemicals, starting before seed germination and continuing after harvesting. For instance, the Ethiopian rose cultivators use more than 212 different pesticides with different active ingredients (Sahle & Potting, 2013). The intensive use of pesticides is deteriorating the health and safety of the workers and a large proportion of these pesticides ends up in other destinations than their target via drift, volatilization, leaching and run-off (WRI, 2016; Damalas & Eleftherohorinos, 2011; Rao et al., 2005; Tenenbaum, 2002; Kargbo, 2010; Donohoe, 2008).

Besides, most cut flowers are grown in the south (Colombia, Ecuador, Ethiopia, Kenya, Uganda, Zambia, Zimbabwe) with limited environmental laws and state have not been successful in enforcing policies on restricting pesticide distribution and use (PAN UK, 2008; Mengistie et al., 2015b, 2016; Stadlinger et al., 2013). There is a need to convey the message that prevention of adverse environmental and health risks and promotion of sustainability and profitable investments for growers and workers as a support to a sustainable development of the flower sector.

The cut flower industry is not properly regulated by the Ethiopian government. There is (i) a lack of specific laws to regulate the sector, (ii) a lack of commitment to enforce relevant laws, while (iii) the government provides long-term credit on very generous terms (Getu, 2009; Gebreeyesus & Iizuka, 2010). In general, the government's desire to attract foreign direct investment is manifested in deregulation of the sector. In importing countries, the flower sector is also weakly regulated because flowers are not edible (Tenenbaum, 2002; Kargbo, 2010; Donohoe, 2008)). Even at the international level regulatory standards are generally weak. This failure of public governance institutions to keep pace with economic development has created a "governance deficit."

In response to these problems, different private standards have been developed by business coalitions and NGOs (Riisgaard, 2008; Raynolds, 2012). The majority of these initiatives have been developed in Europe, but recently exporting countries, such as Kenya, Ethiopia, Uganda and others have also developed their own standards. Overall, at least 20 different social and environmental standards exist in the cut flower industry (Ponte, Gibbon & Riisgaard, 2011). Examples of these standards are the Horticulture Producers Exporters Association (EHPEA) code of practice (at three levels: Bronze, Silver and Gold), MPS-ABC, MPS-SQ, MPS-GAP, Fairtrade, Ethical Trading Initiative (ETI), Fair Flower Fair Plants (FFP) and Global-GAP (BTC, 2010; Raynolds, 2012). In this context, it is common for Ethiopian flower growers to hold two or more certificates.

Several studies have been conducted on the Ethiopian floriculture industry (Joosten, 2007; Belwal & Chala, 2008; Gebreeyesus & Iizuka, 2010; BTC, 2010; Mano & Suzuki, 2011). However, little attention has been paid to the existence of multiple sustainability standards and to raise the question whether these standards have a positive impact on the environment and the workers' health and safety in the Ethiopian cut flower industry. Hence, we will analyse (i) whether differences exist between growers complying with advanced standards and those only complying with the minimum standard required for export with respect to the environment and to workers' health and safety; (ii) what the contribution is from private standards to the improvement of the environment and the working conditions.

This article begins with outlining a conceptual framework of private certification in global supply chains and then explains the research methods. Then we assess the potential impact of certification on fostering sustainable production practices and on strengthening workers' well-being and reducing the risks and impacts of pesticide use environment.

5.2 Private certification as global pesticide governance instrument

Global supply chain analysis provides both conceptual and methodological tools for understanding the dynamics of economic globalisation and international trade (Gereffi, 1999; Gereffi et al., 2005; Trienekens, 2011). The globalization of trade and the decline in government regulatory capacity have fuelled the rise of private, non-state-mandated and transnational governance arrangements (Raynolds, 2012). Currently, producing for international markets requires meeting certain quality standards. Agricultural products are faced with more strict rules on residues and pest management than in the past. Many of these standards are private, non-state-mandated and transnational as a consequence of the globalization of trade and the decline in government regulatory capacity (Ponte & Riisgaard, 2011; Raynolds, 2012). Private governance arrangements may take many forms: NGO-initiated standards governing a vast array of environmental, labour, product safety and other issues; codes of conduct promulgated by corporations, industry associations, and non-governmental organizations (NGOs); and even self-regulation by corporations under the banner of corporate social responsibility (CSR) (Gereffi et al., 2005; Humphrey & Schmitz, 2001).

This study mainly focuses on the use of certification schemes as a non-state regulatory mechanism. Certification is a procedure by which an independent third party provides assurance that a product, process or service is in conformity with the standards. The most credible and successful certification schemes are developed by NGOs that establish production criteria, oversee compliance, and award product labels. Multi-stakeholder initiatives engage NGOs, businesses, civil-society groups, and consumers.

Global supply chain analysis helps us to understand how pesticide governance through certification takes place. This perspective underlines that the introduction of environmental and social standards in the international flower supply chain, which is a buyer-driven global value chain, should be seen as complementing the wider shift downstream in the power balance. Growing consumer concerns create a more demanding regulatory setting for importer/exporters, wholesalers and retailers and oblige growers to manage their practices more precisely, to avert negative publicity and to have their products shown to be different. Social and environmental standards are a prominent governance strategy for global buyers who seek to reduce risk (Riisgaard, 2008, 2011).

Standards set entry barriers for newcomers in the supply chain, and create challenges to existing developing country suppliers (e.g. on safety/working conditions, pesticide residues and toxins). Standards also provide the opportunity for selected suppliers to add value, integrate new functions, improve their products, and even spur new or enhanced forms of cooperation among the actors in the industry (Gibbon & Ponte, 2005; Tanner 2000).

5.3 Research methods

This study on the impact of private certification on the environmental and labour performance of the floriculture sector in Ethiopia takes flower farms as its main object of research. Currently, 84 flower farms operate in different agro-ecological zones in Ethiopia. Of these, 29 farms were selected on the basis of several criteria, including the distribution among different geographical regions/clusters, the country of origin of the owner, accessibility of data, membership and consultation of EHPEA[8] and certification status of growers. In-depth interviews were conducted at 29 farms in five regions i.e., *Ziway, Koka, DebreZeit, Sebeta and Holleta*.

An important assumption in this research is that farms that comply with more standards are more likely to perform better than farms certified with the minimal standard only. To evaluate environmental and social performances, farms were therefore categorized in two groups. The first group consists of farms with only EHPEA bronze level certification (a minimum requirement in Ethiopia to allow exporting), farms in the process of auditing for this bronze level certification and farms with only bronze and a single international certification (MPS) (a de facto minimum requirement for the floricultural sector in the EU). Accordingly, 19 farms were included in this category. The second category consists of farms who have EHPEA silver or gold (higher requirements) and/or double and more international certifications (GlobalGAP, MPS, ETI, FFP or FT). Silver and Gold levels contain higher requirements for social and environmental performance compared with bronze and equate with various international labels for the sector. Accordingly, 10 farms were included in this category (see Table 5.1 for details). The names of the farms are not included in order to respect their request for anonymity.

[8]The Horticulture Producer Exporter Association (EHPEA), was established in 2002 to promote the expansion of the horticulture sector as well as to address workers' health and safety and environmental sustainability in the sector. About 90% of the producers are member of the EHPEA.

Table 5.1 Detail of sample flower growers

Number of farm	Nationality	production area (ha)	Size work force	# Sprayers	Export destination	Certification
Farm 1	Dutch	22	600	30	Netherlands, Japan	Silver, GAP,MPS A, SQ, FFP,ETI
Farm 2	Ethiopian	12	400	16	Netherlands, UK, Germany , Middle East	Silver, MPS A, MPS SQ
Farm 3	Ethiopian	15	340	15	Netherlands	Silver, MPS A, SQ, GAP, ETI,
Farm 4	Belgium	14		22	Europe, USA, Asia	Silver, on process for GAP
Farm 5	Dutch	37	1150	48	Netherlands, America, Japan	Silver, GAP, MPS A, SQ, FT, FFP
Farm 6	Ethiopian	15	420	22	Netherlands, Middle East	Silver, MPS A, MPS SQ
Farm 7	Dutch	25	500	20	Netherlands	Silver, MPS SQ , MPS ABC
Farm 8	Dutch	325	10000	250	Netherlands	Gold, FFP,FT, ETI, Global GAP, MPS A, MPS SQ,
Farm 9	German/Dutch	41	1827	40	Europe and USA	Gold, Global GAP, FT ETI, MPS A, MPS SQ
Farm 10	Dutch	14.5	800	30	Europe	Gold, MPS A , MPS SQ
Farm 11	Dutch	12	200	21	Netherlands	Bronze, MPS A, MPS SQ, GAP
Farm 12	Indian			-	Middle East	Bronze
Farm 13	Russian	10	260	13	Middle east and Russia	In process
Farm 14	Israel	70	1400	40	UK, France, Germany, Norway	Bronze, Global GAP
Farm 15	Dutch	40	1200	62	Netherlands	Bronze, MPS A, MPS SQ
Farm 16	Indian			-	Middle East	Bronze
Farm 17	Ethiopian	10	340	18	Netherlands	Bronze, MPS A, MPS SQ
Farm 18	Ethiopian	18	450	26	Netherlands, German	Bronze, MPS A, SQ, Fairtrade
Farm 19	Dutch	15	474	22	Netherlands, Germany, Middle East, Russia	Bronze
Farm 20	Ethiopian	12	300	19	Netherlands	Bronze
Farm 21	Indian	-		-	Middle East	Bronze, MPS A,
Farm 22	Belgium	15.6	278	13	Belgium, Netherlands , South Africa	In process
Farm 23	Multinational	18	700	40	Europe	Bronze, Global GAP
Farm 24	Israel	14.6	270	14	Netherlands, Dubai	Bronze, MPS A
Farm 25	Joint venture	20	350	7	Netherlands	Bronze
Farm 26	France	9.2	220	12	France, Rome Middle East & South Africa	In process
Farm 27	Ethiopian	15	260	13	Netherlands, Middle East and German	Bronze, MPS A.
Farm 28	Indian			-	Middle East, Europe	Bronze, MPS A, MPS SQ
Farm 29	Indian			-	Middle East	Bronze
Note:	Farms 12,16, 21 28 and 29 have 950 workers, 40 ha and 22 sprayers together. Handover to ANSA Group during fieldwork.					

Source: Field survey, 2015; Ethiopian Horticulture Development Agency, 2012 and MPS database/ websites, 2015

The study combined qualitative and quantitative research methods. Data were collected using structured and semi-structured questionnaires adapted from an audit check sheet, as well as interviews with key informants and personal observations between August and December 2015. To examine the impact of certification on environmental aspects of pesticide use, 29 farm/production managers were asked about registration, selection and types of pesticide, strategies with regard to minimize pesticides use (implementation of

IMP), obsolete pesticides, empty containers, solid and liquid waste disposal, audit/certification status, distribution channels and experience of rejection due to certification or pesticide residues. Survey Interviews were also carried out with 180 randomly selected pesticide sprayers (from a total of 835) to examine the impact of certification on occupational health and safety with respect to quality and availably of protective gears, (im)proper use, training on safety, medical check-up (cholinesterase test), labour union, and experience with accidents in relation with pesticides application. Besides, interviews were carried out with 32 randomly selected pack-house workers and 30 harvesters to investigate re-entry intervals, accidents in relation with pesticides and the availability of protective gears. Interviews were also carried out with buyers in the Netherlands (3 wholesalers, 1 from the auction Flora Holland, 3 supermarkets, 18 florists and 48 consumers) to examine the influence of certification and labeling along the supply chain. And finally, Key informant interviews were held with EHPEA (4), MoA (1), and EHDA (1) to examine their interactions with flower growers in supporting, regulating and monitoring the sector. Observations were used to enhance information for instance on the quality of the spray suite, the pesticide storage and the condition of inclinators.

The data were subjected to both qualitative and quantitative analysis**.** The raw data were coded, entered and analysed using Chi-square and Fisher’s exact test in SPSS (version 20) to determine significant differences or similarities between two categories of farms.

5.4 Environmental and social standards and certifications in floriculture

Producer associations in developing countries are increasingly active in introducing standards and codes of practice (Joosten, 2007; BTC, 2010). In 2007, the EHPEA developed the EHPEA Code of Practice (EHPEA CoP). This is a voluntary standard developed to guide, monitor and communicate the social and environmental performance of flower farms engaged in export production. The code sets requirements for good agricultural practices, protection of the environment, worker welfare and employment practices at three levels: Bronze, Silver and Gold. The Bronze level certification includes basic legal requirements and key issues for the market and local stakeholders, while the Silver level certification is broadly similar to Global GAP for flowers and ornamentals and contains social components equivalent to the Good Social Compliance of the ETI standard and to MPS SQ. The EHPEA Gold level certification requires a farm to be active in the implementation of corporate social responsibility (CSR), product quality management and capacity building for the sector.

Table 5.2 Sustainability standards in the interviewed cut flower farms (n=29)

Certifications	**Full specification**	No of certified growers included
EHPEA CoP	Growers/suppliers Code of practices in standards (bronze, silver & gold level), certified by independent external audits	Bronze (16), Silver (7) Gold (3)
MPS ABC	Environmental certification: reduction of pesticide, water, fertilizer, waste and energy use	*17*
MPS SQ	Socially Qualified certification: occupational health and safety aspects	*15*
Global GAP	Good agricultural practices with a small section on workers' health, safety and welfare	*7*
Ethical Trade Initiative (ETI)	Labour /promoting respect for workers' rights	*4*
Fairtrade	Fairtrade flower: mainly occupational health and safety standards and small section on environmental issues	*3*
Fair Flower Fair plants (FFP)	Contain ecological and social certification scheme of floriculture	*3*

Field Survey, 2015

EHPEA-CoP is adopted by 90% of the sampled farms (see Table 5.2), with the majority having adopted the Bronze level. The international standards that are adopted most are MPS ABC and MPS SQ, which are adopted by 65% and 52% of all farms respectively. The survey also shows that certifications are more adopted by farms that are foreign-owned, larger sized, involved in direct-sales channels than by those that are nationally-owned, new, small-sized, and involved in auction sale (Table 5.1). Of all foreign-owned farms (fully or joint venture), 34% were Dutch-owned, 22% Indian and 12% Israeli (EHPEA, 2015). During the period of the survey, about 62% of the growers exported to the EU through auctions (mainly Dutch) combined with direct sales to supermarkets and retailers, while 21% used only auction and the remaining 17% was exported to the Middle East (mainly from Indian-owned farms). Ninety-two percent of all farms perceived certification a requirement from European supermarkets (especially for direct sale). However, participation in a certification scheme is not mandatory for supplying products to the auction. Certified growers differ in terms of their destination. For instance, many Indian and Russian growers in *Holleta* cluster selling directly to the Middle East doubted the added value of certification and were not ready to pay the additional expenses. According to the respondents compliance with the standard costs about 100,000-150,000 Ethiopian *Birr* (about USD 5,000). Compliance did, however, not only provide a 'gateway' to the larger markets, but also improved human and material resource management (87% of the farms), environmental performance (73%) and workers' safety (68%).

Photo 5.1 Certification of flowers posted at wall of one of the sample farms and a poster displaying farms commitment to certifications at the entrance of one of the sample farms
(Photo by Belay Mengistie (right) and by Suzan van der Schenk (left))

5.5 Results and discussions

5.5.1 Assessing the impact of certification on improved environmental safety of pesticide use

Cut flowers are among the commodities most sensitive to diseases and pests (Eshetu et al., 2009). According to the survey, spider mites, aphids, trips, powdery mildew, downy mildew, botrytis, nematodes, mealy bugs, and caterpillars are the most common ones. To control these pests and diseases, pesticides (insecticides, fungicides, nematicides, herbicides, growth regulators) have played a major role and their use has increased. According to PAN UK (2007) Tamiru (2007) Vieira and Abarca (2009) Tilahun (2013) PPC/EIAR (2011) and MoA (2014) between 2007-2014 flower farms in Ethiopia have imported 96 types of insecticides and nematicides and 105 types of fungicides; of these, 37 were not officially registered in Ethiopia. For the roses alone, more than 212 types of pesticides with different active ingredients were used (Joosten, 2007; Sahle & Potting, 2013). For most growers pesticides rank 2nd on their list of expenditures, after the international (air)transport costs. To assess the environmental impact of strict regulation through certification a set of variables was applied (see Table 5.3).

Table 5.3 The impact of certifications on selected environmental aspects of pesticides (n=29)

Environmental variable	**Response category**	**Bronze certified growers**	**Silver/gold & MPS ABC, GAP, certified growers**	**P-Value - Fisher's exact test**
Legal/registration status of pesticide	both registered & unregistered/ untested	19	10	1.000
	Only registered	0	0	
Types of pesticide currently used	class II	19	10	N.A: due to double response
	class III and above	19	10	
Strategies of alternative pest management	IPM	0	3	0.032*
	Only chemical pesticides	19	7	
Interval of pesticide application	Every three day	11	5	Not fit for Fisher exact test
	Every week	8	6	
	Spraying is only carried out when justified/ depending on scouting	14	10	
Does the farm have obsolete pesticides?	Yes	15	8	0.407
	No	4	2	
Conducted EIA before starting farm operation	Yes	0	0	1.000
	No	19	10	
Have a policy on environment, waste disposal, risk assessment	Yes	16	10	0.265
	No, but we have plans to do so	3	0	
Pesticide store inspection	Yes	3	3	0.159
	No	16	7	
Audit procedure	Announced	19	10	1.000
	Unannounced	0	0	

**P values < α =0.05, is significant*

According to the pesticide registration and control proclamation (PRCP) No 674/2010 all pesticides that are to be introduced for use in Ethiopia must undergo the necessary registration procedures that are implemented under the plant health regulatory directorate (PHRD) of the MoA. However, the Ethiopian government made an interim arrangement allowing flower growers to import unregistered pesticides which they considered essential for their farms. As a result, flower growers have been importing many different kinds of pesticides for routinized use. The pesticide market depends heavily on pesticides imported by growers and/or agents representing flower companies such as Agri Sher, Greenlife and HortiCop. Comparing Bronze-certified growers with growers certified at higher-level standards we do not observe significant differences in the registration process, nor in the type of active ingredients used.

Both categories reported the use of pesticides that the WHO classifies as Class II (highly toxic) and III (moderately toxic). Although none of growers reported the use of Class I-pesticides, some growers nevertheless still use WHO class I active ingredients such as Dichloruos 1000G/L, Dichloruos 1000G/L, Cadusafos 100 G/L. Besides, some pesticide that entered for the flower industry are found on the WHO negative pesticide list (prohibited/unknown on the European Union Pesticide Database (EUPDB, 2015) (Table 5.4; see annex V).

Table 5.4 Some imported pesticides not approved for use in the EU (import data for flower, 2014)

Trade name	Active ingredients	Environmental fate	Human health issue	WHO Class
Evisect	Thiocyclam Hydrogen Oxalte 50%	High	Skin and eye irritant	II
Ace	Acephate SP 25%	High	Endocrine disrupter, Cholinesterase inhibitor, Neurotoxicant	II
Dexon	Fenaminosulf SP 45%	High	N/A	II
Orthene	Acephate SP 70 G/KG	High	Endocrine disrupter, Cholinesterase inhibitor, Neurotoxicant	II
Rugby	Cadusafos 100 G/L	Moderate	Cholinesterase inhibitor	Ib
Orthene	Acephate170 GR/KG	High	Endocrine disrupter, Cholinesterase inhibitor, Neurotoxicant	II
Divipan	Dichloruos 1000G/L	High	Mutagen, Cholinesterase inhibitor, eurotoxicant, Skin and irritant	1b
Diazoll 60 EC	Diazinon 600GM/L	Moderate	Reproduction effects, Cholinesterase inhibitor, Neurotoxican, Respiratory tract irritant, skin irritant	II
Starchlor 100 EC	Dichloruos 1000G/L	High	Mutagen, Cholinesterase inhibitor, Neurotoxicant, Skin and eye irritant	1b
Evisect 5	Thiocyclam Hydrogen Oxalte 50%	High	Skin and irritant	II

The results show that farms certified with higher level standards significantly differ (p=0.032) in applying good agricultural practices/IPM compared to those certified at lower levels. The farms applying IPM have a large number of pesticide sprayers compared to bronze level certified farms. Farmers not using IMP revealed that although IPM has a positive effect on controlling spider mite *(Tetranychus urticae)*, others pests are becoming a bigger problem, especially trips, aphids and mealy bugs. Most interviewed growers carried out *on-farm trials* to evaluate the efficacy of biological control in the local context. The progress differed per farm but predatory mites proved able to control spider mites. However, farmers rarely resort to this alternative because they fear the risks associated with possible outbreaks and rapid spread of other pests. Informants from MoA and EPA pointed at the shortage of well-qualified IPM experts, limited access to IPM inputs and difficulty/complexity of implementing IPM compared with conventional pesticides management as the main obstacles hindering IPM adoption. EHPEA reports its strong support to IPM and offers trainings for the flower industry.

Most growers stored pesticides in a separate room, but appropriate warning signs and indications of their class are often missing. One farm certified with silver and two other international standards stored pesticides, fertilizers and hoses together. Another problem are *obsolete pesticides.* Higher level certified firms did not differ significantly (P=0.407) from the bronze level certified growers in the accumulation of obsolete pesticides and reducing risks. 25 out of 29 farms have obsolete pesticides that can no longer be use for their intended purpose and therefore require disposal. These pesticides are improperly stored on several farms. For instance, 6 bronze certified and 2 silver certified farms stock records did not show clearly what products are 'Obsolete or Expired' and not being used (See figure 5.2). Most farms reported that ineffectiveness, leftovers, oversupply in previous years and lower pest incidence than expected resulted in obsolete pesticide stocks.

Photo 5.2 Obsolete pesticides tagged as expired/leftover on shelf
(Photo by Dereje Abomsa)

Another environmental concern in the flower industry is unsafe management of empty *pesticide containers*. Empty containers are usually burnt on the farm in an on-farm incinerator, often an old steel barrel. Both groups of higher and lower level certified farmers are burning empty pesticide containers together with damaged cloths used for spraying, cartons, boxes and plastics (Photo 5.3).

Photo 5.3 Unsafe empty pesticide containers(solid waste) management in flower farms
(Photos by Belay Mengistie)

During the survey we observed better environmental practices in three farms. Liquid pesticide waste mainly consists of effluent and wastewater from flushing driplines or cleaning spraying equipment and is diluted and disposed of in soak away pits, which does not prevent chemical residues entering the environment. Three certified growers (with bronze, silver and gold) in *Ziway* use a wetland wastewater treatment system. Although the effectiveness of a wetland is questioned by some growers, this is an example where growers certified with bronze resemble growers certified with higher standards.

Environmental impact assessment (EIA) is an important tool to mitigate environmental impacts and sustain the sector. None of the flower farms had performed an environmental impact assessment to reduce risks before starting their operation. Hence intensive and unsustainable use of water continues to be an important problem around all farms. For instance, in *Ziway* where large flower farms are concentrated and water from the lake is exploited, the supply of drinking water is no longer guaranteed. In 2009-2010, Alterra conducted a water quality study at three sites near a floriculture complex around Lake *Ziway*. They tested for 200 pesticides and found 30 with concentrations of 0.1 µg/l or higher, five of which are classified as high-risk pesticides (Jansen & Harmsen, 2011). While lower and higher level certified growers did not differ in having an environmental policy document, on environment, waste disposal, and risk assessment the latter category of firms did carry out significantly more frequently risk assessments. Similar water problems resulting from floriculture have been reported from Kenya. A case study of the Lake *Naivasha* region in Kenya identified the negative impacts from flower production due to worsening environmental conditions affecting fishing, local food security and community health from water pollution and over-abstraction (David, 2002; Bolo, 2007). A significant number of the foreign farms (Linsen, Abyssinia, Maranque, Karuturi, and Sher-Ethiopia) came from other African countries, including Kenya.

Last, unannounced audits by certifiers or visits from flower importers are expected to increase the level of compliance. However none of the farms received unannounced audits and when announced, the grower is informed, prior to the actual audit, which issues are considered most important and which documents need to be prepared. Besides, most growers pesticide store have never been inspected by the MOA or other state regulatory bodies for the past two years. In addition, the interaction/coordination between growers and relevant state environmental actors at local and national level seems to be non-existing.

5.5.2 Impact of certificates on improvements in workers' health and safety

Work on Ethiopian flower farms is divided in greenhouse, pack house, spraying and other work. Most activities are exclusively done by female workers between 18 and 25 years while jobs which demand muscular force are left to male workers (spraying, irrigation and maintenance). This study focuses on sprayers because here the influence of complying with private certification should be most noticeable (Table 5.5). Pesticides are applied every day both in greenhouses and in open fields. All pesticide sprayers are men with an average age of 32 years (range 18-46) and most (87%) had between 8-10 years of education. On average they had four years' experience of pesticides spraying (range 6 months-11 years).

No significant difference (χ^2 =3.012) was observed between the two categories of growers with respect to sprayer's knowledge of the EHPEA-CoP and their ability to read safety instructions. A discussion with sprayers showed that safety data sheets are accessible to workers but they are written in English or other languages like Dutch, Chinese and Kiswahili which are not familiar to the store man, the sprayer and other workers. However, there was a significant difference(χ^2 =15.088) the two categories of growers with respect to the training on pesticide use that sprayers received.

Personal protective equipment is provided in all farms except in farms 6 and 18 where workers use their own clothes and some old and torn gloves to protect themselves. Most sprayers were provided with spray suits (overalls) (71%), rubber boots (68%) respirators (62%), and impermeable gloves (57%). However, only 13% of the sprayers were provided with impermeable goggles. Some PPE items were rarely used since they hindered the speed in spraying (47%), were uncomfortable in the humid climate (53% or made it difficult to breathe properly. Seven bronze certified and four higher certified growers provided workers with cheap safety gears like polyester sheets to cover their body and disposable cotton masks that were not manufactured for pesticide spraying, with unknown protection effectivity. The majority of sprayers reported that their personal protective equipment was inappropriate for their work, with no significant difference (χ^2=2.023) between lower and higher level certified growers. Periodic monitoring and replacement of personal protective equipment was challenging for both groups of farms.

The survey also revealed the incidents and symptoms among the sprayers. All sprayers reported incidents of pesticide-related health symptoms including eye irritation, permanent sight reduction, skin irritation, headache, and abdominal pain after routine pesticides application. 28 year old informant stated that the flower is his source of life and cause of his death as sometimes his body is wet from chemicals' spraying. Another informant (33 year) told how his sight had been severely impaired. From our own observation, the smell in the greenhouse was a sign of the high levels of pesticides that workers were exposed to on a daily basis. All sprayers were offered 'compensation' in cash or kind (milk and soap), with no significant differences between the two groups of growers.

According to the standards a quarterly blood test for cholinesterase activity should be included in the medical check if organophosphate pesticides and/or carbamate insecticides are being used. Cholinesterase is an essential enzyme required for the proper function of nervous system (normal range: 5100-1700U/L). The large majority of the workers was provided with free medical care for occupational illnesses and injuries on site or in a city nearby, and no difference between the groups was found. However, the frequency of cholinesterase testing for sprayers differed significantly (χ^2 = 8.818) between the two categories of growers. The majority (83%) of the sprayers working on higher level certified farms reported that they were tested on a quarterly basis, while the majority of the workers (63%) working at lower certified farms reported these tests to be unscheduled. Although the results of cholinesterase tests were not accessible for all farms, we obtained 5,719 tested samples of sprayers' blood (between 2011-2014) from five farms that complied with multi safety (SQ) certification. About 10% of these samples were found to be out of the normal range (<5000U\L). Standards require sprayers to rotate their work when their cholinesterase level is out of the normal range but in practice this does not seem to happen at most farms in both categories of certification.

The majority (76%) of growers certified with higher standards had a health and safety officer on site as well as a joint workers and management health and safety committee. Even most lower certified farms had either one of these. This is one of the positive effects of certification. Nevertheless, their impact should not be overestimated as a health officer reported: *"farm owners are not comfortable when we write about real pesticide exposure".* An informant also added that as a member of health and safety committee she/he is *"experienced in signing minutes for the purpose of the audit without conducting actual meetings".*

Other workers exposed to pesticides are harvesters and pack house workers who are predominantly female. All interviewed workers reported that injuries from working with scissors, skin pain and fingers pricked by thorns are common as only 28% of the workers were provided with gloves. Some workers complained that their protective clothes were not suitable because they wore torn gloves made from cotton. Bunch makers in the pack house are often not provided with gloves since it is believed this affects the quality of the flowers. According to most safety standards this is unacceptable due to the persistent nature of some chemicals. Personal observations clearly learned that there is no big difference between farms with lower and those with higher level certification.

Standards in the cut flowers sector state that greenhouses should not be entered by other people when pesticides are being applied and that re-entry warning signals should be placed outside the sprayed areas. However, according to the interviewed harvesters and sprayers the official re-entry period is not applied on 42% of the farms, similar in both groups of farms . Harvesters complained that their supervisor asks them to enter a greenhouse when the chemical pesticides are still wet. We also observed harvesting going on in one side of a greenhouse while chemicals were being sprayed in another side. A manager in a silver certified farm reported that: "*On other farms they do not have good personal protective equipment: in fumigating they do not have boots, or masks and filters; in production they have no gloves. They go back in an hour after spraying. Here no one enters the greenhouses during fumigating, (…) and spraying is done in late evening. Some farms are exposing workers and the environment; they use pesticides on the red list. Here it is better because of the certifications".*

There is a significant difference (χ^2 =51.717) between the two categories in the provision of basic facilities (toilets, shower and canteen) for the workers. Canteens were absent in many farms complying with lower standards and this is a major health threat. On the other hand, first aid and warning signs ("water not for drinking" or "hazardous chemical") were easily spotted while walking in greenhouses of higher level certified farms.

Photo 5.4 Workers working without PPE and hanging their lunchbox at the metal poles of the entrance of greenhouse
(Photos by Belay Mengistie)

Social standards call for the formation of a workers' committee to negotiate with management. All growers reported to have a workers' union and 81% of the workers said they are member of such associations. These workers' unions function very differently; while some are virtually non-existent, a few others strive actively to change working conditions. Many workers from lower certified growers (72%) as well as from higher level certified farms (64%) were not satisfied with the effectiveness of the union. After putting a lot of effort in identifying problems at work (as required from workers' committee, gender committee, health and safety committee, HIV/AIDS committee among others), committee members feel discouraged when the management is not taking action. The leader of a workers' committee in one farm said it openly "*they push us so much for the audit…but after a while no one remembers it.*"

Table 5.5 The impact of certifications on selected health and safety issue of workers between two categories of growers, n=180

Variables		Single and/or double certified growers(Bronze level) n=74		Triple and/or more certified growers (Silver/gold and SQ, ETI, FT, FFP) n=106		
	response	%	N	%	N	χ^2test
Are you informed on the EHPEA Code of practice?	Yes	4	3	11	12	3.012
	No	96	71	89	94	
Did you receive training on the safe handling of pesticides?	Yes	55	41	82	87	15.088*
	No	45	33	18	19	
Can you read pesticide labels and safety information?	Yes	39	29	52	55	2.822
	No	61	45	48	51	
Is the personal protective equipment (PPE) adequate and appropriate?	Yes	34	25	44	47	2.023
	No	66	49	56	59	
Is PPE changed/replaced when necessary?	Yes	24	18	32	34	1.274
	No	76	56	68	72	
Is your cholinesterase level checked quarterly?	Yes	78	58	93	99	8.818*
	No	22	16	7	7	
Have there been incidents, such as feeling /sick after application (pesticide-related health symptoms?	Yes	88	65	92	98	1.085
	No	12	9	8	8	
Are there shifts in the applicator's position when the result of blood tests is out of normal range?	Yes	11	8	17	18	1.342
	No	89	66	83	88	
Is a re-entry period applied?	Yes	45	33	38	40	0.850
	No	55	41	62	66	
Are basic safety facilities (shower, toilet, eating) available?	Yes	39	29	90	95	51.717*
	No	61	45	10	11	
Are you satisfied with the labour /worker committee /union?	Yes	28	21	36	38	1.103
	No	72	53	64	68	

*significant at $p<0.05$, df. (2−1) × (2−1) = 1, Critical value =3.841

Another issue that relates to the adoption of certification especially Fairtrade and ETI is that growers are whether they paid respective of living wage. Wage is a crucial issue and vital for workers. However, the industry is paying the workers shockingly low wages *(See Zembla documentary, 2016).* All (100%) respondents are dissatisfied with their wage. The majority of workers earned between 18-30 ETB (approximately $0.9-$1.5) for an 8 hour working day and 468-780 ETB (approximately $24-$40) for 208 working hours during a month. Most workers found it difficult to meet their daily needs with their inadequate salary. One of the factors behind this problem may be the government's policy to attract foreign investors by pointing at cheap labour. The owners argued that there is no legal minimum wage in the country. Interestingly, some growers with higher level certifications provided a hospital to the community, and support schools. In Ethiopia there is no system for the certification and licensing of pesticide applicators. Being licenced would impact positively on their health and safety and salary. A certified (licensed) applicator may only be used to apply according to label directions and negotiate such matters as minimum wage and working conditions. Some growers from both categories developed mechanisms to allow workers to earn more, such as: allowances for transportation, no-absenteeism, a bonus for productivity and overtime at "pick seasons" such as during Valentine's Day, Christmas, and Mother's Day.

In sum, besides the aforementioned variables, other social issues like grievance, harassment, safety concerns about travelling home at night, sick leave, inappropriate punishment, dismissal, deductions from pay and related problems are repeatedly mentioned in both groups of farms. Nevertheless, key informants from EHPEA, EHDA, PHRD of MoA and most farm managers argued "*the entire Ethiopian flower sector has seen substantial improvements in safety conditions. When the industry started there were many problems with worker safety, with chemicals. The farms have improved a lot. Certifications have been essential in showing the way forward, showing what protective equipment is needed*". But a farm manager compliant with higher level standards mentioned that "*in spite of these improvements, even certified farms hurt human and environmental health*."

5.5.3 Buyer and consumer power in the cut flower supply chain

The cut flower industry is increasingly globalized. The Netherlands plays an important role in international flower trade, as the main importer (also from Ethiopia) and exporter to the different EU countries (Rabobank, 2015). Pesticide governance may therefore also be exercised through buyers' requirements and stringent standards because at the side of production governance is very weak. The Africa-Europe or Ethiopia-Netherlands cut flower value chain entails two distinctive modes connecting grower and consumer, whereby certification is relevant in a variety of ways (Figure 5.1).

Flora Holland is the largest flower auction in the world with around 5,000 members, 9,000 suppliers and 5,000 customers; 12 billion units of flower and plants traded per day in a day in-day out logistic puzzle connecting all parts of the world (FloraHolland, 2016). The auction is characterized by relatively loose trading relationships based on a market-based form of coordination between grower and buyer. The auction serves both as a market place and as a distribution hub through which cut flowers from the world including Ethiopia are distributed to wholesalers and supermarkets. Their main customers are wholesalers who typically focus on export. According to a key informant at Flora Holland, the world's largest flower auction, participation in any certification scheme is not a mandatory requirement for supplying flowers to the auction. Quality control inspectors make sure that flowers meet the standards of quality information such as freshness and maturity, variety, country of origin, quality type (damage and diseases), length and number of stems per bunch. Only a small number of the wholesalers who buy at the auction clock pass information about certification on to their customers. Nonetheless, most auction suppliers adhere to one or more standards, with MPS-ABC being by far the most popular standard. Hence, growers often consider obtaining MPS environmental certification a good way to enhance the farm's reputation.

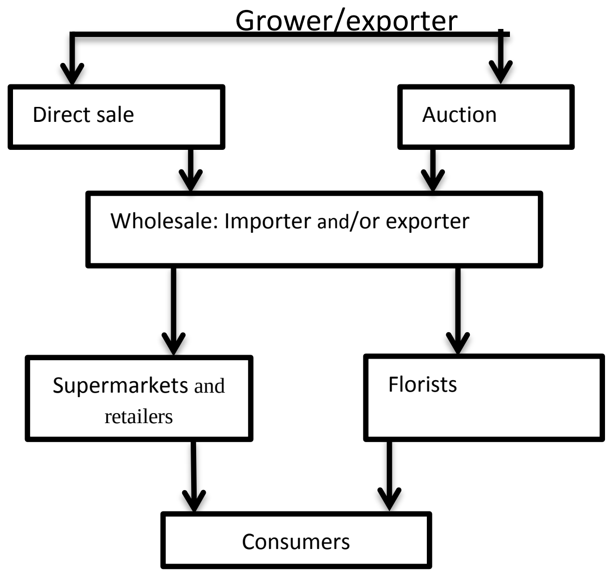


Figure 5.1 Different channels for flowers entering the EU market

Growers and buyers may also do business directly whereby wholesalers link the growers to retail (supermarkets and florists). Most wholesalers purchase flowers from certified and uncertified growers through agents (or also at auctions) in order to obtain the best flowers at the best prices. Some large wholesalers even import themselves following demand from large buyers and some even have their company certified. Social and environmental certificates have become a real license to export in the direct sales channel, especially through supermarkets. Flowers are controlled by the buyers and the chain is strongly buyer-driven, whereby wholesalers, supermarkets and retailers want to be seen as “responsible companies”. Interviewed Dutch wholesalers revealed that to be successful one should have “good certifications for good marketing”, whereby the wholesaler’s choice of certification depends on customer interest which is country specific. MPS is employed largely for the Dutch auction system, FLP cater mostly for the German flower market and ETI is for UK retailers. For Ethiopian growers supplying several markets this means fulfilling demands from several (2-7) different standards.

None of the wholesalers pays random visits to the farm or checks imported flowers for pesticide residues or active ingredients. Wholesalers rely on the certification report handed in by the supplier. Informants confirmed that an entire shipment can be rejected because of a single botrytis of fungus, but no grower experienced import rejection due to the presence of above-standard active ingredient residues.

The demand for social and environmental certification differs significantly between the florist channel and the supermarket channel. Florists dominate the distribution of flowers in most EU countries and they are supplied by wholesalers. However, social and environmental certification is less important in this segment. For example, 14 out of the 18 interviewed Dutch florists do not ask for certifications (see also BTC, 2010). Interviewed wholesalers confirmed that, although MPS certification is transferred through the auction system, they do not incorporate this information in their communication to customers and florists hardly ever ask for certification.

Much more than florists, supermarkets have an interest in standards and certification schemes. For example, in the Netherlands, the NGO Hivos and the supermarket company Albert Heijn are joining forces to create a socially and environmentally sustainable flower sector. Hivos and Albert Heijn are also founding members in the Floriculture Sustainability Initiative (FSI), an international platform for businesses, governments and CSOs working together to achieve a sustainable flower sector. According to the key informant the ambition of FSI is to have 90% of all flowers and pot plants internationally traded by its members sustainably produced by 2020 by prompting sustainability and transparency through involvement of all stakeholders. Supermarkets have a lot to lose in case of negative publicity about labour conditions and environmental impacts. This would not only affect their flower sales but may harm their entire business reputation. Supermarkets therefore, use consumer labels to differentiate themselves from others and to make their efforts visible. Supermarkets are believed by our interviewees to have more leverage to enforce standards than the auction but even they do not inspect suppliers on actually meeting the social and environmental requirements.

In Dutch supermarkets, such as Albert Heijn, Lidl and Jumbo, consumer sustainability labels are printed on the flower sleeve. However, most environmental and social standards in the flower sector are not communicated to the consumers as standards like MPS-ABC, GlobalGAP and ETI are only used in the business-to-business environment. Florists and supermarkets found that public awareness on the sustainability impact of flowers is limited and so the willingness of Dutch consumers to pay higher prices for labelled flowers is relatively low. For example, the large majority of the interviewed 48 Dutch consumers had no idea what Fairtrade certified flowers are, where the flowers come from and how they are produced. Many responded that *"flowers is a luxury product, it is not food so why worry about all these issues".*

5.6 Conclusion

This article presents the results of a study on the impact from certification on the safe use of pesticides on the environment and workers health and safety in Ethiopia's cut flower industry. These findings show that flower certifications and labels have limited effects on workers' health and safety conditions and on the environment. No significance difference could be found between farms certified with lower level standards compared with higher level standards with respect to the use of registered pesticides, their toxicity level (mostly class II), unsafe re-entry period, accumulation of obsolete pesticides, unsafe solid and liquid waste disposal, burning of empty containers with old barrel on farm, lack of proper protective equipment's and exposure to chemicals (feeling sick after pesticide application). Positive impacts were found on some aspects of workers' rights (reduction in working hours, formation of labour unions, provision of medical services) and support to the surrounding community. Although only on three of the 29 farms, IPM practice can be identified as a positive impact from certification. Also the administration and documentation on farms have greatly improved. The adoption of certifications plays a positive role in promoting the image of the flower farms and acts as reputation insurance. Farms that have adopted more strict certifications have a better and professional outlook than farms without them. Most growers participated in certification schemes to comply with international buyer requirements and ensure access to international markets (i.e. certification fulfils its role as a market tool).

Private governance mechanisms such as certification schemes or standards are designed to address concerns among supply chain actors, mainly consumers, and to support failing state regulation at the sites of production. In such arrangements producers are expected to comply with predetermined quality and safety indicators embedded in the standards. However, realizing these intentions for non-food commodities like flowers proves a challenge. Buyers have no solid evidence on the active ingredients and maximum residue level (MRL) that guarantees a positive impact on the environment and workers' health and safety. They can only rely on the reports from auditing organizations. Once an audit is completed, little is done up to the next audit, and this confines certification to a one or two-day event per annum. In the EU, flower imports are not inspected for pesticide residues because they are not edible; on the other hand, since flowers are considered an agricultural product, they must be free from pests when imported. As a result, such trade regulations encourage over-spraying and the use of more toxic pesticides. In addition, cut flowers are produced by independent producers without ties with specific buyers so no buyer pays random visits to check whether a mismatch exists between the standard and the reality in the greenhouse. Physical tracing is being replaced by document tracing, so the consumer cannot be assured that his/her bunch of flowers is indeed produced in a sustainable way. Moreover, most certification schemes are foreign-controlled and lack the local ownership that is necessary for their success.

Another challenge is related to idea that private governance could fill the gaps left by (failing) state regulation. Most cut flowers are grown in the South where environmental legislation is limited and/or enforcement lax, allowing growers to apply a wide range of highly or extremely hazardous and toxic pesticides. Our study on Ethiopia proved that private governance is not able to assist the authorities in regulating the use of hazardous, toxic and even banned pesticides.

Scholars such as Buthe, (2010), Gereffi & Mayer (2010), Ponte (2008) and Riisgaard (2011) argue that successful private governance through certification has two options. One option is to focus on 'stronger public regulation in developing countries (to) reinforce rather than replace private governance, and promote multi-stakeholder initiatives involving both public and private actors'. A second option is to build on effective societal pressure, which depends on collective action. Growers are aware that their market may get smaller unless they are committed to adopt certifications and improve the environment and working conditions. Therefore, new patterns of consumption, media pressure, and campaigns by NGOs could push consumer interest in the conditions under which their flowers are produced. The assumption from this research is that the ultimate driver of private governance is some form of external social pressure.

We conclude that certification has emerged as a private governance mechanism in the cut flower industry. However, certifications and labels alone are not a viable option and do not always effectively improve the workers safety conditions and environmental impacts at the production site. Hence, assessing other options is fundamental to more achieve more impacts. Our findings suggest that establishing impacts beyond certification requires coordination among all players in the supply chain. This can only be achieved *through* transparency and traceability in the entire supply chain (Trienekens et al., 2012; Mol & Oosterveer, 2015; Bush et al., 2015; Mol, 2015). Arguably, in this case, establishment of private transnational governance (PTG) institutions (Pattberg, 2004) may lead to possibly interesting effects. A PTG institution is a self-coordinated network of two or more private actors operating in more than one country (involving the non-profit and/or the profit sector), engaged in the establishment, implementation and monitoring of voluntary rules (codes of conduct, management standards or labels) directed towards a specific issue area. It is the producer, consumer, trader and retailer together who legitimise a certain rule-making system. There is therefore room for the introduction of regulatory instruments (an international platform) for businesses, and other stakeholders in a collaborative manner among flowers producers in the developing countries to achieve a sustainable flower sector.

Chapter 6

Conclusion

6.1 Introduction

Pesticides are intensively used in agriculture across the globe. In this process, improper pesticide distribution and use has become more serious, which has resulted in heavy environmental and human health risks in many parts of the world. This holds especially true for developing countries, including Ethiopia where good agricultural practices are often poorly implemented. To safeguard human health and the environment, a strict regulatory policy is essential. In line with this, Ethiopia has developed pesticide registration and control procedures, which are regulations and directives in which the country also included different international agreements related to pesticides. Therefore, the overall policy with respect to pesticide registration, distribution and use plays a key role in improving the environment, the health of growers and the surrounding community and stimulates the economic performance of the Ethiopian agricultural sector. However, there was no clear answer to the question whether the policy on pesticide registration, distribution and use was implemented in an effective and sustainable way. The aim of this thesis is to investigate the pesticide policy-and-practice nexus, which includes the roles of governmental actors, traders and farmers, and to review the actual and potential contribution from various governance actors in changing the existing (unsafe) pesticide practices. To reach this aim, four research questions were formulated in chapter 1, and these have been addressed in the empirical chapters 2 to 5. The following sections present the fruits of the research and relate them to the existing literature. The research questions are answered in section 6.2. In section 6.3, I reflect on the usefulness and shortcomings of the four theoretical perspectives applied in this research. Section 6.4 discusses the roles and contributions of non-state actors in the governance of pesticides. Sections 6.5 and 6.6 present policy implications and possibilities for further research, respectively.

6.2 Answering the research questions

This thesis addressed the following research questions:

(i) What are the main challenges (barriers) to effective state enforcement of existing pesticide policy in Ethiopia?

(ii) How, why and under what circumstances can private actors contribute to addressing problems and offering solutions across the pesticide supply chain?

(iii) In what ways have pesticide selection and use practices among smallholder vegetable farmers been influenced by their lifestyles and the systems of provision?

(iv) How and to what extent do private certification standards govern the environmental and social dimensions of pesticide use practices along the global flower supply chain?

6.2.1 Challenges for effective policy implementation: What policy says and practice does

In evaluating how, why and under what conditions pesticide policy implementation might work or fail, chapter 2 analyzed key challenges affecting implementation of pesticide policy. As discussed in chapter 2, Ethiopia has developed regulatory legislation on the registration and control of pesticides to address their environmental and health effects. Based on the Contextual Interaction Theory (CIT), the output of pesticide policy was assessed in terms of state actors' characteristics (access to information, motivations, resource availability) and their interaction to determine what happens after a policy is enacted, including whether and to what extent it is implemented. This thesis identified barriers to implementation and the results point towards low information, motivation and resources of state actors (implementers). *Information* provision about the policy, and the reasons why the state has adopted it, is crucial to obtain support for policy implementation. However, all extension workers and retailers at the district level indicated they are remain unfamiliar with the proclamations of pesticide registration and control. Moreover, lack of *motivation* is manifested by inadequate support from federal and regional state actors, such as inadequate training, lack of a clear career structure, and workload due to a shortage of extension workers compared to the number of farmers. Aside from information and motivation of the state actors, their *resources* determine the degree of implementation. This thesis indicates that resources such as financial, material, and human input are a core variable in explaining policy implementation because they determine, for example, who is actually empowered to implement the policy or to avoid its implementation.

The overall result of this study has shown the widening distance between stated pesticide policy objectives and the actual performance of the policy. Evidence from chapters 2, 3 and 4 shows that pesticide actors (state, dealers and growers) are not carrying out tasks on registration, distribution and use in conformity with the pesticide proclamation (No. 674/2010). Pesticide registration is an important step in the governance of pesticides, as it enables authorities to determine which pesticide products are permitted to be used and for what purposes. However, the findings revealed that the present national pesticide registration system is not supported by experimental laboratory tests. Double/triple registration of pesticides with the same active ingredient (ai) under different commercial names is also a major problem. Similarly, it was noticed that dossier evaluation is severely limited by a shortage of qualified experts (toxicologists, environmental scientists). The present registration process is carried out through the assessment of data provided by the registrant (importers) without independent, in-depth assessment and control over active ingredients. Lack of laboratories for pesticide quality analysis hinders the quality control of pesticides as well as pesticide exposure assessments for store keepers, traders, transporters and farmers to monitor pesticides and their residues in key export crops.

With respect to distribution and use, the lack of enforcement of pesticide policy has resulted in improper trading and use of pesticides (chapter 3). The monitoring of pesticides (still) receives much less attention, and the regulatory body has no information regarding products once they are registered. While some importers follow the requirements of the policy, most retailers are not complying with national pesticide legislation on the registration and sale of their products (chapters 2, 3 and 4). For instance, according to the pesticide policy, the powers of pesticide inspectors are clearly stated in article 30 (1), which gives power to carry out periodic inspection of import, pack, repack, label, store, sale, distribution or use, at working hours, without a warrant and upon presentation of his/her identity card, to carry out all responsibilities. However, evidence from this thesis (chapters 2 and 3) shows that there is no effective enforcement to regulate illegal retailing and that state pesticide inspectors are not carrying out their tasks in conformity with the power given in the proclamation. This study noted that retailers in pesticide shops have no agricultural background. Additionally, none of the retailers had a certificate of competence (CoC), and some retailers had no valid licenses at all to sell pesticides. Moreover, all retailers replied that their shops had never been inspected by the state inspectors from their district or from the federal state. Moreover, most vegetable farmers did not receive adequate technical assistance and information on safe pesticide handling, storage, and doses from state official extension services (chapters 2 and 3). The presence of unauthorized traders with incompetent personnel has resulted in a lack of information for end users. Hence, small scale vegetable farmers are not adequately advised on the use of pesticides, and they tend to use pesticides incorrectly, which threatens the health of the applicators and the environment. Moreover, most flower growers were never inspected to ensure that they were working according to environmental and workers' safety standards (chapters 2 and 5).

The study also revealed that policy implementation has suffered from the absence of coordination among pesticide actors at local, regional and national levels and this has significantly hindered the implementation of these policies. For example, linkages between/among MoA, the Pesticide Advisory Board, the customs office and other relevant partners have not been institutionalized. Exchange of information among pesticide-relevant actors (policy makers, protection experts, researchers, extension workers, importers, retailer, farmers) is missing. In a nutshell, a number of barriers were identified in this study, ranging from a weak registration system at the national level to a lack of monitoring of pesticide distribution and use at the local level. Pesticide policy output is shaped by the existing challenges of pesticide governance through a lack of information, resources, motivation and interaction among actors, while the Contextual Interaction Theory calls for the availability of these inputs (context of policy actors) for the successful implementation of policy.

6.2.2 Contributions of private actors to sustainability in pesticide importation, distribution and use

Considering the state's failure in policy implementation (chapter 2), private governance beyond the state is being suggested as a prominent governance mechanism in addressing environmental problems, focusing on the roles and activities of private non-state actors (Pattberg, 2006 & 2010; Pattberg & Stripple, 2008; Mol, 2009, 2010). This thesis analyzed how, why and under what circumstances private actors could contribute to addressing problems and offering solutions across the pesticide supply chain. The supply chain approach supposes that understanding interactions between and/or among chain actors allows the discovery of potentials and bottlenecks within these levels and the dynamic interactions between them, and to identify points of intervention (Roduner, 2007; Van Wijk et al., 2009). Along these lines, the thesis focused on potential avenues of influence for private actors who are engaged in pesticides governance through three different mechanisms (managing products, information and services).

The overall findings revealed that uncoordinated pesticide trade resulted in unsustainable overall pesticide importation, distribution and use. The existing distribution and sale practices for pesticides in Ethiopia are conducted by trained as well as untrained suppliers/registrants and retailers with no proper permit/license. First, there is no quality control mechanism through laboratory testing of bulk materials at MoA and the customs level (chapter 1). With this gap, doubly/triply registered pesticides with the same active ingredient (ai) under different commercial names are being imported from different countries (mainly China) with inferior qualities and efficacies. Second, there is no tracking or tracing system on the distribution, sales and use of pesticides once they are imported or cleared from customs, and a number of retailers still remained uninspected (chapters 3 and 4). Inspection of pesticide trading places and storage facilities is not carried out regularly (chapter 2). These weaknesses may provide an opportunity for some corrupt pesticide traders to import pesticides illegally and for others to keep illegal or expired pesticides to sell in their shops. Pesticide retailers in Ethiopia did not have the necessary knowledge to safely handle pesticides or to advise farmers on their proper use. Licensed shop owners were rarely found in their shops; instead, untrained personnel were employed to sell pesticides. Third, pesticide usage by smallholder farmers is frequently accompanied by misuse (overdose, underdose) (chapter 4). The existing situation shows that the pesticide chain is characterized by “market relations” between suppliers and farmers and by efforts to generate (maximum) profit. Markets that provide farmers with information and products are often incomplete and inefficient. Finally, farmers (as end users) are forced to handle pesticide risks associated with resistance and misuse. Based on the findings of chapters 2 and 3, the poor capacity of the state regulatory system encouraged importers and retailers to market aggressively, and some companies benefitted by distributing banned/expired pesticides, putting smallholder farmers in a disadvantageous position.

Undeniably, the roles played by private actors in pesticide governance up to this point have been very weak in Ethiopia. However, there is still substantial room to improve the potential contribution of private actors to sustainable pesticide importation, distribution and use. This option is particularly open to importers, who have better financial and human resources, power and knowledge compared to retailers and farmers for taking a leading role in governing/improving environmental safety and sustainability. This thesis also provides evidence for the potential contribution, as witnessed through best practices by a few pesticide importers as well as important work undertaken by supply chain supporters to solve these problems. The question is not purely about involving private actors as such, which is how it is currently framed within pesticide trading and retailing, but primarily how these private actors are engaged. The findings show that there are a number of mechanisms that could help the supply chain become more actively involved in environmental and safety governance of pesticides. First, stronger involvement of state agencies could force private actors to engage in better pesticide trading and use. Second, reputation damage to traders could be a potential driver for supply chain actors to implement better environmental governance measures (Oosterveer et al., 2011; Stadlinger et al., 2013). Third, sustainability governance *of* the supply chain (Trienekens et al., 2012; Bush et al., 2015) requires the active involvement of lead firms, such as the importers , to organize the chain and impose particular quality and performance standards upon other chain actors. Fourth, private environmental pesticide governance could also be executed by a "private interest government", such as a strong business association coordinating and governing pesticide distribution and use (Streeck & Schmitter, 1985; Bennett & Ramsden, 2007).

6.2.3 Pesticide selection and use practices among smallholder vegetable farmers

The third research question asks "In what ways have pesticide selection and use practices among smallholder vegetable farmers been influenced by lifestyles and systems of provision?" This thesis identified a broad variety of factors that plays a role in shaping farmers' actual pesticide practices because the farmers act rationally within the context of their available resources and socioeconomic objectives (chapter 2, 3 and 4). The key assumption of such an understanding is that the farmers' pesticide buying and use practices are important in developing interventions that prevent or reduce environmental and health risks and in creating a more sustainable pattern of use. This thesis tried to "open up the black box" of Ethiopian smallholder farmers as far as their pesticide buying and using practices are concerned. Chapter 4 shows that vegetable farmers in Ethiopia have been applying different types of pesticides to control a variety of pests and diseases affecting crops (onion, tomatoes, pepper, cabbages). Approximately 41 different chemical pesticides with different chemical compositions were used by vegetable farmers. The main findings of chapter 4 demonstrate that there are several dimensions of unsafe practices in the purchase (selection) and use of pesticides, including: farmers apply pesticides indiscriminately in violation of scientific recommendations, they store pesticides unsafely, they ignore pesticide risks and safety instructions, and they dispose containers unsafely. Moreover, the high-risk practices revealed during the survey included a lack of use of personal protective clothing, short re-entry intervals, and the spraying of pesticides in the wrong direction by a manual knapsack sprayer. Farmers are only concerned about the effectiveness of the pesticides for killing pests and diseases without paying attention to the effects on their health and the environment. The findings of the study also indicated that farmers intensively use older, more toxic and environmentally persistent pesticides obtained from untrained and unlicensed local retailers and have no choice regarding which pesticides they receive (chapter 2 and 3). The findings further revealed that most farmers were influenced by neighbor farmers, their own past experience and pesticide dealers in their decision to purchase and select their pesticides and how to use them. The long-term application of the same chemicals against pests and disease resulted in an increasing problem of resistance. Some farmers also found from experience that the amount recommended on the label was not effective and consequently started to apply higher quantities and combined two or more pesticides. Unsafe pesticide handling (chapter 4) coupled with a non-functional farmer training center (FTC), inadequate education and extension service, training and technical support, which is documented in chapters 2 and 3, subject the farmer to major health hazards and contaminate the ecosystem.

Clearly, the purchase (selection) and use practices reported here seriously conspire against the desired goal of sustainability, creating serious health and environmental risks. Safe pesticide purchase and use basically demands a behavioral change. To promote a behavioral change among vegetable farmers, a profound understanding is needed of the formation and transformation of farmers' pesticide use practices. Chapter 4 showed that the current pesticide practices of buying and using are both constrained and enabled by farmers' lifestyles and systems of provision. Focusing on a transition to safe pesticide use in Ethiopia, basic ideas of social practice are introduced into this research to develop suggestions for more sustainable patterns of pesticide use. On the one hand, individuals make pesticide choices by taking into account their farm size, education, age, gender and income, and also make judgements based on their perceptions. For example, farmers from higher income groups are more likely to buy appropriate pesticides from official retailers or suppliers, while farmers from lower-income groups use less expensive, broad-spectrum products that are available on the open market, as found in chapters 3 and 4. On the other hand, the transition of pesticide buying and using behavior is closely affected or driven by the specific context of pesticide provision. These findings show that pesticides are sold illegally by unauthorized and untrained persons at local village markets and other non-designated sites and then repacked in small containers without appropriate labelling or product information. Some international pesticide manufacturing and trading companies have set up a country-wide technical service with company representatives who provide technical assistance to their customers (importers) and offer knowledge and information on pesticide application. Some importers promote their pesticides by distributing colorful leaflets and posters and making presentations at farmers' gatherings (chapters 3 and 4). Lack of inspection in the pesticide market allows the provision of hazardous and poor quality pesticides. Moreover, uncontrolled pesticide promotion encourages farmers to misuse and overuse pesticides with a tendency to increase the use of (cheap and generic) pesticides. Generally, most of the smallholder vegetable farmers did not receive training and technical support from manufacturers, importers, or state agencies (extension workers and/or cooperatives) on safe handling and storage (chapters 2, 3 and 4).

In short, I conclude that lifestyle is a factor in explaining the shaping of farmers' buying and using practices, while the specific context of pesticide provision co-determines the available pesticide options and practices. The practice approach to pesticides purchase and use offers a wide range of options for behavioral change. Therefore, re-orienting farmers' lifestyles and the contextual structure will also play a crucial role in the improvement of use practices of farmers. The system of pesticide provision makes clear that the possibilities for sustainable consumption to a large extent depend on the amount and type of socio-technical innovations available in a specific domain. This requires social and technological innovations, interventions and policy reforms. It is also important to realize that modernizing systems of pesticide provision crucially depend on choices made by farmers (chapter 3).

6.2.4 Governance of pesticides through private certification on cut flowers supply chain

The fourth research question aims to assess "how and to what extent private certification standards govern environmental and social dimensions of pesticides' use practices along the global flower supply chain." As discussed in chapter 5, flower growers are among the heaviest users of agricultural chemicals, including pesticides that are suspected of being among the most toxic and hazardous**.** Chapter 2 of this thesis shows that growers never inspected their stores or pesticide utilization to ensure compliance with statutory regulations (standards). The interaction between growers and relevant state actors (at the national and local levels) is very weak in this sector (chapters 2 and 5). Although cut flowers are booming in Ethiopia, they are not properly regulated by the local or federal government. The government's desire to attract foreign direct investment is manifested in deregulation of the sector (e.g., a lack of specific laws to regulate the sector, an interim arrangement to import unregistered pesticides).

One of the private actors' responses to state failures has been the development of private standards enforced through third-party certification. In the last fifteen years, a large number of social and environmental standards promising to address sustainability concerns of the flower sector can be identified at the national and global level, including so-called business-to-business (B2B) standards (e.g. MPS-ABC, MPS-SQ, GAP), the Ethical Trade Initiative (ETI), consumer labels (e.g. Fairtrade, Fair Flowers Fair Plants (FFP), Flower Label Program (FLP)), and, as a form of industry self-regulation, producer association codes in developing countries (e.g. EHPEA CoP). Moreover, supermarket chains offer social and environmental responsible flowers under their own private labels, which are communicated to the consumers. However, evidence lacks on the impact of these promises on regulating pesticide use. To address this issue, this thesis used detailed farm-level data to analyze the environmental and social performance of flower certifications in Ethiopia and in the Netherlands (related to buyers). The overall findings indicated that most environmental, health and safety variables do not show significant differences between growers with different certifications (those who had many certifications with high-level standards and those who had one or two certifications with low-level standards), except for providing some basic facilities and sophisticated farming systems. The results showed that some of the pesticides used in both categories of growers are classified as "highly" or "moderately" hazardous by the WHO and have been banned or restricted in many developed countries. Both categories of growers also do not fulfill the environmental requirements of selected characteristics of pesticide management issues (unsafe pesticide storage, label written in a foreign language, unsafe liquid and solid waste disposal, empty container management with poor incineration techniques and availability of obsolete pesticides), contributing to environmental pollution. Commitment was weak towards using less toxic (green) pesticides and promoting IPM (integrated pest management). In addition, most of the flower growers were not following basic occupational health and safety measures (e.g., still keeping lunch in the greenhouse, lack of appropriate training, lack of appropriate protective gears/equipment, among others). Sprayers suffered from self-reported toxicity symptoms and discomforts including headaches, eye irritation and skin problems, among others, after applying pesticides.

Additionally, there are generally no mandatory requirements with respect to certification when selling flowers via the auction and florist systems. Certificates are only mandatory through the supermarket channel in the international market. Moreover, most flower consumers are not environmentally conscious and flower certification does not influence the characteristics of the end products in the florist channels. The flower industry still seems far from achieving sustainability, and certifications allow farms to hide their unsustainable pesticide use practices because it is hard to see how certifications make a substantial difference on the ground in terms of safety for the environment and workers' health, especially given the need for the industry to increase market access above anything else. The problem is that buyers have no solid evidence, such as inspection of active ingredients and MRL for inedible crops like flowers, which may carry an amount of pesticides 50 times higher than that allowed in foods (Tenenbaum, 2002; Kargbo et al., 2010; Donohoe, 2008), to guarantee whether these certification standards have a real positive effect. The only evidence is the certification report from an accredited auditing organization handed in by the supplier. Therefore, the findings from this thesis confirm that flower certification and labeling schemes are currently insufficient because they do not always reflect the real workers' health and safety conditions and environmental impact of pesticide use at a production site. All players in the supply chain (from growers to consumers) should consider themselves responsible for fair social and environmental conditions and act accordingly, which can only be achieved through transparency and traceability throughout the entire supply chain.

6.2.5 Comparing sectors

What this research also clearly shows is that there are a number of similarities and differences between the vegetable sector and the flower sector in terms of pesticide use practices, which also influence the possibilities and strategies of reducing health and environmental consequences.

The two sectors vary in the methods of agricultural production, the amount of products generated, the pesticides applied, the (inter)national character of customers/consumers, the farm size and many aspects of pesticide use practices (such as source of pesticides, availability (usage) of personal protective equipment (PPE), access to information, resources and training from pesticide handlers, methods of empty container disposal, time of pesticide application, government support).

- Although both sectors share characteristics of pesticides use (such as intensive use of (mostly class II) pesticides), few class I pesticides (without approval for use in the EU) were used in the flower sector.
- The primary source of pesticides for smallholder vegetable farmers are retail shops. The easy access to pesticides in the local market, and the limited knowledge about pesticides' environmental and health effects are among the factors determining the

indiscriminate use of agrochemicals by vegetable growers, whereas flower growers heavily depend on imports of both registered and unregistered pesticides by themselves and/or agents representing flower companies. Flower growers have imported many different kinds of pesticides for routine use in pest control activities. Flower farms use many types of pesticides with different active ingredients (insecticide, fungicides, herbicides, nematocides, fumigants, growth regulators and post-harvest chemicals) to grow and export pure pest-free flowers, whereas vegetable farmers mainly use insecticides and fungicides. In contrast to vegetable farms, however, obsolete pesticides (due to ineffectiveness, leftover, oversupply, expiration) were mostly found in flower farms.

- Vegetable farmers lack resources, information (knowledge) and training to avoid risky practices such as misuse and abuse of pesticides including illegal diversion of DDT to the agriculture sector, repacking, wrong mix of different types of pesticides, use of pesticides for unintended purposes, while these practices are not reported among flower growers as pesticides are here stronger managed by experts. However, it is hard to see commitment of flower farm owners and managers towards environmental and workers health and safety.
- Empty pesticide containers are used for other purposes (e.g. food and water storage) and/or thrown away in the environment by smallholder vegetable farmers, whereas flower farmers burn empty containers in open air on farm.
- Most vegetable farmers apply pesticides with large personal health risks (manual knapsack sprayers, washings in rivers, no protective equipment), whereas in flower farms protection is much better (although quality, availability and comfort of protective equipment is often questionable).
- Vegetable farmers generally do not attain pesticide-related training and are not aware of modern alternatives for chemical pesticides (such as IPM). Most sprayers at flower farms received some training, though often irregular.
- Unlike the vegetable supply chain, market signals and pressure pushes towards a reduced reliance on pesticides in the international flower supply chain (through certification and labelling), although the effectiveness of these market-based instruments remains unclear.

These differences between the two sectors mean that there can be not one single strategy to handle the environmental and health risks of agrochemicals in Ethiopian agriculture. Most likely, the inclusion of other agricultural sectors in the analysis (e.g. staple crops) will result in findings that even differ from the two sectors included in this research.

6.3 Reflection on theories

The research chapters in this thesis engage with the literature on public and private (environmental) governance and policy. I have applied four theoretical perspectives as different lenses through which to view pesticide governance in Ethiopia. I also applied them to a number of different real-world cases. In this section, I reflect on the usefulness and shortcomings of these perspectives and discuss the thesis's key contribution to environmental governance literature, on four points.

First, in this thesis, I choose implementation as a stage in the policy process after finding a lack of connection between policy goals and results regarding pesticide registration, distribution and use in the Ethiopian context. Studies on policy implementation (O'Toole 2004; Owens, 2008; Lulofs & Bressers, 2010; De Boer & Bressers, 2011) are hampered by a large number of variables, little theoretical consensus and accumulated theory, improper and imprecise definitions of concepts and constructs, and scarce validated findings. This complexity has challenged the formulation of a simple theoretical framework with which to analyse interventions to improve implementation. In this thesis, implementation assessment made use of a theory of policy implementation, the so-called Contextual Interaction Theory (CIT) (Bressers, 2004, 2007), which provided a helpful way to conduct systematic analyses of pesticide actors' overall challenges (barriers) in governing implementation problems. The theory included the idea that the policy implementation process is heavily contextual as it involves a particular set of actors and institutions. Furthermore, the framework considers processes of interaction at every stage of pesticide use. Hence, a framework was applied that included major contextual factors and actors at different phases that shape implementation success or failure.

Despite the analysis of the barriers to pesticide policy implementation with the three core variables (motivation, information and resources), other crucial implementation variables were identified in this thesis, such as corruption and lack of sufficient and sustained political will in government policies. These and other variables are related to the 'marriage' between professionalism and politics in the civil service (e.g., extension workers) and the continuous restructuring of the MoA from the federal to local levels that led to its instability and weakness in tackling problems associated with pesticide registration, distribution and use. To some extent any relevant variable beyond motivation, information and resources can be channeled into the analysis through the core variables, but by not specifically articulating such 'hidden variables' they may remain unrevealed in empirical analyses. The complexity and diversity of the implementation arena contributes to the inability (and perhaps undesirability) to comprise one general underlying theory of implementation. The development of various heuristic models is considered to provide better promises for the future of research on policy implementation failure.

Second, it is noted that private environmental governance is an increasingly important aspect of environmental policy to policymakers, practitioners, and theorists. In chapter 3, this thesis assessed the specific role, as well as potential avenues of influence, for private pesticide actors in Ethiopia from the perspective of private environmental governance (PEG). PEG proved a useful perspective in capturing the role of pesticide chain actors with regard to three pesticide governance pathways (managing products, information and services). The findings provide detailed insights into role of private actors in the area that help map the factors that influence the success or failure of private governance initiatives. However, the overall findings confirmed an problematic role of private actors and modes of private governance in securing the quality, environmental safety and sustainability of pesticides' importation, distribution and use. Thus, despite the growing recognition of the involvement of private actors, Ethiopia (similar to most developing countries) finds it difficult to move beyond the government spiral. Although scholars (Pattberg & Widerberg, 2015; Spaargaren & Mol, 2008; Falkner, 2003) have studied the role and function of different private actors in environmental governance in detail, these are still very weak in developing countries. The contribution to the private governance literature is the insight that there are no strong data on the contribution from private actors in Ethiopia towards sustainability in pesticide governance. This may ask for a developing country variant of private governance theories, that takes this into account. On the contrary, there are good reasons to suggest that the rising discourse on involving private actors in environmental governance results in an ongoing erosion of state capacity (Mol, 2010, 2016). This leads to another type of debate with private environmental governance and raises a number of issues that ought to be central to future research on private governance in pesticide sectors. In examining the engagement of private actors in the governance of pesticides, this study found few signs of hope for the implementation of better environmental practices based on private governance.

Third, agricultural *practices* are most important contributors to environmental pollution. To improve our understanding of how to address sustainability challenges in agrochemical use, this thesis applied a theoretical framework based on the *Social Practices Approach* (SPA; developed by Spaargaren, 1997), which (in line with Bourdieu and Giddens) has its focus on the interactions between actors and structures within the context of social practices, thereby connecting the opposites of actor- and structure-oriented research. In this research, SPA was helpful in investigating the constraining and enabling factors in making a transition to safe pesticide use by farmers. By focusing on buying and using pesticides, the three components of the social practices model (lifestyle of farmers, practices, systems of provision) provide important contributions to the analysis of innovation processes in the domain of sustainable pesticide use. Investigating and emphasizing the role of farmers' lifestyles and the systems of provision in pesticide practice transitions has particular relevance for safe pesticide policies. An important scientific insight is the important role of agency and structure in understanding and influencing farmers' pesticide buying and using practice.

It is interesting that, in addition to the analysis of drivers (enablers) and barriers (constraints) of *pesticide use practices*, the study of social practices has commonly focused on the urban context in Europe by comparing practices in different consumption domains (such as food consumption, energy, tourism, housing and car mobility) (Verbeek, 2009; Nijhuis, 2013; Sargant, 2014; Spaargaren & Oosterveer, 2010; Spaargaren, 2013), whereas in this thesis, *SPA* proved useful in studying practices in the rural domain in the context for developing countries. Pesticide analysis in particular brings a new dimension to this theory. In addition to the fact that applying a practice approach to pesticide consumption is new, the theoretical framework developed and applied in this thesis also adds to existing practice approaches because it applied SPA to sustainable consumption in Africa.

Fourth, global supply chain analysis provides a conceptual tool for looking at the power and influence of chain actors in governing pesticides in the international flower supply chain. Cut flowers value chains are characterized by an increasing degree of globalization. In terms of market coverage, social and environmental standards and certifications have become mainstream in international cut flowers chains originating in developing countries. At the moment, most of flower growers in Ethiopia hold one to seven certifications, so-called business-to-business (B2B) standards, consumer and/or supermarket labels and EHPEA Code of Practice. These innovations are a response to social pressures unleashed by globalization and the inadequacy of state governmental institutions in addressing the social and environmental impacts (Riisgaard, 2009; Büthe, 2010; Raynolds, 2012). Across sectors of the global economy, private governance has emerged as a new instrument for addressing pressing social and environmental problems. Therefore, in this thesis, *private certification* as a governance instrument was analyzed on its impact along the flower chain actors (grower-consumer) in regulating pesticide use. It was found that private certification focuses more on prescriptions and outcomes in the form of audits and certifications than on actual changing pesticides use practices at the local level (Havinga, 2006; Hatanaka et al., 2005; Henson et al., 2011).

Private governance has had some notable successes, but there are clear limits to what it can be expected to accomplish alone (Mayer & Gereffi, 2010). Although there is a growing debate on private certification, there is still little known about whether it actually affects producers' environmental and social performance. This debate is part of wider discussions about the changing nature of governance in the context of private certification. Standards can solve information asymmetries between trading partners, reduce transaction costs and promote consumer confidence, thereby acting as a catalyst to trade (see Maertens & Swinnen, 2014; Tanner, 2000; Golan et al., 2001) with government agencies also moving to implement them (Greene & Kremen, 2003; Martinez & Banados, 2004). This might be true especially for food crops exposed to MRL test. Hughes (2001), Tallontire et al. (2005), and Dolan, Opondo and Smith (2003) further criticize private standards in general for focusing on satisfaction of Northern interests instead of changes in labor practices on the (developing country) farms. In contrast to much of the literature on private certification, this thesis found that private certification is not (yet) an instrument that protects human and environmental health on non-edible crops, such as flowers. Both certified and uncertified flower companies have a long way to go before they might be considered environmentally sustainable given the pesticide-intensive nature of production. In this light, this thesis contributes to debates on improvement of *private certification* as an instrument for successful pesticide governance.

6.4 Reshaping state-business-civil society relationships in environmental governance of pesticides

Following the findings in this thesis, I have to conclude that both state and private actors hardly contribute to significant improvements in achieving sound pesticide management in Ethiopia. The state regulatory system has revealed an inability in controlling proper registration, distribution and safe use. Pesticide registration systems are not well established. A major challenge in pesticide registration is the double/ triple registration of pesticides with the same active ingredient (ai) but under different commercial names. Importing unregistered pesticides (only with import permits) by most flower growers allowed them to use banned/restricted/extremely harmful/chemicals toxic to the environment and workers for higher risks. The government's political commitment in this regard has never been observed in the floriculture industries, where there is no supervision or monitoring at all. In addition, commercial pesticide traders prove unable/unwilling to comply with regulations prescribed by the government proclamation. Among other problems, importation of pesticides with the wrong labels, conflicts of interest between importers (registrants) and double/triple registration of pesticides with the same (ai) under different commercial names cause confusion for retailers and farmers. Moreover, importation without obtaining a prior import permit and requests to import unregistered pesticides have grown over time. At the same time, the responsibility for controlling the pesticide market (inspection) failed in terms of quality control in distribution and use. The retailing of pesticides has been handled by unqualified and unlicensed retailers in shops and open markets with other commodities. Finally, this challenge is particularly critical at farm (local) level. There is substantial overuse, misuse and abuse of pesticides by end users, especially by smallholder farmers, due to lack of knowledge, technical support and training on hazards and risks associated with pesticides. Challenges to pesticide governance throughout the pesticide supply chain has resulted in negative policy outcomes for the environment and human health, particularly with the failure of state authorities to actively engage non-state actors in the complex pesticide registration, distribution and use system.

These situations call for the reshaping of the pesticide governance system throughout the country. To effectively address the human health and environmental impacts of pesticides requires a pesticide governance system that facilitates agricultural and environmental sustainability. Governance can be related to a collective problem solving practice by actors within the public and the private domain (see Driessen et al., 2012; Mol, 2002, 2016; Arts, 2001; Pierre, 2000; Falkner, 2003) where state and other non-state actors can all play a critical role. Different countries have adopted different governance systems based on their own social, economic, ecological and political realities. Pesticide governance can foster the necessary relationships between and among actors who have a stake in pesticides on multiple levels. Hence, it would be more interesting to indicate what would ensure improved pesticide governance.

Ethiopia's problem is not policy, but its implementation. In particular, the government has acknowledged the need for better management of pesticides, which resulted in the development of the Pesticide Registration and Control Proclamation. Irrespective of some efforts made by the government, there are a number of problems that need special attention from all stakeholders in the area of pesticide registration, distribution and use to reduce the environmental and human health effects of pesticides. The legal instruments that have been enacted to implement these policies and strategic documents have major limitations that require serious attention. The limitations include the fact that the major roles and responsibilities of pesticide governance has been primarily given to state organs alone by disregarding the non-state actors. Additionally, the functional linkages among state, private and civil society have not been sufficiently defined despite the fact that governments no longer are, and in many cases cannot be, the sole source of environmental decision-making authority (Mol, 2008, 2010; Pattberg, 2010; Falkner, 2003). Still, there is a considerable room for improvement in governmental institutions dealing with pesticide governance.

A challenge, identified in this thesis however, is that what might be called the “pure” form of private governance (governance outside the realm of the state system) is of only limited effectiveness in practice. This finding also supports the argument that state action alone is not necessarily the most effective way to achieve sustainability, and state involvement is also both necessary and inevitable in a developing country through monitoring (controlling), inspecting and correcting pesticide market failure without jeopardizing the public good**.** In this regard, it is crucial to place the government in the driver’s seat to play its part. This will still require a supportive government that expands the opportunity for other non-state actors to participate along the supply chain of pesticides in monitoring, evaluating and reporting of pesticide policies. States are not the driving force behind the creation of such governance systems but lend them strength through official recognition or incorporation into national law. The international debate on regulatory practices repeatedly concludes that proper state regulation is the key condition for reducing pesticide risks (See FAO, 2009, 2010, 2013). The major works of Skocpol (1985, 2008) about “*bringing the state back in“* advocate states’ political commitment to realize policy goals focusing on state autonomy and the capacity to affect policy change. In fact, much of the data and even most of the conclusions and recommendations of this thesis confirm this. Moreover, the state, with its regulatory tools, can restructure present pesticide registration and use and influence pesticide management and extension services. Studies could also focus on the role of political culture/will (commitment) of the state to actively engage non-state actors.

Arguably, the new (promising) agenda in pesticide governance is defined by an intricate private-public-civil society nexus in which private-public-civil society authorities work hand in hand to redefine the unsustainable registration, distribution and use of pesticides. A better pesticide governance system is a function of policy and legal instruments that are developed in a participatory manner and are effectively applied by using strong and well-coordinated institutions. This leads the governance of pesticides to open up to (further) collaboration and partnerships between *state*, *private actors* (pesticide traders, end users (farmers), product (vegetable and flower) and consumers) and *civil society.* In fact, these three categories of actors have different traditions, practices, interests, and expectations. Civil society organisations, particularly environmental (pesticide) activist groups, have to acquire a larger role in shaping pesticide governance and pressuring private actors into action (see also Pesticide Action Network (PAN)-Africa, 2008; PAN-UK, 2006; Pesticides Trust 1989; Dinham 1996, 2004; Hough, 1998, 2003). The pesticide governance literature (e.g., Jansen, 2003, 2008; Jansen & Dubois, 2014) also argues that successful pesticide governance requires civil society advocacy, such as the Pesticide Action Network (PAN). The possibility of naming and shaming (associated with insufficient (expired) quality of pesticides, illegal practices, incorrect labeling, etc.) by environmental groups plays a key role in effective pesticide governance. Civil society groups have to be observers at meetings just like the industry, and they should be enabled to provide input into the discussions (Hough, 1998, 2003; Karlsson, 2004, 2007). Civil society can also facilitate effective feedback, learning/supporting of IPM, training farmers on proper pesticide application and the selection of new (safe) and better pesticides that can sustain community motivation to participate in sustainable pesticide management. All this has been significantly lacking in Ethiopia, where civil society has hardly been involved in policy making and implementation, resulting in a one-sided involvement of non-state actors in pesticide policies and practices.

By embracing partnership governance, civil society organisations can provide support for local pesticide users affected by market failure to create sustainable (safe) use systems and overcome the adverse effects of pesticides (Jansen, 2003, 2008; Karlsson, 2004, 2007). This can foster stronger institutions that build trust and cooperation to enable private actors to implement rules for access, use, monitoring, sanctioning and resolving conflict. Arguably, several problems in pesticide distribution and use are promising targets for *traders' (private*) governance initiatives. These actors dominate the pesticide supply chain from pesticide registration (as registrant), importation, sale to retailers, often all the way to distribution for use by farmers. Viewing it in this light, private actors may be an important gap-filler to some of the most intractable pesticide problems. Particularly, reputation damage is a potential driver for supply chain actors to implement better environmental governance measures (Oosterveer et al., 2011; Stadlinger et al., 2013). In this context, full consideration should be given to business (industry) in taking all responsibility for pesticides from the importing (producing) process to final disposal. Another group sharing the responsibility is the end user, the farmer. Smallholder vegetable farmers play a role by adapting their buying and use practices concerning pesticides. While systems of pesticides provision are crucial, the lifestyles and individual choices also determine the environmental and health consequences of pest control. Especially large flower farmers have major possibilities to reduce the use of (highly toxic) pesticides and introduce the concept of IPM and other non-chemical pest control alternatives.

To conclude, the growing importance of non-state actors in pesticide governance reflects a host of considerations including limitations on the capacity of government agencies, pressure from civil society for a greater role in decision making, acknowledgement of the increasing complexity of pesticide management and thus the need for more minds and different types of knowledge, taking into consideration the context of developing countries. Accordingly, effective pesticide governance requires different forms of partnerships between public, private and civil society: (i) public-private, (ii) private-civil society, (iii) civil society-public and (iv) public-private-civil society. Arguably, civil society has to play an increasingly important, active role in all aspects of pesticide governance, particularly with regard to (i) monitoring and compliance of the national law by sending memoranda to the government; (ii) urging government authorities involved to be more transparent about their activities and take into account the input of the civil societies; (iii) carrying out activities such as conferences, training programs and public awareness; (iv) naming and shaming private actors that do not behave according to the norms of sustainable pesticide management; and (v) acting as the bridge between governments and pesticide industries in seeking to influence policy and propose solutions or work as research bodies. Above all, the triangular partnership between public-civil society-private sectors holds a major potential in terms of achieving sustainable pesticide governance goals. As part of this mix, non-state actors can contribute to a further reduction of pesticide risks by developing competing initiatives using multi-stakeholder approaches. The question then remains as to whether and how far the increasing political will and state engagement, and the resulting new relationships between the state, business, farmers and civil society in the registration, distribution and use of pesticides, can be sustained.

6.5 Policy recommendations

My recommendations for policy making follow directly from the analysis carried out in this thesis and focuses on three areas:

(i) *Strengthening the ties between pesticide registration, distribution and use*. Systems of pesticide registration, distribution and use are highly fragmented in Ethiopia and MoA has no information regarding pesticides once registered. There is no tracking or tracing system for risk monitoring in the whole pesticide lifecycle. The pesticide delivery system is quite complex due to the presence of a number of multinational companies, national companies (importers/distributors), licensed and unlicensed retailers and street vendors. Finally, vegetable farmers buy pesticides from different sources and apply them indiscriminately in violation of the scientific recommendations. The premise of this thesis is that strong ties are necessary in the future as a consequence of the emergence of a (world) society of risk in which the actions of some may bring about risks for many in this era of globalization (Beck, 1999; Jarvis, 2007; Alemanno et al., 2013). Controlling these risks implies managing product quality, information and services through an emphasis on strengthening the ties between state, traders and users without jeopardizing general public health and the environment. In this respect, the government of Ethiopia should review mechanisms for the enforcement of existing legislation on pesticides for importation, registration, distribution, usage and disposal. Registration processes have to become transparent and open to scientific scrutiny (laboratory analysis), and it should be mandatory that each imported container of pesticides undergo registration at a check post with sample-based testing. The interim arrangement for importing unregistered pesticides by flower grower should not continue. Most importantly, monitoring and quality control is essential, as it ensures pesticides are used correctly and allows the exchange of information on economic, scientific, legal, and technical aspects of pesticides.

Local suppliers (retailers) are the major distributors of pesticides to farmers. However, they lack training on the storage of pesticides at the shop level and on the usage information on safe handling practices and the correct advice to give to farmers. There is a need for effective training and inspection of the pesticide trade in view of the availability of spurious/sub-standard pesticides on the market. Pesticide traders, especially retailers, should adhere to the requirements of the law (to be registered, not selling unregistered, unlabeled, or repackaged goods), which requires stricter monitoring, also by civil society. This thesis clearly indicates that vegetable farmers lack the appropriate knowledge for the safe handling and use of pesticides. This is attributed to the limited availability of extension services and training. Vegetable farmers and pesticide applicators need regular training to encourage appropriate practices for the safe use and handling of chemicals and pesticides by educating them about the risks involved in the misuse and abuse of these poisonous materials. In addition, training in integrated pest management (IPM) methods, which could reduce the quantity of pesticides used and hence reduce potential exposure, is recommended. All these require multi-stakeholder dialogue and interinstitutional collaboration between the government, importers, retailers, farmers and civil society.

(ii) *Public investments in research*. Growing public concern about the effect of pesticides on health and the environment has prompted some governments to use IPM as an environmentally friendly form of crop production. Alternatives to chemical control of pests, such as crop resistance and biological control methods, should be further developed, disseminated, and reinforced through policy reform. The further development of pesticide risk reduction will depend on the engagement of public investments in applied research in some key issues, including IPM and provision systems for organic and less toxic pesticides. The very nature of IPM requires participatory and transdisciplinary research that integrates the perspectives, knowledge, and actions of the various stakeholders, including farmer groups, research and extension services, civil society organizations, the private sector, and policy makers. Further collaboration between these actors should be encouraged, as should the identification of scaling up strategies to broaden their scope and to multiply their effects. As an IPM system becomes more complex in design and implementation, the involvement of the farmer in the development of the system becomes more critical, and this places emphasis on the most recommended approach: the "participatory-research-participatory implementation approach."

(iii) *Comprehensive human and institutional capacity development*. All actors involved in the manufacture (or import), distribution and use of pesticides need to be enabled based on a thorough and systematic analysis of existing gaps at different levels. The low level of awareness, particularly among smallholder vegetable farmers and the wider community, of the potential risks to public health and environmental hazards associated with the use of pesticides needs to be addressed with the help of multi-stakeholder platforms and consistent programmed awareness creation sessions. Competence in policy making, management and higher technical levels will be the other area of focus for capacity development, which should be geared towards addressing capacity gaps in pesticide registration and monitoring. Farm managers, pesticide applicators, other greenhouse workers of large scale flower farms, development agents (extension workers) and pesticide retailers are to be targeted in the capacity development interventions.

6.6 Suggestions for future research

While this study has found a number of answers to the research questions, several new questions and challenges have emerged. Four promising areas for further research are outlined here.

First, a wider selection of case studies, including different locations, crops and ecosystems will improve our knowledge of the environmental and health consequences of pesticides, and the possible measures to reduce these consequences. Such studies will also increase the external validity of this research on the Ethiopian agricultural sector.

Second, as a limitation, this study did not address vegetable consumers' perspectives and rationales concerning low pesticide vegetables and how these may affect or shape the governance arrangements of pesticide practices related to vegetable production. Food crops are currently not tested for pesticide residue in Ethiopia. In the absence of such testing, there remains uncertainty about food safety. As Mol & Oosterveer (2015), Oosterveer & Sonnenfeld (2012) and Oosterveer, Hoi & Glin (2011) argue, consuming food requires people to permanently trust its quality and safety. As far as organic commodities are concerned, it would be interesting to further investigate how the determinants of consumer trust in organic attributes are actively integrated and codified in the governance arrangements of the commodity chain, and how these might reshape the consumer’s attitude towards organic vegetables. Thus, in-depth research on the governance of the organic vegetable chain from the retailer and consumer perspectives is needed.

Thirdly, currently so-called ‘fair labelled flowers’ spur images of ‘a fair deal’ for Southern greenhouse workers and Southern producers. However, eco- and fair trade labels are no guarantee for sustainable agricultural practices. The relationship between labels and certification on the one hand and actual impacts on the ground on the other deserves further research.

Fourthly, altogether the current research points towards the possibility for a significant reduction of occupational and environmental risks related to the use of pesticides in vegetable and flower farms. But the actual impacts of pesticides in a given locality has not been clearly identified, assessed and complied. There are strong indications of substantial environmental and human health problems associated with the misuse of pesticides in horticultural farming in Ethiopia, but there are very limited systematic and well-documented data on actual health and environmental effects of current pesticide use practices. A laboratory-based research (residual analysis of blood, crops, soil and water) is recommended so that the extent of pesticide damage on public health and the environment can be confirmed.

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Appendices

Appendix I. In-depth interview questions (guides)

Dear valued respondent

First of all let me thank you for sharing your time and information with me. The Pesticide Risk Reduction Program -Ethiopia is a comprehensive programme for pesticide registration and management. In the program the Ministry of Agriculture of Ethiopia (MoA), Alterra, part of Wageningen UR (Netherlands) and FAO of the United Nations work jointly on pesticide risk reduction in Ethiopia. Currently, within the PRRP project I am pursuing my Ph.D program at Environmental policy group of Wageningen University in the Netherlands. My research is entitled Environmental Governance of Agricultural Pesticides in Ethiopian Vegetable and Cut Flower Production. My research encompasses an extensive analysis of the governance of pesticide in Ethiopia, particularly registration, distribution and use, and to review potential contributions from state (regulator) and non-sate actors (smallholder vegetable farmers, large scale flower growers, pesticide sprayers/applicators, growers association, pesticide importers and retailers, and flower consumers) to fill the gap and to recommend sustainable pesticide governance arrangements. You have been requested to participate in this survey. Because I believe that you can give me ideas, information and views on issues related to pesticide registration, distribution and use. Your kind cooperation in giving me and/or my research assistants an interview is highly appreciated. I want to assure you that the information you give me will be completely confidential and will be used exclusively for our study, and I will not be taking down your name so your answers will be anonymous .

A. Plant health regulatory directorate (PHRD) of MoA, at national level

1. Why was the current pesticide proclamation formulated?
2. What are the barriers in implementing the pesticide proclamation ?
3. Have you been involved/ did you participate in the formulation of the Ethiopian pesticide proclamation? 1. Yes 2. No If your answer is yes , what were your roles?
4. Does your office introduce the proclamation to the implementers or local agricultural officers?
5. Do you think that there are gaps in the proclamation itself?
6. What efforts/measures should be made to implement the pesticide proclamation?
7. What are the advantages of pesticide registration?
8. What are the challenges on proper pesticide registration?
9. What are the specific challenges in conducting pesticide registration in your directorate ?

10.How are the regulations of the State for pesticide companies/retailers (inspection and quality control)?

11. What is your observation on the distribution of illegal pesticides in your locality in recent years ?

12.What are the supports of the State (technical know-how, information) for smallholder farmers towards safe pesticide use?

13.How are unregistered pesticides imported to Ethiopia?

14.Have you had training about the use of pesticides? 1.Yes 2. No

B. Pesticide importers (registrants)

1. Name of the company
2. Sex : 1. Male 2. Female
3. Current working status/position
4. Work experience in years
5. Educational background
6. Education level: 1. Diploma (10 +2 or 12 +2) 2. BSc 3. MSc 4. PhD
7. When did you start your pesticide business
8. What type of pesticide products do you import ?
9. Product name/s
10. Manufacturer/s
11. Where is the source of your pesticide? Please specify the country of origin
12. What are the factors that influence your decisions on choosing your suppliers?
13. Do you have a license or permission from government to import/sell pesticide? 1.Yes 2. No.
14. What do you know about the pesticide registration and control proclamation?
15. As stakeholder, were you involved or did you participate in the formulation of the Ethiopian Pesticide law of 2010? 1.Yes 2. No : If your answer is yes , what were your roles?
16. Why was the proclamation needed?
17. Are you clear about the purposes (objectives) to be met by the pesticide registration and control proclamation of Ethiopia?

18. Are you satisfied with pesticide registration by APHRD of the MoA? 1. Yes; 2. No; If No, What challenges did you face when registering pesticide at APHRD?

19. Do you request license when clients purchase pesticide from your company? 1.Yes; 2. No; 3. Sometimes

20. How often does your institution collect feedback from the users/growers or retailers? 1.Often; 2. Sometimes; 3 Never.

21. What are the reasons for promoting chemical pesticide rather than IPM?

22. Do you provide Material Safety Data Sheets (MSDS) to the end users? 1.Yes; 2. No; If No, why not?

23. Are there obsolete pesticides in your store? 1.Yes; 2. No; If yes, how did this happen?

24. Do you have detailed information about the pesticides you bought (its origin, distribution & application) ? 1. Yes 2.No

25. Do you have records showing imported, stored and sold pesticides? 1. Yes; 2. No;

26. What challenges did you face in pesticide distribution/use in the locality ?

27. Are you aware of the following issues:

- smuggling of hazardous and unregistered pesticides across borders by illegal pesticide traders? 1. Yes; 2. No; If yes, who is involved
- importation of pesticides with wrong labels? 1.Yes; 2.No;
- importer who Imports without import permit? 1.Yes; 2.No;
- problem regarding expired pesticides? if Yes please specify

28. Have you had training/support from international pesticide training companies (like Syngenta, Bayer, BASF) about distribution and use of pesticides? 1. Yes; 2. No;

29. Have you had information or training from producers about importing products? 1.Yes; 2.No; If yes: does this include any of the options below:

- Information from sales person, No of hours / days
- Training (indicate details below), No of hours / days
- Precautions to take when mixing or spraying
- Precautions to take on storage and disposal
- Other (please specify)

30. Do you give advice to your customers when they buy pesticides ? 1.Yes 2. No If yes: does this include any from the options below:-

- Information you received from the manufacturer
- Information you have learnt yourself about the product
- Precautions to take when mixing or spraying
- Precautions to take during storage and disposal
- Other (please specify)

31. What could your organization accomplished by working together with others? 1.Pesticide producers/manufactures; 2.Pesticide importers; 3.Vegetable farmers/cooperatives; 4. Pesticide retailers/wholesalers; 5. Others (please specify)
32. Are you a member of Croplife Ethiopia? 1.Yes; 2.No; If No why not?
33. For a better (safer) pesticide distribution and use, what do you think is needed?
34. Do you have direct contact with a researcher on local efficacy of the product you wanted to import?
35. What are the responsibilities of your company for proper distribution and use of pesticide?
36. How are the roles and responsibilities of exporters/manufacturers in the international trade of pesticides to address improper distribution and use?
37. Can the market perform better to secure safe pesticide use? If so why and how?
38. How and to what extent do pesticide formulators and importers contribute to safe distribution and use of pesticides?
40. Should government intervene to safeguard safe pesticide distribution and use? If so why and How?
41. How often was your store inspected by a state inspector during the last year ?

	Response	Please specify your response
1.Not at all		
2.Once in a crop season		
3.Two-four times		
4. Five times		
5.More than five times		

42. Who are your clients that directly purchase pesticides from the company?

	Response	Please specify your

		response
1.Small scale holder farmers		
2.Commerical farmers		
3.Farmers union /cooperatives		
4. Retailers		
5.Others		

43. For a better (safer) pesticide distribution and use, what do you think is needed (indicate as 1 = completely agree; 2= agree; 3= neutral; 4 =disagree; 5 = completely disagree)?

Statements	response
1.Pesticide companies should provide more biological pesticides with high biological efficacy.	
2.More effective state pesticide management	
3.Improving technical knowledge among pesticide retailers	
4.Improving technical knowledge among farmers	
5.Information exchange among the stakeholders(state, traders and users)	

44. Finally, is there anything more you as a distributor would like to tell me about challenges on pesticide distribution and use?

C. Pesticide retailers

1. Place of interview /name of town: 1. Ziway 2. Meki 3. Addis Ababa
2. Age
3. Sex: 1.Male; 2.Female
4. Education level: 1.Cannot read and write; 2.Primary education (1-8); 3.Secondary education (9-12); 4. Diploma; 5.BSc and above.
5. When did you start your pesticide trade?
6. What types of pesticide products do you sell? Please list down
7. Is there any person who studies plant sciences by profession in your shop? 1. Yes 2. No
8. Who are your customers?
9. What is the source of your pesticide ? 1. always from one importer; 2.from different

importers; 3. from retailers; 4. other, please specify

10. Are you aware of pesticides registration? 1.Yes; 2. No;
11. Do you have a list of registered pesticides ? 1.Yes; 2. No;
12. Where do you store pesticides?
13. Do importers (wholesalers) request you licence when you purchase pesticide from them? 1. Always; 2. Sometimes; 3. Never
14. Pesticide distribution (retailing) practices by retailers

	Yes	No
Kept record of pesticides		
Sold pesticides in their original packages		
Gave adequate explanations of the labels		
Displayed posters with health and safety information,		
Mentioned the possibility of health effects		
Had agricultural background or related work experience		
Had valid licence to sell pesticides		
Used family house to store and sell pesticides.		
Had Certificate of Competency (CoC)		
Received training on safe handling & storage		
Inspected by federal or regional or local state actors(inspector)		
Have knowledge about pesticide toxicity		

15. How often does your company collect feedback from the end user/farmers? 1. Mostly; 2. Sometimes; 3. Never
16. Do you provide Material Safety Data Sheet (MSDS) to the end users (farmers)? 1. Yes; 2. No; If No, why not?
17. Do you give advice to your customers when they buy pesticides? If yes: does this include the following: 1. Precautions to take when mixing or spraying; 2. Precautions to take on storage and disposal; 3.Other (please specify)
18. Are there pesticide inspectors in your district? 1. Yes; 2. No;
19. Have you ever been punished by inspectors ? 1. Never; 2. Sometimes; 3. Many times. If you are punished, please mention the reasons for your punishment?

20. How often has your shop been inspected by state inspectors/protection expert during the last crop season?

	Response	Please specify your response
1.Not at all		
2.Once in a crop season		
3.Two-four times		
4. Five times		
5.More than five times		

21. If your shop was inspected, which state organization did the inspection in the last crop year?

Organs of a state	Response	Specify frequency & inspection type
1.Federal government, APHRD /MoA		
2.District/zonal /regional office of agriculture		
3.Environmental protection institution		
3.District/zonal/regional/health institution		
4.District/zone/regional office trade & industry		

22. Is there a label on the container of pesticides? 1. Yes; 2. No;
23. Can you explain what the pictograms on the pesticide label mean? (i.e., supported by bottle/containers of a pesticide)
24. Have you ever sold chemicals with instructions in a language you don't understand? 1. Yes; 2. No;
25. Have you ever bought chemical pesticides without a label or without instructions? 1. Yes; 2. No; (if so, please specify from whom/where)
26. Do you sell any pesticide protective equipment ? If yes, indicate them
27. Have you advised customers to use personal protective equipment (PPE) while spraying? 1.Yes; 2. No;
28. Have you advised customers to use personal protective equipment (PPE) while spraying? 1.Yes 2. No

29. Are you aware of the pesticides which are supposed to be registered with MoA before operating your business? 1. Yes 2. No

30. To what extent could you determine the toxicity of the pesticides? 1. All types of pesticide 2. Many types of pesticides 3. Several types of pesticides 4. Not at all

31. Have you had information or training from importers/wholesalers on how to convey customers? If yes, does this include the following:

    - information from sales person; Number of hours / days
    - training (indicate details below); Number of hours / days
    - Precautions to take when mixing or spraying
    - Precautions to take on storage and disposal
    - Other (please specify)

32. Do you give advice to customers/farmers when they buy pesticides ? If yes, does this include the following:

    - Information you received from the importers/wholesalers
    - Information you have learnt yourself about the product
    - Precautions to take when mixing or spraying
    - Precautions to take on storage and disposal
    - Other (please specify) If not, why not

33. What are the factors that influence your decisions for the producers of pesticide?

34. What is your observation on the distribution of illegal pesticides in your locality in recent years? 1. Increased; 2. No change; 3. Reduced; 4. Others

35. What is the degree of farmer's technical dependence on pesticide retailers?

    - Not relying on pesticide retailers for technical information.
    - Relying on pesticide retailers for technical information only for new pesticides or uncommon pests/diseases.
    - Relying on pesticide retailers for technical information for all pesticides when purchased.
    - Other, please specify.

36. What modes of transport do you use for your pesticide?

37. How and to what extent do pesticide retailers contribute to safe and sustainable use of pesticide?

38. Finally, is there anything more you would like to tell me about challenges on pesticide retailing?

D. State plant protection experts at regional and local level and farmer cooperatives

1. Age
2. Sex: Male Female
3. Position
4. Education level
5. Are you involved or did you participate in the formulation of the Ethiopian Pesticide proclamation?
6. Are you aware of pesticide registration? 1. Yes; 2. No
7. Do you have a list of registered pesticides? 1. Yes; 2.No;
8. How does the existing pesticide delivery system look like for vegetable farmers?
9. How does your office provide support to local actors regarding sustainable safe pesticide distribution and use (retailers, farmers and extension workers)?
10. How do the prevailing knowledge and attitudes of smallholder vegetable farmers influence and shape pesticide use practices?
11. How do farmers interact with extension workers?
12. What strategies does the office have for pesticide management?
13. Is there training or technical support given to the farmers on how to use pesticide? If any, how and by whom?
14. Are methods of handling, application, storage and disposal of pesticides considered by vegetable producers strictly so as to avoid risks on humans and the environment? If no, why not?
15. What are the problems/constraints related to pesticide retailing and use in your district/region?
16. What are the problems/constraints with the current extension service?
17. To what extent is the provisioning of sustainable alternatives of chemical pesticides effective?
18. To what extent do farmer cooperatives provide the following options:
    - training in pesticide management to small holder vegetable farmers,

- Integrated pest management (IPM) assistance
- Better access to information, technologies, innovations and extension services.

19. How and to what extent do farmer cooperatives provide quality pesticides for more safe and sustainable pesticide practices?
20. Do cooperatives form networks through which farmers can pool their assets and competencies to overcome pesticide misuse and other risks on human health and environment?
21. How do farmers develop their safe/ best pesticide management practices in response to environmental and human health risks/ exposures?
22. Finally, is there anything more you would like to add about challenges and solutions on pesticide use practices?

E. Flower buyers: wholesaler importers/exporters, retailers (florists), supermarkets and end users (consumers)

1. What is the source of your flower? (i) from certified grower; (ii) from uncertified grower; (iii) both.
2. What is the role of the auction?
3. Is certification mandatory to sell flowers via the auction system?
4. What are the auctions rules? (can the auction exclude growers and buyers who do not meet various criteria?)
5. How do you know whether a flower is produced according to the environmental and social standards/certification?
6. Do you inspect whether a supplier meets the requirements? Or do you go by a recent certification report by an accredited auditing organization handed in by the supplier?
7. What is the best certification for flower? Why?
8. What do you know about workers safety (sprayers, harvesters and packhorse workers and environmental issues related to chemical exposure?
9. How do you know the toxicity (active ingredient of pesticide) growers use in flower production process?
10. How is the share of flowers labelled as fair trade or other sold by firms?
11. Is there a significant price differences between certified & non-certified flowers?

12. To what extent does certification on standards control pesticide use in flower production? And how do you check the claim behind certification?
13. To what extent are you aware of how and where flowers are produced?
14. As end-user, do you purchase certified (labelled) flowers during different events? 1. Yes, 2 No. Why (not)?
15. How do you know if the flowers you buy are fairy produced?
16. Which actor is the most important and relevant for change in the global flower supply chain.

F. Advocacy groups/ NGOs, The Netherlands

1. What is your organization doing regarding environmental protection and safety of workers in developing countries?
2. What is a sustainable flower?
3. Do national and international standards (certifications) meet the requirements with regard to environmental protection and safety of workers in flower production from developing countries?
4. Which actor is most important and relevant for change in the global flower supply chain for environmental and social sustainability? Where will change come from and how?
5. How is your collaboration with other relevant actors in creating awareness? (state and private actors)
6. Finally, is there anything more you would add about environmental and workers safety and challenges related to pesticide

G. State authorities: MoA, EPA, EIAR, ELSA and EHDA

1. What is your organization doing regarding environmental protection and safety of workers related to pesticide registration, distribution and use?
2. Are you involved or did you participate in the formulation of the Ethiopian Pesticide proclamation?
3. How is your collaboration with other relevant state and non-state actors?

4. How do you control pesticides as being “socially responsible” and “environmentally friendly”?
5. What is the regulation of the State for flower growers?
6. Do you advise growers in using registered pesticide safely and with appropriate pesticide handling techniques?
7. What mechanisms of pesticide quality control and monitoring of pesticides use and disposal are being used?
8. How long will the interim arrangement continue for flower growers to import unregistered pesticides?
9. How many flower farms have done Environmental Impact Assessment (EIA)?
10. Did you conduct random or periodic inspections of flower producers with regard to appropriate storage, distribution and use of pesticide?
11. What are the major challenges your office faces in implementing the pesticide proclamation?
12. Which actor is most important and relevant for change in the global flower supply chain?
13. How do private actors gain authority in governing pesticides?

H. Ethiopian Horticulture Producer Exporter Association (EHPEA)

1. Total number of commercial flower growers (farms) currently active in Ethiopia?
2. How many are members of EHPEA
3. Do producers see membership as something that is difficult to attain?
4. What do growers consider to be the benefits of being a member of EHPEA?
5. What do they get for complying with the EHPEA code of practice? 1. a certificate 2. a label 3.a price premium 4. other, specify
6. What are the main flower growing companies by nationality? 1. Ethiopia; 2. Dutch; 3. Israel 4.India 5 mention others countries
7. How many of the farmers are engaged in growing the following: 1.Rose flowers 2. Summer flower 3. Cuttings
8. Total number of people employed in floriculture industry (in 2014/2015)?
9. Total area of land covered by floriculture industry (flower farms) in hectare)?

10. How many farms are currently applying biological pest control and/or IPM mechanisms?
11. How many of flower farms have conducted EIA (environmental Impact assessment)?
12. How many of the flower growers have certificates in favour of social and environmental responsibility:
    - EHPE Code of practices in standards (•Bronze • Silver •Gold)
    - MPS ABC
    - MPS SQ
    - Global GAP (flowers & ornamentals)
    - Fair trade labeling organization (FLO), Max Havelaar
    - Ethical Trading Initiative (ETI)
    - Fair Flower Fair Plants (FFP)
    - Others, specify
13. Do you face any experience of sanction/punishment for non-compliance?
14. Are there significant differences in the environmental and social practices related to pesticide use between certified and uncertified growers?
15. Does certification ensure good treatment of workers and environment ?
16. Does certification achieve a positive outcome on environmental and social issues for the Ethiopian flower growers? If yes, what are the positive effects on environmental and social concerns?
17. Are there differences in the environmental and social practices related to pesticide management between
    - Larger size farms Vs smaller farms in complying with the private standards?
    - Older farms Vs younger ones in adopting the international private standards?
    - Foreign-owned farms Vs domestic-owned farms in complying with the private standards?
    - Farms mainly supplying to the direct sales channel Vs those supplying mainly through the auctions in adopting international private standards?
18. Is there an actual link (match) between the certification of best practises' on environmental and occupational health and safety issues in terms of pesticide management?

19. How and to what extent does the flower export value chain govern farmers pesticide use or to what extent do buyers embed elements of standards and certification/labels?,
20. What are the specific roles of the flower growers'/exporters' association in relation to low pesticide use?
21. What is the specific roles of the association in relation to safe pesticide use by the workers and for the environment ?
22. Which actor is most important and relevant for change in the global flower supply chain
23. What are the major challenges in floriculture industry in Ethiopia from environmental and social sustainability perspective?

Appendix II. Survey interview questions (guides)

A. Smallholder vegetable farmers

1. Name of *Kebele*(site): 1 Ziway 2. Meki
2. Sex: 1 Male 2. Female
3. Age of respondent ? (1) 20-30 (2) 31-40 (3) 41-50 (4) 51-60 (5) 61-70 (6) > 70
4. Socio- economic background of smallholder vegetable farmers

Items	response	remarks
Education level		
- Illiterate (unable to read and write)		
- Elementary (grade 1-8)		
- Secondary (grade 9-12)		
- Tertiary level		
Farm sizes (ha)		
- ≤1.0		
- >1.0		
Land tenure situation		
- Landowners		
- Land holders		
Trend pesticide use past 5 years		
- Increasing		
- Constant		

5. Do you use chemical pesticides for your vegetable production? 1. Yes 2. No
6. Which vegetables are you growing?

Type of vegetables	1.subsistance	2.commercial	3. irrigated	4. rainfed
Onion				
Tomato				
Green pepper				
Cabbage				
Potato				

Other, specify				

7. Which chemicals are you using? (Note: If the respondent does not know the name, or if it is a brand-name product, (you can see the container)
8. Who are the dominant work forces for pesticide application 1. Hired labour 2. Family labour
9. When do you spray?
   - Depending on the damage
   - Depending on the weather
   - I spray always regularly during the season
   - Other specify
10. Do you usually read the labels on pesticide containers? 1. Yes 2. No
11. Have you ever bought chemical pesticides without a label or without instructions?

    1. Yes (if so, please specify from whom/where 2. No
12. When (season/month)and how frequently do you spray pesticides per season?
13. Have you ever used pesticides with instructions in a language you don't understand?

    1. Yes 2. No
14. Do you know the doses of every pesticide you use? 1. Yes 2. No
15. What major difficulties did you face in using pesticide ?
    - Low quality (ineffective)
    - lack of safety devise
    - high price
    - unavailability when it is needed
    - Other, please specify
16. What problems did you encounter in selecting (buying) using pesticide?
17. Could you explain what the pictograms on the pesticide label mean? (answers supported by container/ bottle of a pesticide
18. Please tell me some aspects pesticide use practices:-

Place of pesticide mixing	Yes	No
-Near a river canal/community water sources		
-In the field (farm)		
-At home		

How farmers mix pesticides		
-With a stick, but bare hands		
-With bare hands		
-With hands and wearing gloves		
-With a stick and wearing gloves		
Devices used for mixing pesticides		
-Knapsacks		
-Various types of mixing containers (drum)		
Reasons reported by farmers behind using current level of pesticides (multiple answers possible)		
-Low efficacy of pesticides		
-Influence from retailers and their guidance		
-High incidence of diseases/pests		
Use of personal protective equipment PPE during application (multiple answers possible)		
-Wearing normal clothes		
-Using hat		
-Spraying with bare feet		
-Using boots		
-Using cotton overalls (*tuta*)		
-Bath after application		
Fate of empty pesticide container (multiple answers possible)		
-Dump them by the field (throw away on farm)		
-Throw into irrigation canals or rivers		
-Collect and bury in ground on farm		
-Collect and burn on farm		
-Keep for domestic uses		
-Collect and sell them		
Farmers' knowledge and understanding about pesticide		
-Do you know the names of pesticides?		

-Do you think that pesticides affect human health?		
-Do you think that pesticides affect livestock?		
-Do you think that pesticides affect environment (water bodies)?		
-Do you ever read pesticides labels?		
-Other please specify		

19. Support services available to smallholder farmers

Items	most important information support source (use and selection)	training on safe use and handling
Importers		
Retailers when buying pesticides		
State extension service		
Neighbouring farmers		
Cooperative (union)		
Own experience		
None		
Others, please specify		

20. Where do you buy your pesticide (sources)?

Statements	response	Remark
Local retailers/shops		
District service cooperatives/unions		
Importers/wholesalers		
Open market /informal dealer		

21. Have you ever felt any discomfort/illness after pesticide application? 1. Yes 2,. No 3. sometimes 4. don't know . If yes, what was your feeling?.
22. Let respondent give an answer and then mark down against alternative answers: do not prompt with possibilities?

Statements	responses	Remark
Nausea		
Vomiting		
Headache		
Skin irritation		

Eye irritation		
Never had any symptom of poisoning		
Other		

23. Have you had training about the use of pesticides? 1. Yes 2. No ; If yes, what type of training or information you receive from state or non-state actors. if yes, from whom?
24. What were you trained on?

Statements	response	Remarks
How to use pesticides		
Storage and safety		
Integrated pest management(IPM)		
Disposal of empty pesticides containers		
Application methods		
Health and environmental effects		
Others, specify		

25. How often local extension worker contact you at farm level during the last crop season 2012/13?

Statements	responses	why you contacted
More than twice a month		
Once every two month		
Once every three month		
Other specify		

26. Do you think that agricultural development agents (DAs) are responding to the demands of the farmers ? 1. Yes 2. No If not why not?
27. Is there farmers training centre (FTC) in your locality? 1. Yes 2. No :If yes ,what assistance, support, or services have you received from FTCs ?
28. Are you satisfied with the services delivered by extension service currently practicing in your area? 1.Yes 2. No
29. Finally, is there anything more you would like to add about challenges on pesticide usage?

B. Large scale commercial flower farms (growers)

1. Name of farm
2. Position
3. Qualification & field of study
4. Hectare under production
5. Ownership/nationality
6. Size of work force
7. Export destination
8. Do you use chemical pesticides for your flower production? 1.Yes 2. No, If yes:-
    - According to WHO hazard classes:1. Class Ia 2. Class Ib 3. Class II 4. Class II 5. Class U 6. All
    - According to band colour 1. Red (Ia and Ib) 2. Yellow (II) 3. Blue (III) 4. Green (U) 5. All
    - Common pesticides with trade name/common name frequently used in flower production.
9. How frequent do you use pesticide protect pest/disease ?
    - Every day
    - Two day interval
    - Three day interval
    - Four day interval
    - Five day interval

10 . Do you use chemicals postharvest enhancement of vase life? 1 Yes 2 No, If yes what type of chemical?

11. Where is the source of your pesticide?

Sources of pesticide	response	remark
Import by myself		
From Agrisher		
From Axum green line trading PLC		
Horticop		
From commercial importers of registered pesticide		
Other, please specify		

12. What is the legal status of currently used pesticides? 1. Registered 2. Unregistered 3. Both
13. If unregistered, what are the challenges for buying registered pesticide from commercial importers?
14. If it is unregistered, what are the consequences of using unregistered pesticide?
15. Have you had training on how to govern/manage pesticides in your farm?1. Yes 2. No, If yes by whom ,when?
16. Do you have pesticide data / recordkeeping that deal with health and environmental issues? 1.Yes 2. No

17.Have you obtained a copy of the relevant material safety data sheet (MSDS)?1. Yes 2. No

18.What strategies do you follow against pesticides and disease in your flower production?

- Apply of integrated pest management(IPM) 1.Yes 2.No
- Apply bio-control agents or natural enemies 1.Yes 2. No
- Apply only pesticides chemical 1.Yes 2.No
- All best pest management options have been considered 2.Yes 2.No

19. Is there obsolete pesticide in your farm? 1.Yes 2. No

    If your answer is yes, what are the reasons for this?

    If your answer is yes, what mechanisms do you follow for disposals of obsolete pesticides?
20. Are there environmental officers in your farm? 1.Yes 2. No
21. How is the environmental responsibility of your farm in terms of chemical tubes, disposed of in the nearby area and fate of empty containers?
22. Are there health and safety officers in your farm ? 1. Yes 2. No
23. What are the problems that you think pesticide sprayers encounter in your farms related to occupational safety and health of farm workers?
24. What are the problems associated with the availability and the quality of personal protective equipments (PPE)?
25. Do you think the working environment on your farm is safe for workers health? 1. Yes 2. No
26. Have you had inspection from government regulatory body? 1. Yes 2. No If yes, which organization and when?

- Ethiopian Horticulture development agency (HDA)

- Ministry of Labour and social affairs (MolSA) /district
- Ministry of Agriculture (MoA)
- Ethiopian Horticulture Producer Exporter Association(EHPEA).
- Environmental Protection Authority(EPA)
- Internal or external auditor
- Others

27. What are the problems that you think the State failed in regulating flower farms?
28. What assistance, support or services have you received from state or non-sate actors?
29. Are you a member of Ethiopian horticulture producer exporter association(EHPEA) ? 1. Yes 2. No, if not, why?
30. Do you have certification? 1. Yes 2. No: If Yes, from whom, when, for what quality)
    - EHPE Code of practice (CoP): (which level bronze, silver & gold level)
    - MPS ABC
    - MPS SQ
    - Global GAP(flowers &ornamentals)
    - Fair trade labeling organization(FLO),Max Havelaar
    - Ethical Trading Initiative (ETI)
    - Fair Flower Fair Plants (FFP)
    - Others
31. How and why do you choose these/(this) amongst available standards and certification?
32. Do you think that there is a greater potential for the code levels to be used in marketing flower?
33. Do you think there is a greater potential for the code levels to be used in governing pesticides in flower market?
34. Do you supply/provide certified flower? 1. Yes 2. No
35. How is your supply channel? 1. Direct sales channel 2.Through the auctions 3. Both
36. Did you face experience of rejection or dumping caused at auction or wholesalers? 1. Yes 2. No
37. If Yes, why?
    - Lack of certification/ flower label
    - Due to pesticide residue

- Due to colour change or distorted leaves of flowers
- other reasons

38. Does your farm work together with other relevant actors? Such as farms, authorities to address environmental safety and workers health 1. Yes 2. No , If yes, which one?
    - Collaboration with trade partners (destiny of your flower)?
    - Collaboration with flower growers
    - Collaboration with state actors
    - Collaboration with other relevant actor
39. Which actor is most important and relevant for change in the global flower supply chain?
40. Where will change come from?
41. Finally, is there anything more you would like to add about challenges on pesticide issue?

C. Pesticide applicators (sprayers) /workers

1. Name of farm:-
2. Sex: 1. Female 2.. Male
3. Age
4. Job position: 1. Pesticide sprayers 2. Cutters/harvester in greenhouse 3. Bunch makers in pack house
5. Marital Status: 1. Single 2. Married 3. Widowed 4. Divorced
6. Educational level: 1.Unable to read and write
    - Able to read and write
    - Primary (1-6)
    - Junior (7-8)
    - Secondary (9-12)
    - Post-secondary

7\. How long have you worked in the flower farm?

8\. Are you employed as: 1.Temporary worker 2. Permanent worker

9\. Have you signed a contract with your employer? 1. Yes 2. No :

10. If yes, has the company given you a copy of the signed contract? 1.Yes 2. No
11. Since you have been working on the farm, have you received training? 1.Yes 2.No
12. What is your monthly salary that you are getting from the farm?
13. What additional payments other than your salary do you get by working on the farm?
14. Do you have a workers' association in your flower farm? 1.Yes 2. No

    If yes, are you a member of that association? 1.Yes 2. No If you are not member of the association, give reasons
15. Do you think that the association is helpful in helping its members trying to solve problems with the management? 1.Yes 2. No
16. Do you think workers have the opportunity to discuss their problems with the management when problems arise? 1.Yes 2. No
17. When do you have issues to be discussed with the management? how do you go about dealing with such issues?
    - Through the union
    - Individually
    - Through supervisors
    - Through other means, specify
18. How many hours do you work per week?
19. Do you think the working environment on your farm is safe for your health? 1.Yes 2.No
20. Have you received proper training with regard to health and safety procedures? 1.Yes 2.No
21. Do you know any accident happened related with pesticide poisoning? 1.Yes 2. No: If Yes , which symptoms did you experience as a result of exposure to pesticides)
    - Eye irritation
    - Vomiting
    - Burning skin/rash
    - Shortness of breath
    - Headache/dizziness
    - Other, specify
22. What do you think are the side effects of the pesticides on your health?
23. Do you take shower after spraying ? 1. Yes 2. No

24. Which of the following facilities are available on your farm?
    - Toilets
    - Drinking Water
    - Washing facilities
    - Showers
    - Housing provision
    - First aid facilities
    - Free medical care
25. How often do you follow safety instructions and proper re-entry intervals with regard to pesticide application? 1. All the time 2. Sometimes 3. Rarely 4. Never practiced
26. Do you think workers are regularly informed about the risks and safety measures related to the pesticides 1.Yes 2. No
27. Does the company undertake a regular medical check-up (cloistral test) and monitor workers' health and safety situations? 1. Yes 2. No
28. Where do you put the empty containers?
    - Keep for domestic purpose
    - Burn in a big incinerator
    - Dump them by the field
    - Others, Specify
29. Have you received proper training with regard to pesticide application? 1. Yes 2. No
30. Are you aware of the Code of practice? 1. Yes 2. No
31. Are you coached by your supervisor about what to say to inspector or external auditor? 1.Yes 2.No
32. Do other greenhouse workers enter to the farm during spraying process? 1. Yes 2. No
33. What time do you spray/apply pesticide?
    - Morning
    - Midday
    - Late afternoon
    - The whole day
34. Do you have any experiences for eating and drinking during spraying?1. Yes 2. No
35. Do you understand the label of pesticide (language)? 1.Yes 2. No

36. What are the major problems you face while working in the flower farm?
37. Is there anything more you would like to add about challenges on working with pesticide in the flower farms?

D. **Extension workers (development agents**)

1. Sex 1 Male 2. Female
2. Age
3. Education level :1. Diploma(10 +2 or 12 +2),2. BSc 3. others-
4. Current working status / position:-
5. Work experience in year at MOA:-
6. Field of study:-
7. Place of interview:1. Ziway 2. Meki
8. What are the aims and the roles of agricultural extension services in your locality?
9. Are pesticide uses included in the agricultural extension service? 1. Yes 2. No If no, why not?
10. Have you had training related to pesticide? 1. Yes 2. No, If yes, what types of training you received?
11. Do you advice farmers on how to act on appropriate use of pesticide ? 1. Yes 2. No, If your answer is No ,why not?
12. How is the frequency of extension workers contact/visit with small holder farmers?
13. Do growers (users)have sufficient and appropriate information on how to use pesticide? 1. Yes 2. No ; If no, why not
14. What are the main problems you face in conducting appropriate pesticide use among smallholder farmers?
15. For a better pesticide use on small scale vegetables , what do you think farmers need?
16. Could you mention the extension worker –farmer ratio in your district or in every peasant association?
17. Are you interested in your profession? 1. Yes 2. No: if no, please specify the reasons
18. Please rate the following items related to technical knowledge and information on pesticide policy, pest and pesticide issues. I
    - am informed on pesticide law (proclamation) 1. Yes 2.No

- have the necessary knowledge& skill to identify symptom of pest attack:1.Yes 2.No
- know different pesticide application methods 1. Yes 2. No
- have technical knowledge on field diagnosis of pest 1. Yes 2. No

19. Please indicate your level of satisfaction with the following items related to motivation
    - Frequent organizational restructuring on the current job is satisfactory: 1. Yes 2. No
    - In-service training, and skills development on the current job is satisfactory:1.Yes 2.No
    - In-service training, and skills development on the current job is satisfactory: 1.Yes 2.No
    - The work itself is interesting: 1.Yes 2. No
20. Career structure for promotion on current job is satisfactory: 1. Yes 2. No
21. Please rate the following items related to the availability of resources
    - Transportation facilities are sufficient to access farmers 1.Yes 2. No
    - The number of DAs assigned to farmers is proportional 1. Yes 2. No
    - Extension materials are available to effectively work and communicate with the farmers 1.Yes 2. No
22. Have you had training about use of pesticides? 1. Yes 2. No
23. Have you ever got any opportunity to participate in the process of formulating or deciding agricultural policy, strategy in the district? 1.Yes 2. No
24. Are you aware of the Ethiopian pesticide policy (proclamation)?
25. What additional resources do you need to improve service and support to farmers?
26. What are the major problems related to the way DAs provide support to farmers regarding proper pesticide use?

Appendix III: Observation checklist

- Safety precautions: did the farmer post a warning sign/poster to point at hazards like *spray in process, keep out)*
- Store conditions: are pesticides store pesticides in a separate room or together with fertilizers/
- Arrangement of the pesticides shelf (solid, liquid), together with other commodities?
- Proper labelling on the shelf and in a familiar language?
- Availability of septic tanks for washing hands?
- Availability of a fire extinguisher?
- Other workers enter the store/farm without an eye or nose protective (re-entry of other workers during spraying) ?
- Record keeping which shows what they import, use, store etc.?
- Presence of obsolete (outdated or expired pesticides)?
- Fate of empty pesticide containers (burn in a big incinerator)?
- Time of spraying (morning, midday, afternoon)?
- Whether sprayers put their normal cloths used in a separate box?
- Availability of appropriate (quality) protective gears and wearing style of PPE ?
- Whether sprayer wear PPE or not?
- Protective gears for cutters in greenhouse and bunch makers in the pack house?
- Pictograms presented to farmers and the level of their understanding?
- Availability of information for customers in the retail shop (information exchange)?
- Safety posters?
- Record keeping?
- Repacking practice?

Appendix IV : List of key informants (interviewees)

Organization/interviewee	**Date**
Twelve experts at APHRD of the Ministry of Agriculture, national level	13/7/2012-24/10/2012
Representative of Croplife Ethiopia	9/10/2013
Pesticide and IPM team leader, Ethiopian Horticulture Development Agency (EHDA)	12/9/2012
Four experts Ethiopian Horticulture Procedures and Exporters Association (EHPEA)	4/10/10/11/2015
Four experts from pesticide advisory board: Ethiopian Environmental Protection Authority, Ministry Labour Social Affairs Institute, Ethiopian Agricultural Research Institute (EIAR) and Authority of Revenue and Customs	21/8/2012-13/10/2012
Fifteen pesticide importers(registrant)	7/8/2012-11/10/2012
Twelve pesticide retailer	10/7/2012-20/11/2012
Plant protectionist at Oromia agricultural Bureau	10/9/2012
Plant protectionist at Ziway agriculture office (local level)	12/9/2013
Plant protectionist at Meki agriculture office (local level)	13/9/2013
Plant protectionist at Ziway Plant clinic	14/9/2013
Two protectionist Meki -Batu Framers cooperative (union)	16/7/2013
Ten agricultural extension workers at Ziway and Meki district	2-24/6/2012&7-19-2014
Fifteen flower growers	7/9/2012-11/9/2012
Senior project manager, HIVOs, The Netherlands	22/6/ 2015
Junior Programme Officer, HIVOs, The Netherlands	22/6/2015
FSI Executive Officer: Floriculture sustainability Initiative, -Netherlands	18/3/2016
Flora Holland (auction) The Netherlands	22/6/2015& 11/2/2016
FleuraMetz flower import/export, The Netherlands	4-7/4/2016
Intergreen flower import/export, The Netherlands	2/5/2016

OZ import/export, The Netherlands	2/5/2016
Three Dutch supermarkets : Albert Heijn, Lidl and Jumbo,	January 2016
Eighteen Dutch florists(retailers)	23January-17 March,2016

Appendix V: List of pesticide registrants(importers) in Ethiopia

No	Company Name	Address, Addis Ababa : P O Box	Telephone Number	Fax Number
1	Filbert & Company	90490	(251)(0116) 613629	-
2	Chemtex private ltd C.	2403	(251)(0115) 519557	-
3	FS Private Limited Company	-	(251)(0113) 201342	-
4	HEARTS P.L.C.	41033	(251)(0115) 521080	251(0115) 520806
5	General Chemical & Trading Pvt. Co	5620,	(251)(0115) 150080	-
6	Syngenta Agroservices Ag. Ethiopia	5939	(251)(0116) 633069/73	251 (0111) 55 2844
7	Marubeni Corporation	2326	(251)(0115) 513366	-
8	Makobu Enterprises	40391	(251)(0114) 654792	-
9	Chemtrade International	101035	(251)(0116) 261589	-
10	T.M. Global Business Services PLC.	5259	(251(0116) 454087/67	-
11	BYSWM P.L.C	863	(251)(0115) 514551	-
12	Tensae International Business Ent.	8743	(251(0111) 121617	-
13	Shell Ethiopia Limited	3174	(251)(0114)	-

			653040	
14	Mobil Oil East Africa Limited	1365	(251)(0114) 651125	-
15	Lions International Trading (Pvt) Co.	101302	(251)(0116) 639244	-
16	Afro German Chemicals Est. PLC.	1109	(251)(0111) 550200	-
17	MITSUI & Co., Ltd., Liason Office	1300	(251)(0115) 511583	-
18	Adami-Tulu Pesticides Processing Factory	5747	(251)(0116) 611311	(251)(0116) 611764
19	Tadi Zerhin General Trading PLC	100755	(251)(0116) 621571	(251)(0116) 621571
20	Hagos legesse	15177	(251)(0112) 760347	(251) (0112) 760479
21	Magbanz Pvt Ltd Co.	21320	(251)(0112) 752430	(251)(0112) 752566
22	Markos Private Limited Company	50964	(251) (0111) 273319	-
23	Alem Business Center PLC.	4663	(251) (0114) 341603	251 (0114) 341752
24	Rangvet Pvt. Ltd. Co.	62699	(251) (0115) 546247/48	251(0116) 615028
25	Omer Haji Woday Import and Export PLC	1563 Dire Dawa	(251) (0111) 11 5367	215 (0112) 13 4633
26	K.M.S.EGGA Trade and industrial P.L.C.	4414	(251)(0112) 130224	(251)(0112) 779635
27	Axum Green Line Trading PLC	618/1250	(251)(0116) 612592 (251)(0116)	(251)(0116) 624655

			183087	
28	Girma Teferi General Importer	57143	(251)(0116) 635787	(251)(0116) 185445
29	BASF Trade Representative Office	27852-1000	(251)(0116) 189136	(251)(0116) 630483
30	D.Get. Pest Infestation Control Plc.	4444	(251)(0116) 622400	-
31	Beker General Business Plc.	121250	(251)(0115) 545287/88	(251)(0115) 545286
32	Mekamba Plc.	21250	(251)(0114) 674381	(251)(0114) 674380
33	Tropical Pharma Trading	6864	(251)(0116) 185442/44/46	(251)(0116) 185442
34	Kaleb Service Farmers House Plc.	9594	(251)(0114) 391459/ (251)(0114) 393675	(251)(114) 393674
35	Tiret Chemicals PLC.	475/1110	(251)(0114) 169993	(251)(0114) 167271
36	GAWT International Business PLC.	62669	(251)(0115) 546247	(251)(0115) 546237
37	Agrisher trading PLC.	406/1110	(251)(0116)631578	(251)(0116)631300
38	B-Nyse General Trading PLC.	377	(251)(0113)200395	-
39	Agrisco Commercial & Industrial PLC.,	2698	251)(0114) 425739	(251)(0114) 422766
40	T.N.M. Business PLC.	2693/1000	(251)(0114) 393595	(251)(0114) 393596

Source: MoA, 2012

Appendix VI: List of some pesticide imported by flower growers 2007-2014(Adapted from, Tamiru, 2007, Vieira and Abarca, 2009; MoA, 2014)

Insecticides/nematicides	**Fungicides**	**Herbicides**	**Growth Regulators**	**Postharvest**
Abamectine	Azoxystrobin	Paraquat	Faty acids	Aluminium sulphate
Acephate	Benalaxyl + Mancozeb	Paraquat +Diquat	Glycol ethers	Chlorine
Acetamiprid	Benomyl	Diquat	Paraphini oil	Citric acid
Acrinathrin	Bitertanol	Oxidazon	Ethylene	Silver thiosulphate
Aldicarb	Buprimate	Glyphosate	Giberellic acid	Wetting agent
Alpha-cypermethrin	Captan		Thiobendazole 75	
Amithraz	Carbendazim		Ammonium chloride 40	
Azadrachtin	Chloropryfos			
Azocyclotin	Chlorothalonil + Metalaxyl			
Bacillus thuringiensis	Cyprodinil + Fludioxonil			
Benfuracarb	Dazomet			
Beta-cyfluthrin	Difenoconazole			
Bifenazate	Dimethomorph + Mancozeb			
Bifenthrin	Dithianon			
Bromopropylate	Dodemorf acetate			
Buprofezin	Famoxate +			

	Cymoxanil			
Cadusafos	Fenamidon			
Carbofuran	Fenarimol			
Chlorfluazuron	Fenhexamid			
Chloroperin + Dichlopropene	Fluazinain 38.5%			
Chlorphenaphyr	Flusilazole			
Chlorpyrifos	Folpet			
Clofentezin	Fosethyl-aluminuim			
Cyhexatin	Fosetyl-aluminuim			
Cypermethrin	Fosetyl			
Cyromazine	Fosetyl 80%			
Deltamethrin	Hexaconazole			
Diafenthiurion	Imazalil			
Diazinon	Iminoctadine			
Dichlovos	Iprodion			
Dicofol	Iprodione			
Dieenochlor	Kresoxim-methyl			
Dimethoate	Mancozeb			
Emamecctinbenzoate	Mancozeb 80%			
Endosulfan	Mancozeb/Manganese + Zineb			
Ethoprophos	Mepanipyrim			
Etoxazol	Mefenoxam (Metalaxyl-M)			
Fenamiphos	Metalaxyl + Mancozeb			
Fenazaquin	Metalaxyl 25%			

Fenbutatin oxide	Metalaxyl M			
Fenpropathrin	Metalaxyl M 8% +			
Fentinacetate54%+Maneb 28%	Mancozeb 64%			
Flufenoxuron	Methram complex			
Hexaflumuron	Methylbromide			
Hexithiazox	Mono&Dipotassium phosphate			
Imidacloprid	Myclobutanil			
Indoxacarb	Oxcarboxin			
Lambda-cyhalothrin	Penconazole			
Lufenuron	Pentachloronitrobenzene			
Methiocarb	E.Tridiazole			
Methomyl	Procloraz manganese			
Methomyl 90%	Polyoxin			
Monocrotophos	Polyoxin Al			
Omethoate	Propamocarb + fosetyl			
Oxamyl	Propamocarb HCL			
Oxymatrin	Propiconazole			
Phytoseiulus Persimilis	Propineb			
Primicarb	Proplant SL			
Primidafen	Propynel + Iprovalicarb			
Profenofos	Pyrifenox			
Propargite	Pyrimethanil			
Pymetrozine	Didecyldimethylammonium chloride			

Sodium fluosilicate(bait)	Spiroxamine			
Spinosad	Strobilurin + Anilide			
Spiromesifen	Sulfur + Tetraconazole			
Tau fluvalinate 24%	Tebeconazole			
Tebufenpyrad	Tebuconazole			
Teflubenzuron	Tetraconazole			
Tetradifon	Thiabendazole			
Thiacloprid	Thiophanate-methyl			
Thiamethoxam	Thiram 80%			
Thiocyclam	Tolclofos methyl			
Thiophonate-methyl	Tolifluazinide 50.5%			
	Tolyfluanide			
	Triadimefon			
	Trifloxystrobin			
	Triforine			

Summary

Pesticides are widely used globally in agricultural production to prevent or control pests, diseases, weeds, and other plant pathogens. Although pesticides are developed through very strict regulation to function with reasonable certainty and minimal impact on the environment and human health, serious concerns have been raised about health risks resulting from occupational exposure and from residues in food and drinking water. Occupational exposure to pesticides often occurs in the case of agricultural workers in open fields and greenhouses. Exposure of the general population to pesticides occurs primarily through eating food and drinking water contaminated with pesticide residues, whereas substantial exposure can also occur in or around the home. Several research studies have documented the world-wide deaths and chronic diseases due to pesticide poisoning especially in developing countries. Many of the adverse effects on the environment (water, soil and air contamination from leaching, runoff, and spray drift, as well as the detrimental effects on wildlife, fish, plants, and other non-target organisms) depend on the toxicity of the pesticide, the measures taken during its application, the dosage applied, the weather conditions prevailing during and after application, and how long the pesticide persists in the environment.

The development and enforcement of effective pesticide policy and regulations represent important components to address these recognized problems. The particular case of pesticides use in Ethiopia is here developed as an opportunity to better understand pesticide governance. As an agricultural country, Ethiopia relies heavily on the use of pesticides to protect crops and increase yields. During the past decades, Ethiopia has experienced an approximate four-fold increase in pesticide use. Ethiopia has developed a pesticides regulatory system with procedures and regulations governing the whole pesticide life cycle: from registration and procurement, import/local manufacture of pesticides to disposal of empty chemical containers. A pertinent and timely question is, whether the Ethiopian policy on pesticide registration, distribution and use are implemented in an effective and sustainable way? Empirical research on the pesticide governance in Ethiopia has not been done up till now.

In this light, the main objective of this study is to examine the interface between policy and practice with respect to governing pesticides in relation to the challenges of registration, importation, distribution and use and to review how different actors (state, market actors and the farmers) can better govern pesticides to achieve environmental sustainability and workers' health and safety. The following research questions are addressed:-

(i) what are the main obstacles (barriers) to effective state enforcement of the existing pesticide policy in Ethiopia?
(ii) how, why and under what circumstances can private actors contribute to address problems and offer solutions across the pesticide supply chain?
(iii) In what ways have pesticide selection and use practices among smallholder vegetable farmers been influenced by their lifestyles and the systems of provision?
(iv) how and to what extent do private certification standards govern environmental and social dimensions of pesticide use practices along the global flower supply chain?

In order to answer these questions, this study uses various concepts drawing on both environmental governance and sociological theories as sources of inspiration and information to assess the overall pesticide registration, distribution and use practices in Ethiopia. Within the domain of environmental governance of pesticides this thesis examines the role of the state, traders and users and their interactions. The study uses the agricultural sectors of vegetables and cut flowers as cases. Methodologically, primary and secondary data collection was done through fieldwork for all case studies, using surveys, key informant interviews, field observations, and document analysis. A combination of quantitative and qualitative techniques were used. This thesis has six chapters: an introduction, four empirical studies and a conclusion.

In the introductory chapter, I provide a brief overview (background) of the existing negative environmental and health effects of pesticides and the governance challenges from the local to the global level, culminating in the objectives and research questions of the study.

Chapter 2 presents an overview of the main obstacles (barriers) to effective state enforcement of the existing pesticide policy through a greater understanding of actors' information, motivation, recourses and their interaction. The regulatory policy to control pesticides importation, distribution and use in Ethiopia has not been enforced effectively at the federal, regional and local (farm) level. The analysis revealed several key barriers for managing agricultural pesticides in Ethiopia. One of the main obstacles to effective pesticide regulation in Ethiopia is the lack of inspection and quality control for pesticide management. This deficit has weakened the enforcement of existing regulations, resulting in improper trading, misuse/overuse of pesticides, and consequently, increased environmental contamination and human exposure. Pesticides regulations are repeatedly violated by private actors (importers, wholesalers and retailers). In addition, lack of an appropriate registration system in relation to evaluation of detailed data on physical and chemical properties, toxicology, efficacy, residues, environmental effects and proposed use on crops and/or pest presents challenges for the Ethiopian government in effectively managing and controlling pesticide use. Hence, a weak regulatory system (lack of collaboration among actors ,and lack of capacity) at a national level and a lack of technical knowledge, motivation, interaction and resources of actors/implementers at the local level jeopardises implementation of pesticide policy. In particular, the lack of technical knowledge among extension workers on pest identification and how to recommend the appropriate pesticide against that pest is a major challenge as witnessed by many farmers and extension supervisors. The chapter concludes that involvement of and collaboration with private actors is likely to improve the implementation of pesticide governance, and may contribute to sustainability in agricultural and food systems in Ethiopia.

Chapter 3 investigates how, why and under what circumstances Ethiopian pesticide supply chain actors deal with (un)sustainable distribution and use of pesticides and assesses their potential contribution to secure the quality, environmental safety and sustainability of pesticides importation, distribution and use. The analysis reveals that the pesticide distribution system largely explains the disorder in the pesticide markets. Distributors have been strongly guided towards (short-term) economic interest without adequate consideration of their responsibility towards policy, safety of other people and the environment. Supply and distribution of pesticides to reach end users is not properly conducted, especially by most of retail shops. While some importers follow the requirements of the policy, most retailers are not complying with recommended practices under national pesticides legislation on registration and sale of their pesticides. As such there are unscrupulous traders of pesticides. The existence of unlicensed and untrained traders, especially among retail shops that have not been registered and with incompetent personnel, has resulted in a lack of information to adequately advise end users as farmers on the use of pesticides. As a result pesticides end users, specifically smallholder farmers, are the victims of the existing trading system. The chapter concludes that the contribution of private pesticide actors (traders) is not helpful in addressing the current problems related to pesticide trade in Ethiopia and that the current situation on selling practices needs change. The classical literature on market failures in the provision of collective goods, such as environmental quality and public health, points to a strong state to look after such provision, where states have a strong and relative autonomous power vis-à-vis the market. But as the Ethiopian state is not very strong, public-private-civil society partnerships might constitute an attractive alternative strategy.

Chapter 4 examines in what ways pesticide selection and use practices among smallholder vegetable farmers have been influenced by lifestyles and systems of provision. I argue that understanding farmers' pesticide use practices is important in order to develop interventions that prevent or reduce environmental and health risks and create more sustainable pattern of use. With this chapter, I try to 'open up the black box' of Ethiopian smallholder farmers as far as their pesticide use practice is concerned. The search for short-term profit dominates the business strategy of most pesticide importers and retailers and leads to the continuous increase in types of pesticides. This increase of pesticide names makes it even more difficult for small holder farmers to make an appropriate selection and is contributing to the misuse of pesticides in vegetable production. The findings reveal that small holder vegetable farmers spray a wide range of different pesticides and apply pesticides haphazardly without using the appropriate rate and frequency of application and safety measures. Lifestyle elements (such as income, farm size, age, gender, their own long year experience) and systems of provision (such as (lack of) technical training/ support either from dealers or governmental services, aggressive marketing by dealers, (lack of) alternatives to chemical pesticides) play a role in shaping farmers' actual pesticide use practices since they act rationally within the context of their available resources and socioeconomic objectives. The chapter concludes that re-orienting farmers' lifestyles and changing pesticide systems of provision requires socio-technical innovations as well as policy reforms and strategic interventions.

Chapter 5 assessed how and to what extent private certification standards govern environmental and social dimensions of pesticides' use practices along the global flower supply chain. As a governance instrument, private certification of cut flowers and other high-value agricultural commodities is used widely. In principle, it can improve growers' environmental and social performance, even in countries where state regulation is weak. In chapter 5, I use detailed farm-level data to analyse the environmental and social impacts of flower certification in Ethiopia. Results are shown from the comparative analyses between bronze certified flower production and silver/gold certified with double and/or triple high level international certifications. An analysis of the characteristics of the growers concludes that most environmental and health and safety variables do not show significant differences between these certification systems in terms of pesticide governance, except for providing some basic facilities and sophisticated farming system. It is hard to see how certifications currently make a visible difference on the ground in terms of safety for the environment and workers health. The chapter concludes that to safeguard the environment and health/safety of workers through certifications, all players in the supply chain (grower to consumers) should feel responsible for fair social and environmental conditions and act accordingly. This can only be achieved through transparency and traceability throughout the entire supply chain.

Chapter 6 reflects on the thesis's research questions and used theories and draws general conclusions vis-à-vis the governing actors in pesticide governance. The overall challenge is that pesticide governance tends to be highly fragmented and has to create interaction (partnership) between state, business (private) and civil society in order to improve formulation and especially implementation of policies and regulations. In pesticide registration, distribution and use I have found that the major governance challenge concerns the translation of pesticide policies and standards into effective implementation in distribution and use practices. This thesis also contributes to theoretical and empirical insights into the changing nature of environmental governance. The contribution of this study is two-fold. First, pesticide governance is increasingly relevant to theoretical and applied governance discussions due to its environmental and human health concerns in a globalized world. The findings may have implications for the development of larger scale pesticide governance structures addressing global-scale environmental issues. Second, using a governance approach provided a useful dimension to improve understanding of the critical aspects of governance structures and processes that shape pesticide registration, distribution and use over time, and which are crucial to the study of agricultural and environmental sustainability. This provided the opportunity to identify additional arrangements that shape policy success that are often missed in policy implementation. I found a number of challenges to pesticide governance resulting from the lack of monitoring and coordination of actors at various stages in the pesticide supply chain; governance that is unresponsive to emerging challenges is causing risk for environment and human health. In light of the findings, I suggest recommendations in three areas: (i) strengthening the ties between pesticide registration, distribution and use, (ii) public investments in research, (iii) comprehensive human and institutional capacity development. Broadly, this thesis contributes to the understanding of the governance arrangements of pesticide to inform policy makers, civil society, business actors, sustainability certifications as well as scientists and academia about the underlying rationalities and processes, the challenges and prospects of proper and safe pesticide registration, distribution and use in developing countries including Ethiopia. The thesis ends with a reflection on a future outlook.

Belay Tizazu Mengistie
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Advanced Social Theory (RSO32806)	Rural Sociology Group, WUR	2011	6
Qualitative Data Analysis: procedures and Strategies (YRM60806)	Research Methodology Group, WUR	2011	6
Environmental Policy : Analysis and Evaluation (ENP34306)	Environmental Policy Group, WUR	2011	6
Research proposal writing	WUR	2011-12	6
Integerated Pest Management (IPM) and Food Safety	Centre for development innovation (CDI)	2013	6
Participatory Approaches in Planning ,Policy and Development	Wageningen School of Social Sciences	2011	3
Social Theory and the Environment (ENP32806)	Environmental Policy Group, WUR	2013	
Climate Governance (ENP36306)	Environmental Policy Group, WUR	2016	
B) General research related competences			
WASS introduction Course	Wageningen School of Social Sciences	2011	1
Scientific Publishing	Wageningen Graduate School	2012	0.3
Information literacy including endnotes	Wageningen Graduate School	2012	0.6
Techniques for Writing and Presenting a Scientific Paper	Wageningen Graduate School	2013	1.2
C) Career related competences/personal development			
'How sustainable pesticide governance can address the environmental and health effects of pesticide in flower and vegetable farms of Ethiopia: Environmental governance perspective '	Poverty and Empowerment In Africa conference ,University of Texas, Austin	2012	1
'What policy says and practice does: Pesticide registration, distribution an use in Ethiopia'	Pesticide Risk Reduction Programme (PRRP) conference, Ethiopia	2012	0.5
'The roles of private actors in Environmental governance'	PRRP seminar, Ethiopia	2014	1
'Environmental and socio economic implications of floriculture industry in East Africa: the case of Ethiopia'	IGAD Economic Conference, United Nations Conference Center (UNCC) in Addis Ababa, Ethiopia.	2014	1
Project and Time Management	Wageningen Graduate School	2012	1.5
Environmental Governance Seminar Series	Environmental Policy Group, WUR	2012-16	2
Editorial board of SM Journal of Environmental Toxicology	SM Journal of Environmental Toxicology	2016	2
PhD Research Exchange on environmental science-policy interface	KU Leuven university, Belgium, University of Bonn and Freiburg, Germany and Eth-Zurich, Switzerland	2014, 2016	3
Total			**48.1**

*One credit according to ECTS is on average equivalent to 28 hours of study load

About the author

Belay Tizazu Mengistie was born in Gojjam, Ethiopia. He completed his primary and secondary education in Bichena, Gojjam. He obtained his bachelor degree in Geography (2002) and his master degree in Geography and Environmental Studies (2006) and second master degree in Development Studies (2008) at Addis Ababa University. From 2003-2011, he has been employed by St Mary's University, Adama Science and Technology University and several public and private higher institutions as lecturer. Since he joined the university, he taught a number of courses including Development Studies and Environmental Management and published several teaching materials individually and with his colleagues. He is also involved in carrying out research and consultancy activities especially those related to rural livelihoods and evaluation of development projects. He contributed to scientific articles on rural livelihoods and environment. He enrolled in several academic and professional trainings on rural livelihoods, management of projects and environmental impact assessment(EIA) among others.

At the end of 2011, he started his PhD research at the Environmental Policy Chair Group of Wageningen University, The Netherlands. He did his PhD research on *'Environmental Governance of Pesticides in Ethiopian Vegetable and Cut Flower Production'*. His PhD study focuses on agropesticides and their governance mechanisms as well as the possible options that state and non-state actors (private-farmers-civil society relationships) play pivotal role in promoting sustainable agriculture. His research interests include policy implementation, pesticides, environmental governance, agro food supply chain, and sustainable consumption and production, Integrated pest management and food safety. He presented several scientific papers in national and international conferences. He will continue to teach and do research on environmental governance and policy. As part of this PhD research project, the author has published the following articles:

- **Belay T. Mengistie**, Arthur P.J. Mol, Peter Oosterveer, Belay Simane (2015).The Missing elements in Agricultural Pesticide Policy Implementation in Ethiopia: *International journal of agricultural sustainability*, 13(3), 240–256.
- **Belay T. Mengistie**, Arthur P.J. Mol, Peter Oosterveer, (2016). Private Environmental Governance in the Ethiopian Pesticide Supply Chain: Importation, Distribution and Use , Wageningen journal of Life Sciences,76: 65–73.
- **Belay T. Mengistie**, Arthur P.J. Mol, Peter Oosterveer, (2015). Sustainable pesticide use practices among vegetable farmers in Ethiopia, *Environment Development and Sustainability*. http://dx.doi.org/10.1007/s10668-015-9728-9.
- **Belay T. Mengistie**, Arthur P.J. Mol, Peter Oosterveer, (in press).Pesticide Governance Through Private Environmental and Social Standards in the Global Cut Flower Chain from Ethiopia. *Ambio, A Journal of the Human Environment,*

Other publications

- **Belay T. Mengistie (**2016 in press) Policy-practice nexus: Pesticide registration, distribution and use in Ethiopia. *Environmental Toxicology*.
- **Belay T. Mengistie** (2016,under review) Sate failure to protect people and the environment: Bamako Convention on the Control of Transboundary Movement and Management of Hazardous Wastes within Africa**.** *Journal of National Resources and Environment Law.*
- **Belay T. Mengistie** (2011) Analysis of socio economic and institutional factors affecting the adoption of modern farm inputs in subsistence farming in North West Ethiopian. Agricultural Geography perspective. Grunham, German.

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