Towards Integrated Pest Management in East Africa

A feasibility study

Youri Dijkxhoorn, Johan Bremmer and Eric Kerklaan

LEI
WAGENINGEN UR

Towards Integrated Pest Management in East Africa

A feasibility study

Youri Dijkxhoorn[1], Johan Bremmer[1] and Eric Kerklaan[2]

1 LEI Wageningen UR

2 DLV Plant

This study was carried out by LEI Wageningen UR and was commissioned and financed by the Dutch Ministry of Economic Affairs.

LEI Wageningen UR
Wageningen, December 2013

LEI 13-103

LEI
WAGENINGEN UR

Youri Dijkxhoorn, Johan Bremmer and Eric Kerklaan, 2013. *Towards Integrated Pest Management in East Africa; A feasibility study.* Wageningen, LEI Wageningen UR (University & Research centre), LEI 13-103. 48 pp.; 16 fig.; 8 tab.; 23 ref.

Key words: East Africa, horticulture, pesticide registration, (bio) pesticides and natural liquids

This report can be downloaded for freer at www.wageningenUR.nl/lei (under LEI publications).

Postbus 29703, 2502 LS Den Haag, The Netherlands, T +31 (0)70 335 83 30, E informatie.lei@wur.nl, www.wageningenUR/nl/lei. LEI is part of Wageningen UR (University & Research centre).

LEI 13-103

Cover photo by Ingrid Korving (Weeding to prevent pests and diseases in Rwanda)

Contents

Preface

Pesticide risk reduction through registration of less hazardous pesticides and the promotion of non-chemical pest and disease control approaches such as Integrated Pest Management (IPM) is essential for a more sustainable plant production in East Africa in order to enhance both export market access and food safety. This study gives guidance for the transition towards a further adoption of IPM in East Africa. It describes the current situation and presents the incentives for and obstacles to the East African countries.

There are various initiatives to strengthen the institutional, economic, political and social aspects in the East African region. The East African Community (EAC) is working jointly on different themes, including agricultural development and reducing trade barriers. Also, in the field of pesticide legislation further steps should be made. A regional approach in establishing a framework for the registration of pesticides and bio pesticides and natural liquids would be a first step in creating the institutional environment to make actions more effective and efficient.

The researchers would like to thank all who have participated in our interviews for their enthusiastic input and cooperation. In particular we want to thank Ingrid Korving from the Ministry of Economic Affairs for her supervision and support, Hans van den Heuvel (Agricultural Counsellor in Ethiopia), Bert Rikken (Agricultural Counsellor in Kenya) and Teddy Muffels (Agricultural Counsellor in Rwanda) for their assistance in the organisation of the mission in Ethiopia, Kenya and Rwanda.

Ir. L.C. van Staalduinen
Director General LEI Wageningen UR

Summary

S.1 Main findings

In East Africa there is difference in the adoption rate of Integrated Pest Management (IPM). There are differences between export-oriented farmers and smallholders. Also between export-oriented farmers there are differences. About 60-70% of the rose famers in Kenya and Ethiopia are estimated to have implemented IPM. However, the adoption level among export-oriented vegetables farmers is still limited. In Kenya this share is estimated at around 5%. The adoption rate among smallholders is nil.

Export farmers have a strong market incentive to adopt IPM. They have to comply with strict regulations on the EU market related to the type and quantity of chemicals. These regulations are set by the dominant retailers and apply to both flowers and vegetables. This limits the available chemicals significantly and farmers are looking for alternative methods to control pest and diseases. In addition, export-oriented farmers have the knowledge and the financial resource to introduce beneficials and natural liquids successfully.

Smallholders have a dominant position in all East African countries and they produce the majority of the horticultural products for the domestic market. The IPM adoption rate is low since there are no incentives from the market to start with IPM. In addition, farmers lack resources like knowledge and finance that are essential to successfully implement IPM.

S.2 Transition

Two groups of countries with similar characteristics have been identified. The first group consists of Kenya, Ethiopia and Tanzania. These countries have a large number of export-oriented farmers. Many are foreign owned, and thus, backed by significant financial capital. This brings in advanced knowledge about alternative pest and disease management approaches like IPM. Dutch owned farms are often considered as a shining example for other farmers in the region. IPM products like IPM compatible chemicals, commercially produced biological beneficials and liquids from a natural origin are available and in some cases locally produced.

The second group is Rwanda, Uganda and Burundi. In these countries farmers are more focused on the domestic or the regional market. They lack the market incentive to use alternative crop protection approaches like IPM. In addition IPM products like IPM compatible chemicals, commercially produced biological beneficials and liquids from a natural origin are hardly available. Often, the supply industry does not see smallholders as a potential market due to a lack of resources (both financial and technical). In addition, there is a lack of a well-developed institutional environment to register for biological beneficials and natural liquids.

The East African Community is working jointly on many different policy themes, including agricultural development. A regional approach is highly recommendable for the following themes:

- Regional harmonisation of legislation;
- Capacity building for registration and post registration, including updating the facilities;
- Critical review of current registered pesticides on a regional level;
- Awareness;
- Development and facilitation of the supply industry;

A country-specific practical training programme for smallholders and export-oriented farmers needs to be developed. The focus for smallholders should be first on GAP and some the basic principles of IPM, whereas the focus for export-oriented farmers can be fully on IPM.

S.3 Method

This study gives an overview of the current incentives and obstacles that are essential for further scalability of IPM in East Africa in order to develop a sustainable horticultural sector. We have assessed the potential of IPM in East Africa based on the framework developed by De Lauwere et al. (2005). We have identified various factors that influence the decision of farmers to adopt IPM:

- Economic factors;
- Personality and firm related factors;
- Institutional factors;
- Technical factors.

Desk research has been executed in which recent documents have been collected and screened for information. Then a mission has been organised to Ethiopia, Kenya and Rwanda in which a number of firms, private, public bodies and universities have been interviewed in order to collect in-depth information.

1 Introduction

1.1 Background

Many of the current practices applied by smallholders in East Africa rely on the input of broad spectrum chemicals for pest, disease and weed control. Overuse, misuse, and mismanagement of chemicals are common. Environmental damage, reduction in agricultural productivity, health risks for users and food safety risks are potential dangers.

Banned, unregistered or counterfeit products are widely available on the East African market and many products are hazardous. Pesticide risk reduction through registration of less hazardous pesticides and the promotion of non-chemical pest and disease control approaches like Integrated Pest Management (IPM) is essential for a more sustainable production of horticultural produce in East Africa.

In addition the Eastern African countries are in the process of intensifying their agriculture to meet national food demands and to increase exports. For export there are strict regulations on the EU market related to the number and type of chemicals used during cultivation. Maximum Residue Levels (MRLs) for vegetables and fruits are controlled by the EU. Also, some supermarket retailers are autonomously testing MRLs on flowers and are setting strict standards. This limits the product range of chemicals for pest and disease control and is a major incentive for the adoption of IPM among export-oriented farmers.

1.2 Objectives

There are various initiatives to strengthen the institutional, economic, political and social aspects in the East African region. The East African Community (EAC) is working jointly on different themes, including agricultural development and reducing trade barriers. Also, in the field of pesticide legislation the first steps have been made: a recent workshop in Rwanda was organised to build a regional strategy for improved pesticides management. In the workshop, organised by Alterra Wageningen UR and FAO, more than 30 participants from national governments, farmers' organisations, and the private sector agreed upon a twenty-one point action plan with actions ranging from import controls to stopping counterfeit and illegal pesticides from entering countries. Also, the importance of using natural controls instead of chemicals was mentioned as important. The East African countries agreed that working together would make actions more effective and efficient. The regional workshop was inspired by the PRRP[1] project, which is currently being implemented in Ethiopia.

This study gives guidance for the transition towards a higher level of adoption of IPM in East Africa. It presents the incentives and obstacles for each country.

[1] The Pesticide Risk Reduction Programme (PRRP) is based on all identified needs in terms of human and institutional resources for the implementation of pesticides and bio pesticides registration and the needs for the enforcement of post registration activities. It covers both agricultural pesticides as well as public health pesticides.The programme is implemented by the Ethiopian ministry of Agriculture, Alterra Wageningen UR and FAO and funded by the government of the Netherlands and FAO.

1.3 Method

Many factors influence decision making by farmers and growers to adopt IPM. In order to assess the potential of IPM in East Africa, we have elaborated on a framework developed by De Lauwere et al. (2005). They distinguish four main categories of factors that influence the conversion to IPM:

- Economic factors;
- Personality and firm related factors;
- Institutional factors;
- Technical factors.

The focus is on IPM for the export crops such as roses and beans. Furthermore, we will give direction for further implementation of IPM in the region. Desk research has been executed in which recent documents have been collected and screened for information. Then a mission was organised to Ethiopia, Kenya and Rwanda in which a number of firms, private, public bodies and universities were interviewed in order to collect in-depth information.

1.4 Reading guide

The reports give a brief outline on the methodology applied in the research. In Chapter 3 we will give a detailed overview of IPM and all the different aspects belonging to this concept. Chapters 4-7 give an overview of the current developments of horticulture in each country, including the main crops and current exports based of a literature study. Furthermore, it gives an overview of the current IPM situation of each country based on the four main categories of factors that influence the conversion to IPM. Chapter 8 will conclude on our findings and will give guidance towards a further adoption of IPM in East Africa.

2 Methodology

2.1 Framework

Many factors influence decision making by farmers and growers to adopt IPM. In order to assess the potential of IMP in East Africa, we have elaborated on the framework developed by De Lauwere et al. (2005). They distinguished four main categories of factors based on various stakeholder meetings to identify the drivers that have been important for the conversion process to IPM in the Netherlands. The following categories have been identified:

- Economic
- Firm and personality
- Institutional
- Technical

Economic factors comprise:

- Market potential (local and export, vegetables and flowers): Is there a demand for IPM-grown products?
- Change in physical production: Can the same production level be realised compared to conventional production?
- Costs for adoption: Which investments and ongoing costs have to be made?

Institutional:

- Governmental support: Is there support for sustainable agricultural development including IPM?
- Legal aspects: Which limitations and support are present in regulations, such as pesticide registration and permit for import of beneficials and natural liquids?
- Knowledge: To what degree is knowledge about and experience with IPM present and to what degree is a network of technical support present?
- Social aspects: aspects such as image, social pressure and consumer wishes.

Technical:

- Inputs: Are all inputs to apply IPM supplied by specialised IPM suppliers or chemical suppliers?
- Natural circumstances: Are all environmental conditions present to apply IMP successfully such as soil quality, weeds, labour?

Firm and personality:

- Ideology: Do farmers and growers have a personal conviction to produce sustainably?
- Capacity: Are farmers and growers capable of applying IPM?
- Firm conditions: does there firm allow application of IPM.

2.2 Interaction

The above-mentioned aspects are interrelated. E.g. if biological beneficials and natural liquids agents are not available, farmers and growers will not have the ability to develop knowledge and get experience. Therefore, we have shown the relationships with the aspects in Figure 3.1. To our view, institutional aspects are at the core of the framework, with strong relationships with the other aspects. Therefore institutional aspects are placed in the middle of the figure. However, application of this framework in field research is not always easy. Therefore, alternative arrangements of the same aspects are possible. A practical structure is to arrange the aspects in the following way:

1. Do farmers and growers have the knowledge to apply IPM:
    a. Personal knowledge
    b. Access to knowledge and experience in network of colleagues, suppliers and advisers

2. Do farmers have the motivation to apply IPM:
   a. Personal ideology
   b. Social conditions
   c. Market demand
3. Do farmers have the ability to apply IPM:
   a. Regulations
   b. Availability of inputs
   c. Personal and firm conditions.

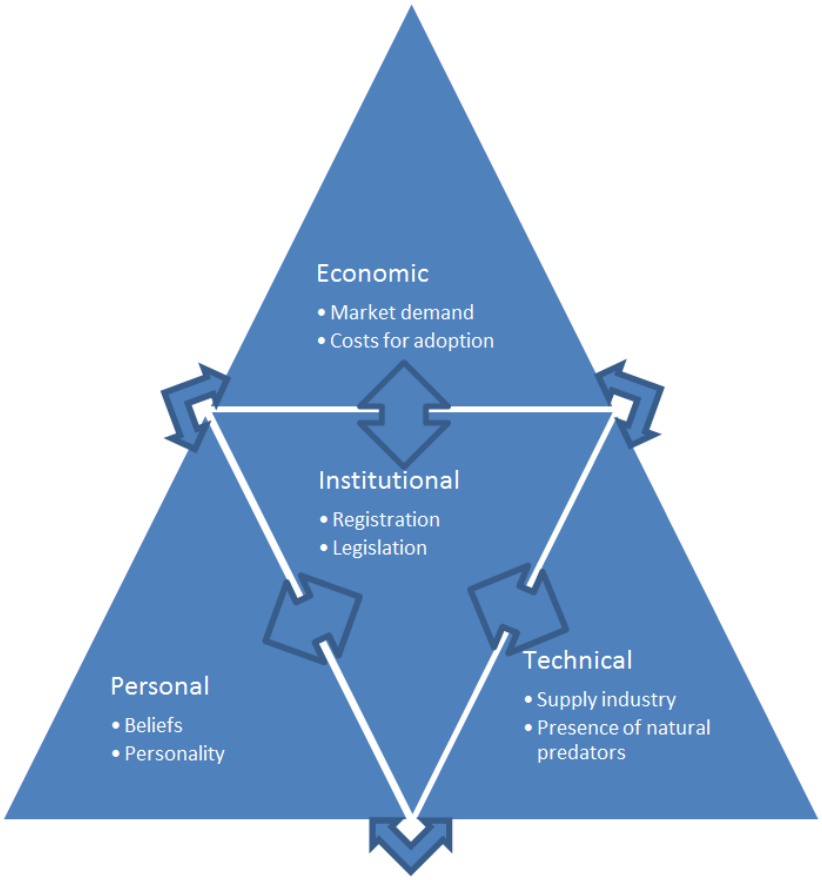

Figure 2.1 *The factors that influence the transition to IPM.*
Source: LEI Wageningen UR

2.3 Approach

In this project the following approach has been followed. Based on the framework presented in Section 3.1 a checklist of relevant aspects was developed. Afterwards, desk research was executed in which recent documents were collected and screened for information. Then a mission was organised to Ethiopia, Kenya and Rwanda in which a number of firms, private, public bodies and universities were visited and interviewed in order to collect additional and in-depth information. A list with interviewed stakeholders can be found in Appendix 1. Finally, all collected information was structured, analysed and then presented in this report.

3 Integrated Pest Management

3.1 Definition

Integrated Pest Management (IPM) is an approach designed to manage pests and diseases with as little damage as possible to people, the environment and beneficial macro- and micro-organisms. Sophisticated, well-considered strategies in which all components to prevent pests and diseases fit together are the cornerstone of IPM. Different techniques and products are used within IPM, including scouting, monitoring, crop sanitation, cultural and mechanical control, and the introduction of beneficial insects and mites. Corrective chemical control measures are used as a last resort (Koppert.com).

Increased environmental awareness has led to the need for sustainable agricultural production systems. Good Agricultural Practices (GAP) and IPM have become essential components of sustainable agriculture. The integration of the various control measures supports consumer safety and enhances international market access.

A study by Den Belder and Elings (2007) mentions heavy use of pesticides in current rose cultivation in Ethiopia. This has a negative influence on the productivity (an estimated 10% yield reduction), high cost (pesticides account for 25% of expenditures in Ethiopia) and increased resistance development. Implementation of IPM can address these issues.

3.2 Origin of IPM

The roots of IPM can be traced to the late 1880s when "ecology" was identified as the foundation of scientific plant protection. The advent of modern synthetic insecticides in the mid-1940s resulted in a shift of focus to pesticides technology. Over the next 30 years, recognition of the limitations, and often risky consequences of over-reliance on pesticides, led to the formulation of the concepts of IPM. Pesticide-based pest control still dominates in global horticulture. However, biological beneficials and natural liquids are increasingly complementary to the conventional agrochemicals.

3.3 Pest and disease control within IPM

The emphasis of IPM is on control, not eradication. Wiping out a whole pest population is often impossible, and it can be expensive and environmentally unsafe (EPA, 2012). IPM programmes work to create acceptable pest levels. But at some point the pest level reaches a point where it begins to cause enough damage to justify the time and expense of control measures. This called the Economic Injury Level (EIL). Below the EIL, it is not cost-effective to control the pest population because the cost of treatment exceeds the amount of damage. Above the EIL the cost of control is compensated by an equal or greater reduction in damage by the pest. By allowing a pest population to survive, selection pressure is reduced and this lowers the chance of pests developing resistance to chemicals. By not killing all the pests there should be unresistant pests left that will dilute the prevalence of any resistant genes that might appear.

To apply IPM there is a wide range of biological and chemical pest and disease products:

- Macro-biological controls;
- Microbiological controls;
- Biological liquids and powder controls;
- Chemical and biochemical controls;
- Other products such as mechanicals controls.

In the following paragraphs we will discuss each product.

3.3.1 Macro-biological controls

Macro-biological controls are natural enemies are organisms that kill, decrease the reproductive potential of, or otherwise reduce the numbers of another organism. Natural enemies that limit pests are key components of IPM programmes. Important natural enemies include insects and mites, which can function as predators or parasites. Picture 3.1 and Picture 3.2. give an example of the effects of spider mite in rose production and natural enemies against it.

Picture 3.1 *Spider mite in rose production.*
Source: E. Kerklaan (DLV Plant)

Picture 3.2 *Macro control: Amblyseius californicus.*
Source: E. Kerklaan (DLV Plant)

3.3.2 Microbiological control

Pathogenic microbiological organisms can be used for pest and disease control. These can include bacteria, fungi, and viruses. They kill or weaken their host and are relatively host-specific. Various microbiological insect diseases occur naturally, but may also be used as biological pesticides. When naturally occurring, these outbreaks are density-dependent in that they generally only occur as insect populations become denser. Picture 3.3 depicts an adult white fly which can be sprayed with the parasitic fungi Verticillium lecanii (Picture 3.4).

Picture 3.3 *Adult white fly.*
Source: E. Kerklaan (DLV Plant)

Picture 3.4 *White fly sprayed with the parasitic fungi Verticillium lecanii.*
Source: E. Kerklaan (DLV Plant)

3.3.3 Liquid and powder control

Liquids and powders are products that work as a repellent against insects, like extracts from a natural origin. These can be products such as insect paracitic fungi, garlic and clove extracts, but also products based on fatty acids that are repellent. These products are often available both as liquids and in powder formulation. In Pictures 3.5 and Picture 3.6, examples are presented of caterpillar control with Bacterial Bacillus Thuringiensis.

Picture 3.5 *Caterpillar.*
Source: E. Kerklaan (DLV Plant)

Picture 3.6 *Caterpillar controlled with Bacterial Bacillus Thuringiensis.*
Source: E. Kerklaan (DLV Plant)

3.3.4 Chemical and biochemical control

Synthetic pesticides are used as required and often only at specific times in a pest's life cycle. Many of the newer pesticide groups are derived from plants or naturally occurring substances (e.g.: nicotine, pyrethrum and insect juvenile hormone analogues), but the toxophore or active component may be altered to provide increased biological activity or stability.

Some synthetic pesticides do fit better in an IPM programme, compared to others (IPM compatibility). A range of products are IPM compatible. Various suppliers of IPM products like Koppert, Bio-best, Real IPM and Dudutech have developed a side-effects list of chemicals. All chemicals available on the market are classified based on the IPM compatibility and the products have been tested on the biological beneficials and natural liquids. Chemicals can have a green, orange or red classification. Green means that there is no waiting time with the introduction of biological beneficials and natural liquids. Orange means that there is a waiting period up to 3 weeks. Red indicates that there is a longer time period than 3 weeks before the reintroduction of biological beneficials.

3.3.5 Other controls

Observation is an essential part of IPM. Observation is broken down into two steps: inspection and identification (Bennet et al., 2005). Monitoring tools are used to monitor pest levels in the crops and accurate pest identification is critical to a successful IPM programme.

Record-keeping is important to understand the behaviour and reproductive cycles of pests. Plant pathogens also have similar patterns of response to weather and seasonal variations. Also mechanical methods are important elements of IPM. They include simple hand-picking, erecting insect barriers, using traps (like mass trapping and pheromones).

3.4 IPM for smallholders

Adoption among smallholders of IPM as defined above is low. Smallholders only use scouting and monitoring techniques occasionally. However, from a technical point of view, there are many more possibilities for smallholders to apply IPM techniques. For example, the introduction of biological beneficials and natural liquids can be of benefit. However, related to biological beneficials only the microbiological controls are suitable since smallholders often produce in the open field. For smallholders that produce in basic tunnels there are also opportunities for introducing macro-biological controls.

4 Kenya

4.1 Introduction

4.1.1 Floriculture

Kenya traditionally produces tea and coffee. Agriculture contributes 24% of the national gross domestic product (GDP). In 2004, the sector accounted for 2,000 ha. There are about 3,300 ha with flower cultivation (HDCA, 2012). The most important flower is the rose with a total area of about 2,600 ha. Other flowers are carnations, arabicum, hypericum, eryngium, alstroemeria and a variety of summer flowers (Figure 4.1).

Kenya is a major exporter of fresh flowers to Europe. The flower export represents a total export value of USD590m in 2012 (UN Comtrade). Kenyan companies have long benefited from a strong euro, making their costs in Kenyan shillings and US dollars relatively low. Important costs such as labour and energy are relatively low compared to other countries, but are on the rise. Kenyan flower producers do not pay import duty when exporting to Europe. The old system of preferential access to European markets for developing countries finished in 2007. At the moment the 'Economic Partnership Agreements' (EPAs) are being renegotiated and are still ongoing. They are now negotiated between the EAC and the EU.

In the EU there is increasing attention for chemical residues on flowers. Many supermarket retailers are sharpening their policy with respect the MRLs, for example specifying the chemical products that are allowed and reducing the total number of chemicals used for pest and disease control. This creates challenges for flower farms to produce good quality flowers with limited chemicals allowed. The main pests and diseases in the Kenyan rose production are thrips and powdery mildew.

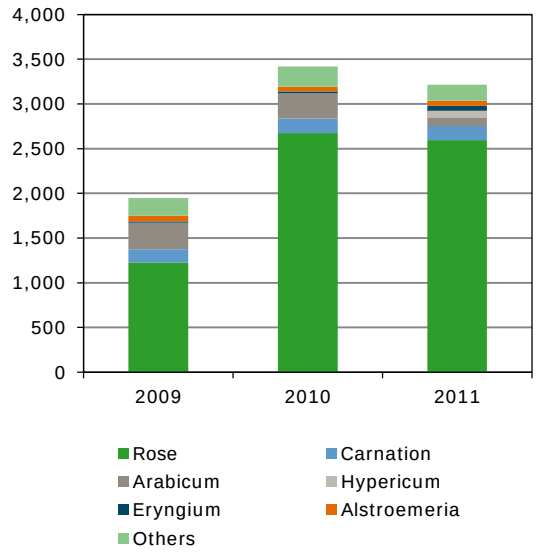

Figure 4.1 *Production area in ha of main flowers (2009-2011).*
Source: HDCA, 2012

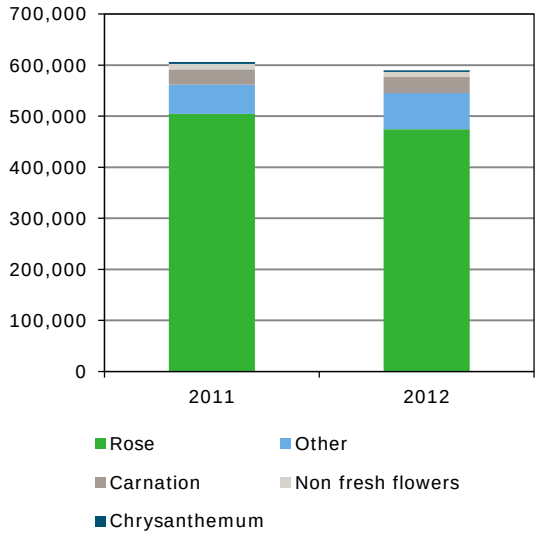

Figure 4.2 *Export of main flowers in USD1,000 (20010-2012).*
Source: UNComtrade

4.1.2 Vegetables

Smallholders are cultivating up to 80% of the horticultural produce (fruits and vegetables). There are also some large export-oriented farmers that produce vegetables on large areas of land. The main export crops are beans, snow and snap peas (Figure 4.4).

The majority of the farmers rely on the seasonal rains and plan their crops accordingly. Also, for smallholders beans are a popular cash crop due to their short growing period, which generates a more consistent cash income. Smallholders typically plant as much as they can sell, and those with contracts or commitment from an exporter may devote 100% of their land to the cultivation of green beans. Major problems in the bean production are aphids, thrips, bean fly and leafminer. The main diseases are rust and hello blight.

Vegetable production in Kenya takes place in the entire country, but especially around Nairobi, Lake Naivasha and Mount Kenya. The total area used for vegetable production is estimated at around 250,000 ha. Main products are cabbages, kales, tomatoes, garden peas and traditional vegetables.

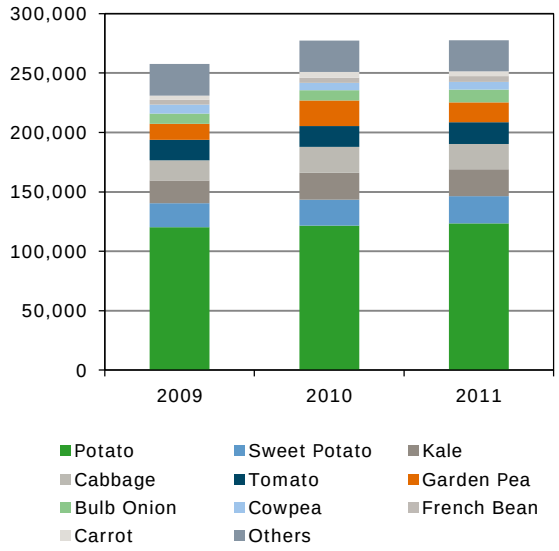

Figure 4.3 *Production area in ha of main vegetables (2009-2011).*
Source: HDCA, 2012

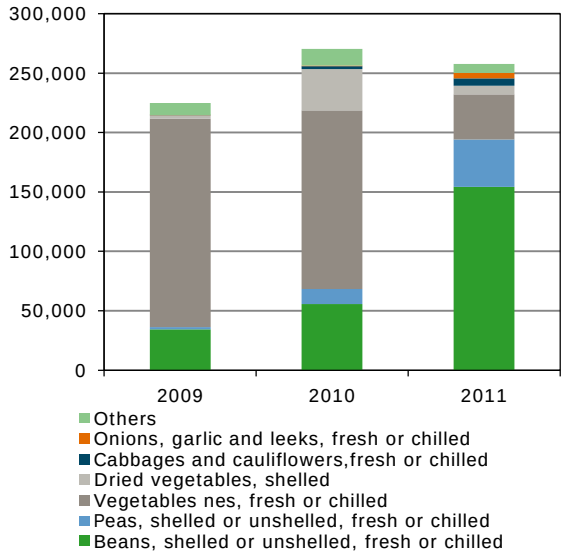

Figure 4.4 *Export of main vegetables in USD1,000 (2009-2011).*
Source: UNcomtrade

4.2 Current IPM practice

The central valley of the country offers favourable climates for many types of vegetables. Arable land in the central valley area is scarce and exploited to the maximum. This causes problems with infected soils, which affect plant health, productivity and product quality. Often growers tend to use large amounts of chemicals of dubious origin to fight plant diseases.

As discussed above, the ongoing discussion on chemical residues on vegetables and flowers creates challenges for farmers to produce good quality products with only limited chemicals allowed on the export market and as a result farmers have adopted IPM.

IPM is regarded as a necessary approach to pest and disease management in order to supply the European market. Based on expert estimations we found that about 70% of the flower producers apply IPM. Only 5% of the vegetable farmers have adopted IPM. Especially the Dutch export farmers have been leading in implementing IPM in the recent years. The main pest that is currently controlled

with biological beneficials is spider mite. Natural predators like californicus and andersoni in combination with selective chemicals are used.

Many flower producers breed their own predators, especially in the summer season. They breed Phytoseiulus persimilis and Amblyseius californicus against spider mite. In winter season they face problems due to humidity, so they source from a specialised supplier. About 30% of the flowers farm are active with breeding predators for spider mite. For some other pests, like thrips, there is no good predator on the market.

4.3 Feasibility

4.3.1 Technology

Kenya has a well-developed supply industry of horticulture inputs. Several companies are involved in the commercial distribution of biological control agents. Kenya Biologics, Dudutech and Real IPM are breeding locally in Kenya. Koppert from the Netherlands is also present on the market and imports the biological controls.

Training and support is also provided by the IPM and chemical input suppliers. But in general, the support is limited and commercially oriented. This means that the suppliers are not focused on helping farmers to produce sustainably with all IPM tools available, but limit their services to their own product ranges.

Compared to the Netherlands the costs of IPM are relatively low. Real IPM and Dudutech are producing locally, reducing the costs significantly. The average costs for natural predators in the Netherlands is between EUR3 and EUR3.5. In Kenya the price is estimated between EUR 1 and EUR 2.25. However, due to the presence of cheap chemicals with a broad spectrum, farmers often opt for the conventional products. This holds especially for the vegetable smallholders sector since the margins in this sector are on average lower compared to the flower sector, so they prefer the conventional cheaper products. This also creates problems for large vegetable producers that source from smallholders.

In Kenya there are various natural enemies that can be used as a biological control. Apparently it is more challenging to breed these macro-biological controls. The interviewed suppliers see a market for this but they lack the technical knowhow. Especially for mealy bugs and thrips in rose and bean production, there are indigenous predators available that can be used as a pest control. Possible predators for mealy bugs are Cryptolaemus montrouzieri (a beatle) and Leptomastix dactylopii (a predator wasp). For thrips, Orius majusculus and Orius laevigatus are native to Kenya. The institutional bodies are not supportive for the registration of locally produced biological controls.

On the EU market there are some IPM-compatible chemicals available, but they are not widely available in Kenya. As a result farmers are forced to use broad spectrum pesticides. This results in a long waiting time for farmers (6-8 weeks) before they can restart with the reintroduction of biological controls.

Suppliers of biological controls argue that supplying smallholders with biological beneficials and natural liquids is challenging. A cold chain is required for the supplying microbiological controls. Also, the price is considered to be too high for smallholders.

4.3.2 Personality and firm related

The knowledge level of export-oriented farmers is high. However, many companies are not exactly aware of the chemicals that are IPM compatible. In other words, farmers often apply chemicals that kill the beneficials.

Smallholders in Kenya lack resources and knowledge to maximise their income. In general there is still a lot of work to be done in the field of Good Agricultural Practices (GAP). The basic principles of farming, like setting up a rotation schedule, or spraying chemicals in an effective way, would already help farmers to improve yields. The risk is that smallholders often apply conventional chemical pesticides that are cheaper to buy but are not allowed on the EU market. Therefore many large commercial farmers have stopped outsourcing from smallholders since they do not comply with the norms.

4.3.3 Economic

Kenya is a large exporter of flowers and vegetables to the EU market. Consumers in the EU market are more concerned about how products are produced. Therefore many retailers are setting limits with respect to the number residues and the nature of the residue. Especially vegetable producers face heavy penalties for applying chemicals that are not allowed on the EU market. In addition, EU buyers attach high importance to food safety and hygiene of food. IPM is regarded as the future for both vegetables and flower farmers.

4.3.4 Institutional

Kenya developed the Kenya Vision 2030 and the agricultural sector has been identified as a key sector within the economic pillar and has for the first MTP an annual growth objective of 5 to 7% (www.vision2030.go.ke). Exporting sectors such as horticulture contribute significantly to the GDP. Therefore the government is focused on facilitating the development of the sector. Also stimulation of sustainable production is an important aspect since sustainability is becoming essential for maintaining the export position. However, many companies in Kenya complain about the current business environment, in particular about the regulation, laws taxes and levies that are imposed and implemented by the government. And although the government claims to stimulate the creation of an enabling environment to encourage investment and trade, the reality in Kenya is far from that.

The Pest Control Products Board (PCPB) is a Statutory organisation of the Kenya Government to regulate the importation and exportation, manufacture, distribution and use of all pest control products. Together with the Kenya Plant Health Inspection Service (KEPHIS), the PCPB regulates the registration of biological controls. All biological controls have to go through the registration. All products have to be assessed on the effects on water, humans and the environment according to the local situation. This includes all biological controls (e.g. macro, micro and products from a natural origin).

The registration process for biological beneficials and natural liquids is similar to the registration process of conventional chemicals. However, an additional 'technical standing committee on the import and export' has been established. The secretary of this committee is facilitated by Kephis. The committee gathers 3 times per year. An evaluation by the committee can take a total of 8-12 months. The standing committee evaluates all submitted literature on the effects of the product. After this the evaluation is sent to the PCPB for re-evaluation. If the PCPB agrees, the product will receive a trial permit. A trial permit is for efficacy trials in the country. This has to be done by accredited public and private institutions. Research institutes like KARI and private companies like Finlay and Oserian are accredited for these trials. In total 3 seasons have to be tested. For example for roses, a period of 7 weeks is regarded as 1 season (= 1 flush). So in total 21 weeks have to be analysed. Other crops have longer seasons.

After this a research report will be submitted to the internal technical committee (PCPB). The results will be evaluated by the technical committee and this can take up to 2 months. After registration commercial trials can be started.

All costs are paid by the applicant. The costs are relatively low. For example, the cost for the trial permit is about KSH10,000 to cover the costs for monitoring and evaluation by the accredited public or private institute. In addition, the costs for the registration are KSH90,000. This is a permit for 3 years. After this period, a renewal is required that costs KSH20,000 and is valid for 2 years.

However, there are some bottlenecks:

- Limited capacity (manpower)
- Limited technological capacity to do the correct tests for the registration of the biological controls.

This creates an enormous backlog of over 100 dossiers to be evaluated. Therefore, liquids from natural origin are sometimes not registered as biological control. They are imported as a nutritional element. For this no registration is required.

Indigenous biological controls have to follow the same steps as the imported biological controls. Therefore, to start breeding indigenous natural enemies is not very well facilitated and a long process is often required in order to start. The total process for registration can take up as long as 3 years.

4.4 Conclusion and transition

In Kenya there is a big difference between export-oriented farmers and smallholders. The export-oriented farmers have strong knowledge about how to implement IPM at farm level. Many export-oriented farmers in Kenya are Dutch owned and work with advanced Dutch IPM techniques. The interviewed exporting farmers in Kenya have a drive for the adoption of IPM; there is incentive from the market to continue working with IPM. Exceeding the MRLs on the EU market will create serious problems for a farm. Previous MRLs were only applicable to vegetables and fruits, but recently the large retailers in Europe are also applying MRLs to flowers. For smallholders this incentive is lacking, except for the decreasing number of smallholders engaged in outgrower schemes.

Smallholders on the other hand lack knowledge about IPM and even have problems in applying GAP. The misuse of chemicals is high. In order to implement IPM successfully among smallholders, improved knowledge on general agricultural practices is required. This is considered to be prerequisite for adoption of IPM.

Inputs for a successful IPM programme are available. As discussed, there are several suppliers on the market with some basic natural predators which are easily to breed. The suppliers are focused on the export-oriented farmers. The more advanced predators to breed e.g. orius for thrips control in flowers and vegetables are missing in the current product range. Another problem is the availability of IPM-compatible chemical products, so growers are forced to use products that are not compatible with IPM and might kill the newly released predators. For smallholders there are no IPM products available. The suppliers of biological beneficials and natural liquids are not focused on this market segment since these farmers are small and lack resources. In addition, the costs are considered to be too high compared to conventional (older) products, so smallholders prefer these products.

In Kenya it is possible to register biological beneficials and natural liquids. However, the registration process is lengthy and the PCPB lacks capacity like specialised analytical equipment to do the right tests for analysing the biological beneficials and natural liquids.

Table 4.1

Summary of the incentives and obstacles per category

	Economic	Firm related	Institutional	Technical
Incentive	Export of vegetables and flowers to the EU creates strong demand for sustainable products. A small but upcoming domestic market is requesting safe food (Niche).	High knowledge level of export farmers Flower famers are breeding their own biocontrols against spider mites.	The registration of (bio) pesticides and natural liquids is possible Positive attitude of government towards IPM and increased sustainable production (Vision 2020). Stakeholders such as KFC and FPEAK are in favour of IPM.	Strong supply industry with local companies and foreign companies IPM compatible chemicals are not always available Natural enemies present in the country that can be used for pest and disease control.
Obstacle	A large majority of the domestic market has no demand for sustainable food production	Smallholders face problems in applying basic GAP as condition for applying IPM	Registration takes a long period and adequate resources are missing to test biocontrols and natural liquids. Companies complain about the taxes, levies, regulations and laws that are imposed and implemented by (local) government.	Training and support is commercially focused Current suppliers of biocontrols lack the knowledge to start breeding the more advanced beneficials.

5 Ethiopia

5.1 Introduction

5.1.1 Floriculture

In 2012, the sector accounts for 1,300 ha, of which the largest share is taken up by rose production, with some diversification into cuttings and products such as hypericum, gypsophila, lilies, and freesias. Most roses are sold on the EU market through the Dutch auction. A small number of firms sell directly to wholesalers and supermarkets.

The growth in the sector did not come easy. The floriculture sector has been heavily supported by the government, by facilitating investors from abroad. Wages are still low, considerably lower than in Kenya. The cold chain functions relatively well, especially since refrigerated trucking service providers joined in and are used extensively by exporters. Concerning the enabling environment, major bottlenecks are strict regulations concerning repatriation of foreign exchange earned on exports, lack of and adequate pesticide regulation, weak phytosanitary inspection and no protection of breeders' rights (Gebreeyesus and Iizuka, 2009). The major pest problem in the Ethiopian rose sector is thrips.

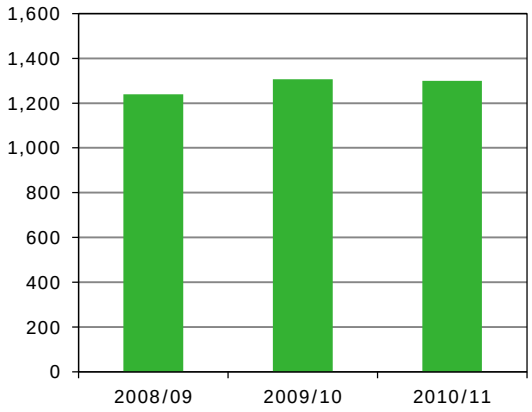

Figure 5.1 *Production area in ha of flowers (2009-2011).*
Source: EHDA

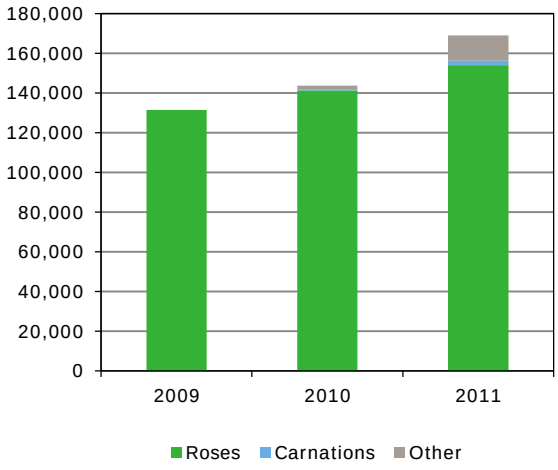

Figure 5.2 *Export of main flowers in USD1,000 (2009-2011).*
Source: UNComtrade

5.1.2 Vegetables

Vegetables are produced in the entire country on small plots of land by smallholders. As per the Census for 2008/09, the number of smallholders engaged in fruit and vegetable cultivation is estimated at 6m farmers. Smallholders produce 2.1m tonnes of vegetables from 260,000 ha.

Given the diverse range of altitudes in combination with irrigation potentials in different parts of the country it is possible to produce virtually all tropical, sub-tropical and temperate horticultural crops (Joosten et al., 2011). Among smallholders, Ethiopian cabbage (Kale) takes the highest share of about 50%, followed by red pepper with a share of 31%, and green pepper (10%). Smallholders often produce in mixed crop-livestock farming systems to maintain self-sufficiency in food and income.

Commercial production is concentrated in the eastern parts of the country in the Rift Valley area. Production by (private) export-oriented farms is encouraged by the Ethiopian Government. A small number of state-owned farms have evolved in large farms and are involved in the production, processing and export of fresh vegetables. In recent years several new horticultural investors have established farms in Ethiopia. In addition to the green beans, Ethiopia also exports fresh herbs, strawberries, and snow peas. The main export destinations are the surrounding countries (Sudan, Somalia, Djibouti), but also markets in the Middle East and the EU are being explored. The main pest in the vegetable sector is the Tuta Absoluta in tomato production, for which there are no chemicals available in the country for effective control.

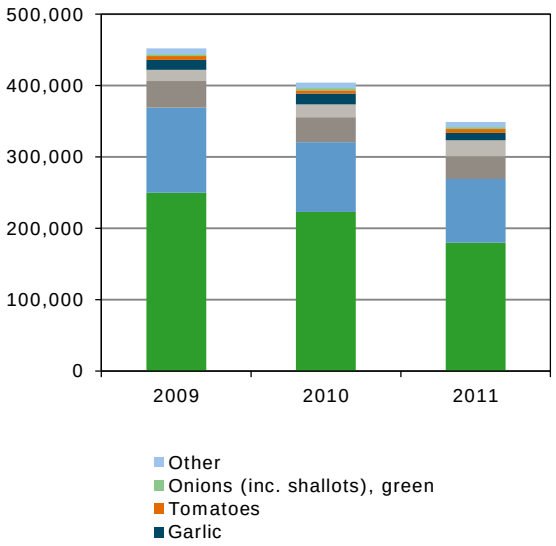

Figure 5.3 *Production area in ha of main vegetables (2009-2011).*
Source: FAOSTAT

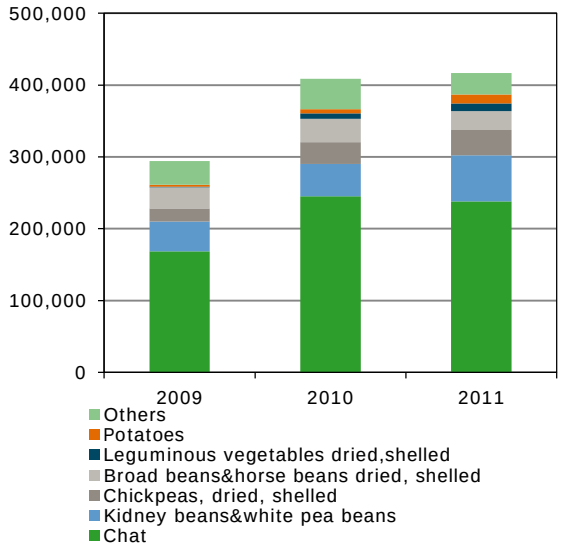

Figure 5.4 *Export of main vegetables in USD1,000 (2009-2011).*
Source: UNcomtrade

5.2 Current IPM practice

IPM is widely adopted by flower growers to control spider mite, for example with californicus and andersoni. Especially the foreign-owned farmers are a shining example. At the moment, estimations on the adoption of IPM among Ethiopian flower growers are at 50-60%. For vegetables there is only one farm (Jittu) that is working on IPM.

Many field trails were set up by Wageningen UR between 2008-2011 in the rose sector (Den Belder et al., 2009). In addition, a predator for thrips control was tested under local circumstances in the Koka region in cuttings. This project showed that Amblyseius swirskii can control thrips under various local conditions (November 2009-July 2010), and herb cuttings (Den Belder and Elings, 2010).

A project called ICPB, implemented by DLV Plant between 2009 and 2011, aimed at promoting a more sustainable way of producing flowers among Ethiopian flower producers. An essential component was IPM. About 20 Ethiopian owned farmers participated, of whom 3 successfully adopted IPM.

5.3 Feasibility

5.3.1 Technology

Ethiopia has a well-developed supply industry of horticulture inputs. The majority of the inputs for the export-oriented sector are imported from Kenya. Companies like Agrisher, Nedopia Horti Agro Trading (Horticoop), Baba Trading, Hortichem, Golden Rose, Ethio Horti Share, Axum and a cooperation formed by flower growers, the Ethiopian Horticulture Cooperative.

In addition there are several companies specialised in the commercials distribution of biological beneficials and natural liquids like Biobee, Dudutech, Koppert and Real IPM. Dudutech and Real IPM are from Kenya and are breeding locally in Kenya. Koppert (from the Netherlands) only imports biological control agents from the Netherlands. Biobee has an Israeli background.

Training and support are also provided by the IPM and chemical input suppliers. But in general the support is limited and commercially oriented and this is similar to the situation in Kenya. This means that the companies are not focused on helping farmers to produce sustainably with all IPM tools that are available on the market, but limit their services to their own product ranges.

Also in Ethiopia there are natural enemies present inside the country, especially for mealybugs and thrips. Possible predators for mealybugs are Cryptolaemus montrouzieri (beatle) and Leptomastix dactylopii (predator wasp). For thrips, predators are Orius majusculus and Orius laevigatus. However, at the moment the suppliers are not considering local breeding of these biological controls.

On the EU market there are IPM-compatible chemicals available, but they are not widely available in Ethiopia. Many importing suppliers face problems with the importation of inputs. In general, input suppliers face taxation of foreign products. As soon as they keep stock, it is obligatory to pay 150% tax. This makes it difficult to maintain sufficient stock. Now foreign products are directly imported by the clients to avoid tax. Therefore they are only available for exporting flower farmers. As a result, smallholders are forced to use broad spectrum chemicals, often produced inside Ethiopia. Endosulvan is produced locally and is therefore very popular in Ethiopia.

5.3.2 Personality and firm related

The export-oriented flower farmers have sufficient knowledge of implementing IPM. Smallholders are not aware of IPM. They often find it too expensive and they lack knowledge. Even basic knowledge on GAP is lacking.

They prefer to spray broad spectrum chemical products that are cheaper and have an impact on the pests and diseases. For example: Endosulvan is still popular in Ethiopia due to its broad spectrum. It is also locally produced and some people have an interest in this product. So substitution of this product might be a challenge.

5.3.3 Economic

Ethiopia is a major exporter of flowers to EU market. Consumers in the EU are more concerned about how products are produced. They demand more sustainable food products from retailers. Therefore many retailers set limits with respect to the number residues (MRLs) and the nature of the residue, which is why IPM is regarded as the future pathway by most the flower farmers.

Also for vegetables there is an increasing demand towards more sustainable produced crops and reducing the number of MRLs on crops. However, at the moment there is still limited adoption of IPM among the vegetable producers.

5.3.4 Institutional

The MoA is the leading party in the registration process. Within MoA the department of animal and plant health regulation is responsible. There is no official process for the registration of biological beneficials and natural liquids in Ethiopia, only for chemicals. However, the present registration process only focuses on completeness of the dossier and some toxic effects. In addition, flower producers are allowed to import non-registered pesticide directly to comply with European standards. The current registration process therefore lacks incentives for the pesticide industry to request registration of the latest IPM compatible pesticides. Biological beneficials and natural liquids are available in the country. They are brought in the country on an import permit. There appears not to be any capacity within MoA to judge biological beneficials and natural liquids for registration, therefore the only work with import permits.

For these import permits, efficacy trials are done by an authorised farm, such as the Ethiopian Institute of Agricultural Research. This institute assigns a researcher who will do the research on a farm that is selected by the applicant. This applies for all biological beneficials and natural liquids. The research focuses on the following: whether it works and what the effects are on other crops. The effects on the environment are often supplied by the applicant and come from the literature. The research takes about 0.5-2 years. For roses this is often short since only one season has to be analysed. But for other crops this can take much longer. The procedure for products for the flower and vegetables are the same. After approval the product can only be used in the tested crop but in practice the products are often sold for use in other crops too. The research costs are 30,000 Ethiopian Birr. This is about €1,200.

The biggest problem for the registration of biological beneficials and natural liquids is the lack of the registration process. In addition the MoA is missing capacity to judge dossiers that are awaiting registration. MoA is also missing the correct equipment to do the analysis required for registering biological beneficials and natural liquids.

However, at the moment the PRRP project in Ethiopia funded by FAO and the Dutch government is working on the improvement of the pesticide registration system. Within this project a new design of the pesticide registration and post registration has been made. This also includes the registration of biological controls. But at the moment the implementation is still pending.

5.4 Conclusion and transition

In Ethiopia there is a difference in resources of smallholders and export-oriented farmers. The export-oriented farmers have strong knowledge about how to implement IPM at farm level. The smallholders lack this knowledge. Many export-oriented farmers have Dutch roots and in the Netherlands the adoption rate of IPM is high among farmers. Smallholders lack knowledge about IPM and the misuse of chemicals is high. In order to implement IPM successfully among smallholders, improved knowledge on general agricultural practices is required. This is considered to be prerequisite for before starting the more advanced IPM.

The interviewed farmers in Ethiopia have a drive for the adoption of IPM, there is a strong incentive coming from the market to work with IPM. Exceeding the MRLs on the EU market will create serious problems for a farm. Previous MRLs were only applicable for the vegetable and fruits, but recently the large retailers in Europe are also applying MRLs for flowers. Especially the German supermarkets like Lidl, are sustaining low MRLs for their products. For smallholders this incentive is lacking. Except for a small number of smallholders engaged in outgrower schemes.

Inputs for a successful IPM programme are only limitedly available. As discussed, there are several suppliers on the market with some basic natural predators which are easily to breed. These suppliers often use insects from Kenya. At the moment the suppliers are focused on the export-oriented flower farms. The more advanced predators to breed, e.g. orius for thrips control in flowers and vegetables, are missing in the current product range, even though these predators are native to the country. The

current suppliers of biological beneficials and natural liquids are not focused on this market segment since these farmers are small and lack resources. In addition, the costs are considered to be to high compared to conventional (older) products often with a wide spectrum, so smallholders prefer these products.

In Ethiopia it is not possible to register biological beneficials and natural liquids. However, with an import permit it is possible to import the biocontrols in the country. This is a lengthy process which requires field tests.

Table 5.1

Summary of the incentives and obstacles per category.

	Economic	Firm related	Institutional	Technical
Incentive	Export of flowers to the EU market in which sustainable products are required.	Export farms have knowledge on IPM (Ethiopian and foreign owned). Situation specific knowledge has been developed by IPM studies and field trials	For exporting farmers a wide variety chemical and biocontrols is available, but are not officially registered Strong governmental support for export-oriented farmers to earn foreign currency.	Supply industry with companies from abroad (Kenya) Natural enemies present in the country that can be used for pest and disease control.
Obstacle	Limited export of vegetables. The domestic market that has no demand for sustainable food production.	Smallholders face problems in applying basic GAP as prerequisite for applying IPM.	Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government. Limited capacity at the MoA to facilitate efficient registration of pesticides. No working system of registration for biocontrols Limited attention for sustainable production from governmental side	Limited availability of new IPM compatible chemicals. Taxation on agro input stock such as chemicals Training and support is commercially focused

6 Rwanda

6.1 Introduction

Agriculture or livestock provides the main occupation to up to 85% of the economically active population. Subsistence farming is dominant, with average holdings of around 0.8 ha in about four separate plots. Most farmers are united in cooperations throughout the country. The main vegetable crops produced are pumpkins, leeks and various cabbages (Figure 6.1). Other important crops are coffee and banana. Productivity is well below potential, and income levels in agriculture remain extremely low (RADA, 2007).

Recently greenhouse farming has been introduced and this is being adopted by some the richer farmers. Especially high value crops like tomatoes are now increasingly being produced inside plastic tunnels. Main diseases in tomato are late blight and Downey during the rainy time. During the wet season there are more problems with pests.

Flowers are produced on a very small scale (RHODA, 2011). However the National Agricultural Export Board (NAEB) is working on the development of this sector: the Gishari Flower Park with 20 ha at an altitude of 1,500 meters is in development. NAEB has also designated other areas for floriculture, including Muhango, Muko, Mutubu, and Kazanze.

In its Vision 2020 plan, Rwanda set ambitious goals for its development and to stimulate export and to reduce the food imports. Rwanda aims to achieve this vision by fostering investments in horticulture and floriculture. Rwanda Development Board (RDB) is attracting investors for these sectors. However, Rwanda has limited space available for large horticultural projects - at most 50-100 ha for potential investors. But the equatorial climate is suited to a wide range of cultivars. Average rainfall is high (800 to over 1,600mm annually, with two extended rainy seasons, March-May and Sept-Dec). The export of vegetables is limited to about USD3.2m (2012). The most important export sector is coffee. Growing seed potatoes for export to neighbouring countries has potential.

Rwanda has a micro-climate that suits a variety of horticultural activities. The marshy valleys offer considerable unexploited potential for irrigation and drainage. A broad band of cool and humid terrain in the north-west is suited to European-style fruits and vegetables, including fruits and vegetables like beans, peas, cauliflower, mushrooms, citrus and strawberries. The warm and humid central-south is ideal for tropical fruits such as banana, passion fruit and pineapple. The warm and dry north-east is suited to groundnut, sunflower and pulses (RDB/RHODA, 2010).

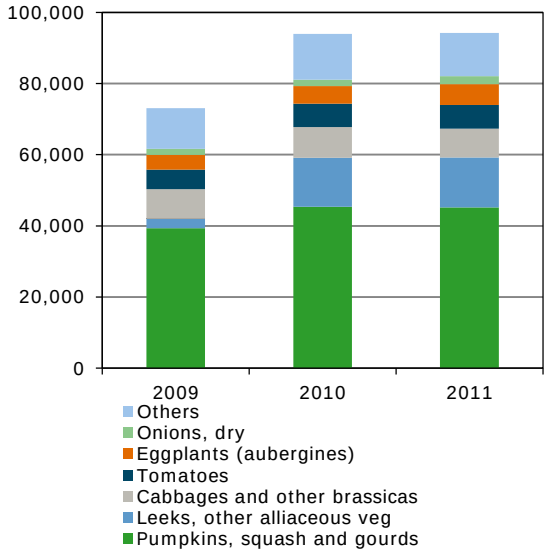

Figure 6.1 *Production area in ha of main vegetables (2009-2011).*
Source: Faostat

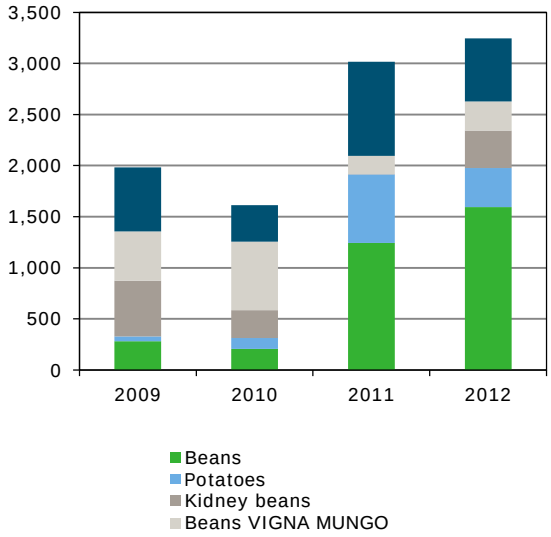

Figure 6.2 *Export of main vegetables in USD1,000 (2009-2012).*
Source: UNComtrade

6.2 Current IPM practice

IPM is not applied in the horticultural sector. However, there was a project funded by BTC. This project was more focused on Integrated Crop Management (ICM). No biological controls were used, but there was a focus on reducing the volume of pesticides by switching from preventive to curative spraying. In other words: only spray when the problem is visible. In practice (for tomato) the farmers started with monitoring of the crop. Farmers sprayed now about 3 times during cultivation instead of 8 times from planting to harvest (tomato). The introduced approach has now been adopted by many cooperation members. Not reducing spraying for biological beneficials and natural liquids.

In high value crops like potatoes, tomatoes and cabbages the chemical pesticide use is high. Farmers use chemical products with a wide range like acrobat. Spraying of the chemicals is sometimes done with bushes. A knapsack for spraying is not available. Training on pesticide use can benefit these farmers to apply the chemicals more effective.

Rwanda is an important producer of Pyrethrin. The pyrethrins are a pair of natural organic compounds derived from Chrysanthemums that have insecticidal activity. Pyrethrins are neurotoxins that attack the nervous systems of insects and in smaller quantities it has an insect repellent effect.

6.3 Feasibility

6.3.1 Technology

Some companies are active as suppliers for the horticulture sector. Agrotech and Balton are the main suppliers in the market. Agrotech works with chemicals from India. Balton is a British company (with close cooperation with Israel) with 9 different offices throughout (Eastern) Africa, they also operate under the names Amiran and Dizengoff. About half of their activities are related to agricultural supplies. The company supplies the high-level irrigation and greenhouse technology (imported from Israel) to more commercial farmer (a small share of the market) and the basic input supply (seeds, fertilisers) to smallholders which is by far the largest share of the market.

Despite the presence of these suppliers, there is no attention for biocontrols and other IPM-related tools for the Rwanda horticulture sector. On the other hand we found outdated chemical pesticides in the chemical shop (owned by some members of the cooperation). This included some chemicals that are banned in Europe, like Dimethoaat / Tafgor 40 EC, Dichloorfos / Lava 92 % EC and Roket Cypermecthrin.

Picture 6.1 *Dichloorfos.*
Source: E. Kerklaan (DLV Plant)

Picture 6.2 *Roket Cypermecthrin.*
Source: E. Kerklaan (DLV Plant)

At the moment is no interest from biological beneficials and natural liquids suppliers in Rwanda. However there are natural predators (macro-biological controls) present in the country. For example, for thrips control Orius majusculus was identified during field visits.

6.3.2 Personality and firm related

Among many stakeholders in the horticulture industry in Rwanda there are big differences in the perceived definition of IPM. Main association of farmers with IPM are to us fertilisers and to reduce general spraying. Not substituting spraying with biocontrols or other IPM controls.

Current farming practices are very limited. Therefore GAP needs attention, before emphasizing IPM. Issues like how to spray (without knapsack) and the misuse of chemicals are still big issues in the horticulture sector. However in general farmers in Rwanda are eager to learn.

6.3.3 Economic

Since Rwanda is not a major exporting of horticulture products, there is limited demand from the market towards sustainable produced products. Most farmers have problems in organising themselves to access the domestic market. Brokers play a dominant role in the supply chain. Especially export is difficult for farmers since they produce small quantities of ever-changing quality. However the government is focusing on the export of high value crops, so many issues have to be addressed. The (right) use of the (right) pesticides will be an important issues in the near future.

6.3.4 Institutional

In Rwanda there is no registration of biological beneficials and natural liquids. Furthermore Rwanda faces serious problems with counterfeit chemicals.

6.4 Conclusion and transition

An important driver for adoption of IPM are market incentives. In contrast to Kenya and Ethiopia, Rwanda lacks an exporting sector of vegetables and flowers. In addition on a national level, consumers are not concerned about food safety. Therefore, the introduction of IPM has to start almost from scratch. Shifting from preventive to curative is a basic step, as well as the production and use of Pyrethrin. However, another necessary step is the development of a knowledge and extension network, in order to provide the farmers and growers with knowledge about plant pests and diseases, how to control them and to give them support. Furthermore, biological agents need to be imported or produced locally. Sufficient IMP compatible chemical pesticides should be registered and the current list with pesticides should be critically reviewed.

Table 6.1

Summary of the incentives and obstacles per category

	Economic	Firm related	Institutional	Technical
Incentive		Smallholders in Rwanda are eager to learn. Smallholders are organised in strong cooperation's.	Government is highly in favour of developing export markets for high value crops.	Natural enemies present in the country that can be used for pest and disease control. Presence Pyrethrin
Obstacle	Demand from the market is missing since there is no export of horticultural produce The domestic market has no demand for sustainable food production	A lot of diffusion on the concept of IPM among farmers and stakeholders Smallholders have problems in obtaining high yields and applying GAP.	Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government. No enforcement on counterfeit chemicals. No working system of registration for biocontrols No capacity to do the test that are required for the registration of biocontrols and natural liquids.	No supply industry for IPM products

7 Other East African countries

7.1 Uganda

7.1.1 Introduction

Rose is the most important flower in Uganda. There are about fifteen exporting companies, of which about half is owned by Ugandans. The total area of flowers is estimated at 170 ha. Most companies are located in southern Uganda, between the cities of Entebbe and Kampala near Lake Victoria. Over the years, cutting production is becoming increasingly important and has an export value of USD5m. Of this about 40% are chrysanthemum cuttings.

Rose growers are facing difficulties. Due to the high day temperatures it is not possible to grow large buds in the traditional rose growing regions. Earning money with the small-flowered roses was already difficult due to declining demand and the rising number of intermediates. Growers tried to remain profitable with a strategy of high production and low costs. Export growth in recent years, however, has stopped. All flowers growers are member of the Uganda Flowers Exporters Association (UFEA) whose main objective is to facilitate production and marketing of the flowers from Uganda.

The total area of vegetable production accounts for about 195,000 ha (Figure 7.1). Most vegetables are produced by smallholders and are grown under rain-fed conditions. It creates seasonality and affects supply. This underlines the need for irrigation to boost vegetable arming and ensure all year round production. To revamp irrigation schemes, the government is implementing two projects to provide water for irrigation.

Fresh vegetable exports are mainly focused on beans and accounts for about USD17m in 2011. Other crops for exports are more traditional crops. Many smallholders sell regularly or intermittently to opportunistic traders for export. There is no developed system to facilitate the export trade. The traders operate with minimal facilities and sell to price-driven fringe importers, usually located in the wholesale markets of UK and Holland. The increasing quality, hygiene and traceability requirements of the supermarkets in the EU reduce the opportunities for smallholders to engage in export.

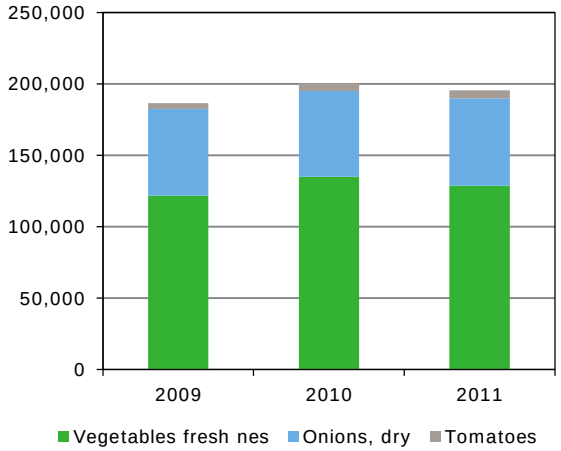

Figure 7.1 *Production area in ha of main vegetables (2009-2011).*
Source: Faostat

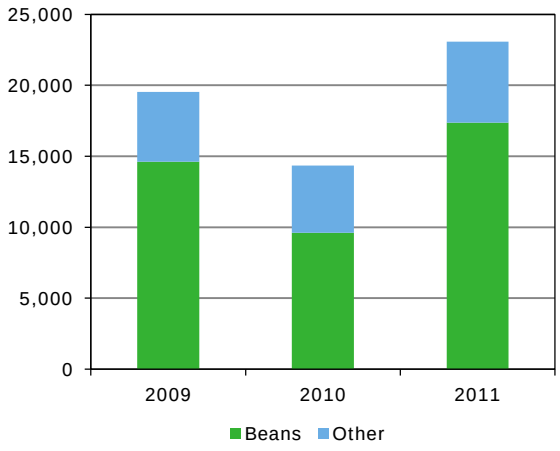

Figure 7.2 *Export of main vegetables in USD1,000 (2009-2011).*
Source: UNComtrade

7.1.2 Current IPM practice

The IPM approach is applied by many, growers identify their pests before spraying. A smaller subset of growers use less risky pesticides such as pheromones. In Uganda, there is no clear policy to guide the development of IPM in the country (Odong et al., 2013).

In Uganda the presence supply industry with macro and micro biological controls is absent. In addition the ago chemical input suppliers lack the sufficient technical knowledge to advise farmers on the use of inputs PRA, 2013).

No importation of pesticide is allowed without an appropriate import permit. The Pesticide Registration and Control Regulations, 2013 regulate the import, manufacture, export, sale, transport, distribution, quality and use of pesticides. There is not regulation for the registration of biological beneficials and natural liquids.

The Ministry of Agriculture Animal Industry and Fisheries (MAAIF) is the primary authority in charge of management of pesticide law in Uganda. The Agricultural Chemical Division of MAAIF as the Regulatory Authority and Secretariat of the Agricultural Chemicals Board (ACB) implement the day to day compliance inspection and enforcement activities.

ACB established under the law is assigned power to oversee, decide or advise on the registration and control of pesticide and exercise responsibility for all policy matter affecting pesticide management. ACB advises the Minister on policy issues. Representation of ACB compromises a wide range of members with representation from agricultural research, universities, farmer organisation, extension, pesticide industry, forestry, environment, and ministries responsible for agriculture, trade, justice, health.

Agricultural Chemicals Technical Committee (ACTC) is a subsidiary committee of the Board appointed to assess efficacy, toxicology, chemistry, environmental impact and advises the Board on the technicalities and registration of an agricultural chemical. Representation of ACTC compromises experts from the field of chemistry, plant husbandry, entomology, plant pathology, ecology, environment, soil science; weed science, wood utilisation, standard officer (UNBS), Revenue Officer (URA), Registrar of drug (NDA), and a occupational safety officer (Ministry of Labour).

The government is encouraging the innovation of biological beneficials and natural liquids and its registration is governed by the Agricultural Chemicals Control Act, 2006. The procedure of data packages and efficacy trials requirement are the same with chemical pesticide. A tiered approach of risk assessments in relation to human and animal health, environment and non-target organisms is required. Special consideration on toxicity, infectivity and pathogenicity of all products based on living organisms. Only a small range of biological beneficials and natural liquids are available. Based on pyrethrum, neem, and derived product from natural material like plants and microbes have been registered in Uganda.

7.1.3 Conclusion

The export of Uganda is limited, this means that an important driver for adoption of IPM is missing. In contrast to Kenya and Ethiopia, Uganda lacks an exporting sector of vegetables and flowers. In addition on a national level, consumers are not concerned about food safety. Therefore, the introduction of IPM has to start almost from scratch. Shifting from preventive to curative is a basic step. Another necessary step is the development of a knowledge and extension network, in order to provide the farmers and growers with knowledge about plant pests and diseases, how to control them and to give them support. Furthermore, biological agents need to be imported or produced locally. Sufficient IMP compatible chemical pesticides should be registered and the current list with pesticides should be critically reviewed.

Table 7.1
Summary of the incentives and obstacles per category.

	Economic	Firm related	Institutional	Technical
Incentive	Small floriculture export sector that needs to meet the standards of the EU market			Very likely that natural enemies present in the country that can be used for pest and disease control.
Obstacle	Export is limited The domestic market has no demand for sustainable food production		Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government. Weak system for registration	No supply industry for IPM products

7.2 Tanzania

7.2.1 Introduction

Floriculture is a relatively small industry in Tanzania and the country plays a small role in the international flower trade. In 1987 the flower sector started with the cultivation of carnations and Euphorbia in the open field, for export to the EU. During the 1990s, more growers entered the sector and there was a steady growth in the area with flower production (from 28 hectares in 1995 to close to 80 hectares in 1998). Thereafter, the number of companies and production area stagnated. Moreover, growing circumstances in the hills around Arusha and Moshi have attracted several plant breeder propagating pot plant material, summer flower seeds, bean seeds and hybrid vegetable seeds. As a results Tanzania is an major exporter of chrysanthemum cuttings.

According to a recent Word Bank study (2012) the flower industry has not reached the critical mass required to boost its exports, like regular cargo flights out of Kilimanjaro Airport, registration and regular supply of chemicals, and local capacity building of staff and labourers. In 2004, TAHA, the

Tanzanian Horticultural Association, was founded. Improving air and road networks are some focal points. Also the Tanzanian government is again promoting horticulture with funding and land. Airfreight is not always available and sometimes growers need to truck a few hours to get a suitable flight. As a result the production and export of cut flowers from Tanzania is often seen as part of Kenya's floriculture, as the sector is geographically close and institutionally well connected to Kenya (more than 50% of all cut flowers are exported via Nairobi).

The total area of vegetable production accounts for about 348,000ha (Figure 7.3). Agriculture in Tanzania is dominated by smallholder farmers (peasants) cultivating an average farm sizes of between 0.9 ha and 3.0ha each. Important vegetable crops are tomatoes, maize and onions. By far the largest category fits in a group defined "not elsewhere specified" by the FAO. This includes various indigenous vegetables. Tanzania vegetables exports accounted for USD75m (Figure 7.2). Tanzania exports to a wide variety of EU and non-EU countries, covering all continents. Most of its fresh vegetables, however, go to the EU, and the majority of those to the UK, the Netherlands and Germany. Only peas and beans are exported in significant volumes.

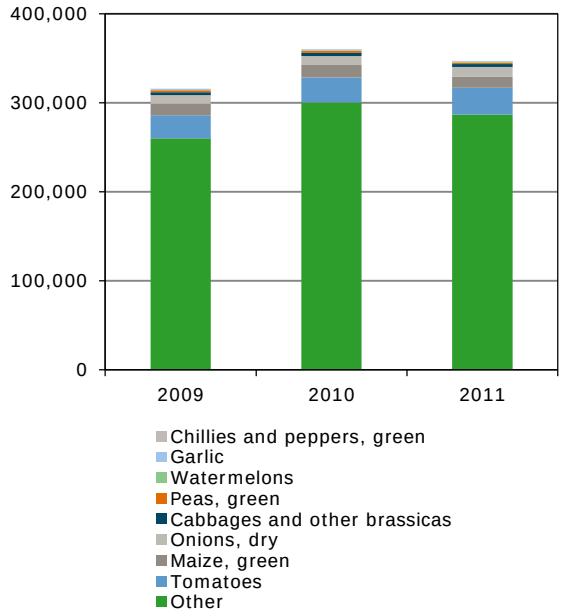

Figure 7.3 *Production area in ha of main vegetables (2009-2011).*
Source: Faostat

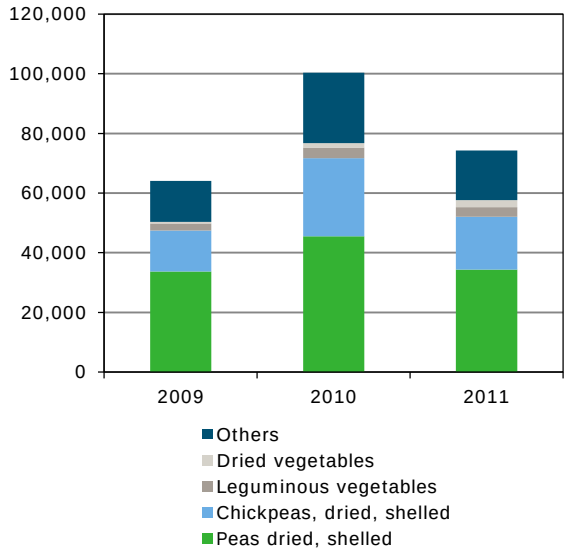

Figure 7.4 *Export of main vegetables in USD1,000 (2009-2011).*
Source: UNComtrade

7.2.2 Current IPM practice

Tanzania Government's aims at a transition from low to middle-income economy, Tanzania is set to adopt the Malaysian Model of Development: The Big Fast Results Initiative. It will be implemented during 2013-2014 and is called Big Results Now (BRN) and focuses on 6 priority areas of the economy:

1. Energy and natural gas;
2. Agriculture;
3. Water;
4. Education;
5. Transport;
6. Mobilisation of resources.

Agriculture is 1 of the priority areas and is focused on (very) large scale farms and a limited number of mainstream crops (sugar, maize and rice). In addition the Southern Agricultural Growth Corridor of Tanzania (SAGCOT). SGCOT is an inclusive, multi-stakeholder partnership to develop the region's

agricultural potential. SAGCOT was initiated in 2010 with the support of farmers, agri-business, the Government of Tanzania and the private sector. The objective is to foster inclusive, commercially successful agribusinesses that will benefit the region's small-scale farmers, and in so doing, improve food security, reduce rural poverty and ensure environmental sustainability.

In Tanzania there have been various projects on IPM in the past years. Nyambo (2009) gives an overview of the various IPM initiatives in the different crops and regions in the country. On project was in the Northern Lake zone where a project was financed for about 10 years by the German Agency for Technical Cooperation (GTZ). The IPM project was initiated in 1992 by the Ministry of Agriculture and Food Security with GTZ. The IPM pilot area was the western growing zone (Shinynanga). This was the area using a lot of pesticides to reduce losses emanating from pests. One of the main impacts of the project was that the pesticides use in cotton in Shinyanga has been reduced from 6 calender sprays to maximum 3 sprays without affecting production. However, in Shinyanga for example, despite the fact that the project was in the region for more than a decade, IPM has not been internalised at the decision making level and decisions by farmers are counterproductive to IPM (Nyambo, 2009).

Farmers within the GTZ-IPM project and the extension staff has compiled a list of useful botanical pesticides (Nyambo, 2009) that could be used on a wide range of vegetables and other food crops. In beans, extracts of Tephrosia vogelii and Neuratanenia mitis have been recommended and farmers are using them because they are easily available and less costly. However few of them have realised importance of using biological beneficials and natural liquids in preventing pests and diseases damage. Some of the identified biological beneficials and natural liquids that have been used include (MoA, 2013);

- Use of biocontrol agents in control of Diamond Back Moth (DBM) in Cabbage(eg. Parasitoid Diadegma semiclausum to control DBM(Plutella xylostella) in all brassica growing region of Tanzania.
- Use of predator mite Phytoseiulus persimilis and Ammblyseius californicus to control red spider mite(Tetranychus urticae) on rose flowers farms.
- Use of predator mite –Amblyseuis swisrki to control thrips on rose flowers farms.
- Use of parasitoid –Encasia dispersa to control Spiralling white fly on fruits and vegetables in most growing areas.
- Use of predator mite Typhlodromalus aripo to control cassava green mite on cassava.
- Use of parasitoid Cotesia flavipes to control Cereal stem borer Chilo partellus and Buseola fusca in maize growing areas.
- Use of Fopius arisanus to control fruitfly Bactrocera invadens in mango growing areas.

There is a supply industry for biological beneficials and natural liquids in Tanzania. The main IPM companies like Koppert Kenya, Dudutec and Real IPM are on the market. However they are mainly focuses on the flower farmers and this is not market that most of them have prioritised. In addition some suppliers argued that the process of registrations is fuzzy and not efficient.

Pesticides in Tanzania are managed under Plant Protection Act (PPA) of 1997 and the Plant Protection Regulations (PPR) of 1999. Tanzania has reviewed the PPA to the Pesticides Management Act (PMA). PMA is aiming at the establishment of a Pesticides Control Board (semi autonomy body) which will be independent from Ministry of Agriculture. However, currently the Ministry of Agriculture has ultimate responsibility and a National Plant Protection Advisory Committee (NPPAC) is established with participation of representatives from different ministries, research institutes and universities. The NPPAC endorses the finding the reports by various subcommittees on the Pesticides Approval and Registration Technical Sub-committee (PARTS) and the Biological Control Agent Sub-committee. The latter is specialised in judging dossiers related to biological beneficials and natural liquids. The registration for biocontrols is comparable to the registration of conventional chemicals. A general problem for an effective registration process is that there are inadequate funds and human resources available. The registration costs to obtain a full registration for 5 years is about USD1,500. Other costs that occur during the registrations process are:

- Application fee USD20
- Laboratory analysis USD50
- Experimentation USD1,000 (for those who apply)
- Efficacy trial USD2,000-5,000 per season

- Provisional registration fee USD1,000 (2 years period)

7.2.3 Conclusion

Tanzania exports to a wide variety of EU and non-EU countries. Peas and beans are exported in significant volumes.Tanzania Government's aims at a transition from low to middle-income economy. Agriculture is 1 of the priority areas. In Tanzania there have been various projects on IPM in the past years. Pesticides in Tanzania are managed under Plant Protection Act. It is possible to register biological controls. It is handled by the biological Control Agent Sub-committee. The latter is specialised in judging dossiers related biological beneficials and natural liquids.

Table 7.2
Summary of the incentives and obstacles per category.

	Economic	Firm related	Institutional	Technical
Incentive	Small floriculture export sector that needs to meet the standards of the EU market Tanzania exports to a wide variety of EU and non-EU countries		The registration of (bio) pesticides and natural liquids is possible. Various governmental policies to develop (sustainable) agriculture	Very likely that natural enemies present in the country that can be used for pest and disease control.
Obstacle	The domestic market has no demand for sustainable food production		Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government.	No developed supply industry for IPM products. Some imports from Kenya, but limited.

7.3 Burundi

7.3.1 Introduction

The economy of Burundi is mainly agricultural. The sector accounts for about 34.7% of GDP (2011) and employs the majority of the population. An estimated 2,15m hectares, or about 58% of the total land area, is arable or under permanent crops. Only a small share of the land is irrigated. Most agriculture consists of subsistence farming with an average farm size of 0.8 ha. The total area with vegetable cultivation is around 45,000 ha. Beans, sweet potatoes and cassava are among the most important vegetables crops.

Burundi's main exports are coffee and tea, which account for 50% of foreign exchange earnings, other export products are gold and cotton. Though exports are a relatively small share of GDP and accounted a total of USD180m in 2011. Burundi is depending on aid from donors. Foreign aid represents 25% of Burundi's national income. Burundi joined the East African Community (EAC) in 2009, which should benefit Burundi's regional trade ties.

Political stability and the end of the civil war have improved aid flows and economic activity has increased, but underlying weaknesses - a high poverty rate, poor education rates, a weak legal system, a poor transportation network, overburdened utilities, and low administrative capacity - risk undermining planned economic reforms. Government corruption is hindering the development of a healthy private sector as companies seek to navigate an environment with ever changing rules

A major donor (USAID) has targeted horticulture in their interventions, but there is an area where specific additional support is required, which is that of environment and compliance to international standards, in particular those of the EU, in order to lay the ground for the resumption of the

horticulture products export flows that existed prior to 1993. In 2011 export accounted for only USD100,000.

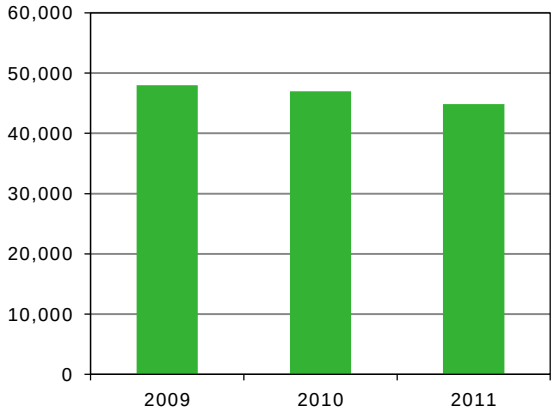

Figure 7.5 *Production area in ha of vegetables (2009-2011).*
Source: FAO stat, 2012

7.3.2 Current IPM practice

More than 213 tonnes of active ingredients are consumed each year, on average. Register of the agricultural pesticides approved in Burundi: 157 commercial products containing 82 active ingredients divided into 8 chemical groups (Sakayoya, 2013). There is limited use of biological beneficials and natural liquids.

In Burundi, the registration of pesticides is done by the Ministry of Agriculture and Livestock. Within the ministry the Directorate of Plant Protection is handling the applications related to the import, manufacturing, labelling, storage, distribution and the use of the pesticides (Sakayoya, 2013). A multi-sector committee, the Registration and the Control of the Pesticides (CNHCP), is analysing the dossiers. Different stakeholders from ministries, universities and research bodies are represented.

Ultimately, CNHCP is responsible for the registration of pesticides. The applications are addressed to the Plant Protection Directorate, which hold the secretariat of the Committee. The CNHCP plans the field test. A pesticide undergoes testing during two years of the efficacy, practical values and environmental effects. The results of these tests are analysed by attaching the toxicological and ecotoxicological data. After analysis by the CNHCP a product can be offered provisional marketing authorisation, be asked for additional information or the product can be rejected.

The results of its proceedings shall be forwarded to the Minister of Agriculture for application. Pesticides approved by the CNHCP are initially recorded in the register of pesticides enjoying the provisional authorisation for a maximum of 2 years. During this period, the product is monitored to detect any adverse effects that where not manifested during the application procedure. If this is not the case, the product is proposed for approval and this time registered it will be registered for a period of 5 years.

No specific system for the registration of biocontrols. In addition, sufficient equipment for quality testing of pesticides is lacking.

Burundi is not an exporting country of vegetables so there is limited incentive to apply IPM at farm level. Farmers do not have to comply with industry standards set on the EU market.

7.3.3 Conclusion

The export of Uganda is limited, this means that an important driver for adoption of IPM is missing. In contrast to Kenya and Ethiopia, Uganda lacks an exporting sector of vegetables and flowers. In addition on a national level, consumers are not concerned about food safety. Therefore, the introduction of IPM has to start almost from scratch. Shifting from preventive to curative is a basic step. Another necessary step is the development of a knowledge and extension network, in order to provide the farmers and growers with knowledge about plant pests and diseases, how to control them and to give them support. Furthermore, biological agents need to be imported or produced locally. Sufficient IPM-compatible chemical pesticides should be registered and the current list with pesticides should be critically reviewed.

Table 7.3

Summary of the incentives and obstacles per category.

	Economic	Firm related	Institutional	Technical
Incentive			NGOs present that work in agricultural development	Very likely that natural enemies present in the country that can be used for pest and disease control.
Obstacle	No export so there is demand from the market Domestic market is not focused on sustainable food production		No system for registration of biocontrols and products from natural origin. Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government.	No supply industry for IPM products

8 Conclusion

8.1 Conclusion

We have analysed several factors that influence decision making by farmers and growers to adopt IPM. We have elaborated on a framework developed by De Lauwere et al. (2005) to assess the potential of IPM in Kenya, Ethiopia, Rwanda, Tanzania, Uganda and Burundi. We used the following categories:

- Economic factors
- Personality and firm related factors
- Institutional factors
- Technical factors

In East Africa there is difference in the adoption rate of Integrated Pest Management (IPM). There are differences between export-oriented farmers and smallholders. Also between export-oriented farmers there are differences. About 60-70% of the rose famers in Kenya and Ethiopia are estimated to have implemented IPM, whereas the adoption level among export-oriented vegetables farmers is still limited. In Kenya this share is estimated at around 5%. The adoption rate among smallholders is nil.

Export farmers have a strong market incentive to adopt IPM. They have to comply with strict regulations on the EU market related to the type and quantity of chemicals. These regulations are set by the dominant retailers and apply for both flowers and vegetables. This limits the available chemicals significant and farmers are looking for alternative methods to control pest and diseases. In addition export-oriented farmers have the knowledge and the financial resource to introduce beneficials and natural liquids successfully.

Smallholders have a dominant position all East African countries and they produce the majority of the horticultural products for the domestic market. The IPM adoption rate is low since there are no incentives from the market to start with IPM. In addition, farmers lack resources like knowledge and finance that are essential to successfully implement IPM.

Based on the findings and conclusion we have identified two groups of countries with similar characteristics. The first group consists of Kenya, Ethiopia and Tanzania. These countries have a large number of export-oriented farmers. Many are foreign owned, and thus, backed by significant financial capital. This brings in advanced knowledge about alternative pest and disease management approaches like IPM. Dutch owned farms are often considered as a shining example for other farmers in the region. IPM products like IPM compatible chemicals, commercially produced biological beneficials and liquids from a natural origin are available and in some cases locally produced.

Table 8.1
Summary of the incentives and obstacles for all countries per category.

	Economic	Firm related	Institutional	Technical
Kenya Incentive	Export of vegetables and flowers to the EU creates strong demand for sustainable products. A small but upcoming domestic market is requesting safe food (Niche).	High knowledge level of export farmers Flower famers are breeding their own biocontrols against spider mites.	The registration of (bio) pesticides and natural liquids is possible Positive attitude of government towards IPM and increased sustainable production (Vision 2020). Stakeholders such as KFC	Strong supply industry with local companies and foreign companies IPM compatible chemicals are not always available Natural enemies present in the country that can be used for pest and disease

			and FPEAK are in favour of IPM.	control.
Obstacle	A large majority of the domestic market has no demand for sustainable food production	Smallholders face problems in applying basic GAP as condition for applying IPM	Registration takes a long period and adequate resources are missing to test biocontrols and natural liquids. Companies complain about the taxes, levies, regulations and laws that are imposed and implemented by (local) government.	Training and support is commercially focused Current suppliers of biocontrols lack the knowledge to start breeding the more advanced beneficials.
Ethiopia Incentive	Export of flowers to the EU market in which sustainable products are required.	Export farms have knowledge on IPM (Ethiopian and foreign owned). Situation specific knowledge has been developed by IPM studies and field trials	For exporting farmers a wide variety chemical and biocontrols is available, but are not officially registered Strong governmental support for export-oriented farmers to earn foreign currency.	Supply industry with companies from abroad (Kenya) Natural enemies present in the country that can be used for pest and disease control.
Obstacle	Limited export of vegetables. The domestic market that has no demand for sustainable food production.	Smallholders face problems in applying basic GAP as prerequisite for applying IPM	Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government. Limited capacity at the MoA to facilitate efficient registration of pesticides. No working system of registration for biocontrols Limited attention for sustainable production from governmental side	Limited availability of new IPM compatible chemicals. Taxation on agro input stock such as chemicals Training and support is commercially focused
Tanzania Incentive	Small floriculture export sector that needs to meet the standards of the EU market Tanzania exports to a wide variety of EU and non-EU countries		The registration of bio pesticides and natural liquids is possible. Various governmental policies to develop (sustainable) agriculture	Very likely that natural enemies present in the country that can be used for pest and disease control.
Obstacle	The domestic market that has no demand for sustainable food production		Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government.	No developed supply industry for IPM products. Some imports from Kenya, but limited.

The second group is Rwanda, Uganda and Burundi. In these countries farmers are more focused on the domestic or the regional market. They lack the market incentive to use alternative crop protection approaches like IPM. In addition IPM products like IPM compatible chemicals, commercially produced biological beneficials and liquids from a natural origin are hardly available. Often, the supply industry does not see smallholders as a potential market due to a lack of resources (both financial and technical). In addition there is a lack of a well-developed institutional environment to register for biological beneficials and natural liquids.

Table 8.2

Summary of the incentives and obstacles for all countries per category.

	Economic	Firm related	Institutional	Technical
Rwanda Incentive		Smallholders in Rwanda are eager to learn. Smallholders are organised in strong cooperations.	Government is highly in favour of developing export markets for high value crops.	Natural enemies and pyrethrin present in the country that can be used for pest and disease control.
Obstacle	Demand from the market is missing since there is no export of horticultural produce The domestic market has no demand for sustainable food production	A lot of diffusion on the concept of IPM among farmers and stakeholders Smallholders have problems in obtaining high yields and applying GAP.	Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government. No enforcement on counterfeit chemicals. No working system of registration for biocontrols No capacity to do the tests that are required for the registration of biocontrols and natural liquids.	No supply industry for IPM products
Uganda Incentive	Small floriculture export sector that has to meet the standards of the EU market			Very likely that natural enemies present in the country that can be used for pest and disease control.
	Export is limited The domestic market has no demand for sustainable food production		Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government. Weak system for registration	No supply industry for IPM products
Burundi Incentive			NGOs present that work in agricultural development	Very likely that natural enemies present in the country that can be used for pest and disease control.
Obstacle	No export so there is demand from the market No domestic market that is focused on sustainable food production		Weak system for registration of chemicals and biocontrols. Smallholders prefer to use broad spectrum chemicals which are widely available at low costs, which is allowed by the government.	No supply industry for IPM products

8.2 Recommendations for transition

8.2.1 Regional versus national approach

The East African Community is working jointly on many different policy themes, including agricultural development. A regional approach is highly recommendable for the following themes:

- Regional harmonisation of legislation;
- Capacity building for registration and post registration, including updating the facilities;
- Critical review of current registered pesticides on a regional level;
- Awareness;
- Development and facilitation of the supply industry;

In addition, a country-specific training programme for the export farmers and smallholders needs to be developed.

8.2.2 Regional harmonisation of legislation

East African countries lack to a greater or lesser extent effective and fully operational systems for pesticide, biological beneficials and natural liquid regulation and control. In many countries a lack of manpower, lack of trained staff and a lack of facilities to do field and laboratory testing are creating enormous backlog of files waiting to be analysed. Furthermore, in most EAC countries no protocol has been developed for the registration of biological beneficials and natural liquids. Temporary or intermediate solutions are often applied to create access to the required inputs for farmers. Working together within the EAC includes working directly with and through the East African Community for an efficient registration of chemicals, biological beneficials and natural liquids.

8.2.3 Regional review of current registered pesticides on a regional level

In most East African countries the list of registered pesticides is out dated and contains many products that damage the environment and human health. In addition, many of these chemicals do not go together with IPM. Especially smallholders use these types of products since they are cheap and easily available.
A critical review of the list with current pesticides that are allowed in region is required. It is important that removed products will be replaced with modern and safe products.

8.2.4 Regional awareness creation

We have seen that market demand is one of the main drivers for the adoption of IPM. Especially the export-oriented farmers in Kenya and Ethiopia have successfully implemented IPM due to the need from the market. Consumers in East Africa should be aware of the risks of pesticide use. In addition, smallholders have limited knowledge about sustainable production. Widespread overuse, misuse, mishandling and mismanagement of pesticides are all too common. The promotion of basic GAP would help farmers to apply correct practices and to improve yield. Smallholders should first be trained in applying good agricultural practices including changing the spray strategy from a preventive to a more curative approach. After this they can be trained in applying IPM, including biological beneficials and natural liquids.

8.2.5 The development of a national supply industry

In the East African countries there are various biological beneficials present. Some innovative companies like Dudutech and Real IPM breed beneficials locally and bring these to the market. However, it seems that their current product range is limited and many more opportunities of using indigenous insects for pest and disease control have not been developed. In several cases the multiplication of these beneficials requires specific knowledge that is not available. There they are in need for capacity building to breed the more advanced biological beneficials and natural liquids like orius for thrips control.

8.2.6 Training exporting farms

The export farms with Dutch influences are frontrunners with the implementations of IPM. However, the non-Dutch-owned farms are often behind. Therefore, on a company level, training of these farms is essential. These farmers have to comply with EU regulation regarding conventional and need to implement IPM at farm level, but lack the knowledge. Outgrowers supplying vegetables to export-

oriented farms should obtain extra training in order to comply with the strict norms regarding pesticides and they should be trained in applying basic IPM

8.2.7 Training smallholders

The main challenge is to get smallholders involved. An incentive is that if they apply IPM, they have more possibilities to get access to export markets, predominantly by delivery to large-scale farmers. This requires the establishment of a network of extension services. Since market forces only are not able to remove barriers, involvement and support of the government is necessary. Governmental support can be enhanced by bilateral programmes.

Reference

Bennett, G.W., 2005. *Truman's scientific guide to pest management operations*. Purdue University/Questex Press.

De Lauwere, C.C., L.W. Balk-Theuws, A.J. de Buck, A.B. Smit and S.C. van Woerden, 2005. *Samen kom je verder dan alleen; Het krachtenveld rondom omschakeling naar geïntegreerde gewasbescherming*. LEI Wageningen UR.

Den Belder, E. and A. Elings, 2007. *A Research and development plan for the introduction of Integrated Pest Management in the Ethiopian Rose Sector.* PRI Wageningen UR.

Den Belder, E. and A. Elings, 2010. *On-farm evaluation of integrated pest management of thrips and whiteflies in herb cuttings in Ethiopia*. PRI Wageningen UR.

Den Belder, E., A. Elings, Y. Yilma, M. Dawd and F. Lemesa, 2009. *On-farm evaluation of integrated pest management of spider mite in cut roses in Ethiopia.* PRI Wageningen UR.

Elling, A. and N. van Dijk, 2013. *Greenhouse horticulture in Rwanda*. BopINC

Gebreeyesus, M. and M. Iizuka, 2009. *Discovery of successful non-traditional exports in Ethiopia and Chile: experimentation and coordination.* First draft, paper presented at UNU-WIDER/UNU-MERIT/UNIDO Conference “Pathways to Industrialization”, Maastricht, 22 Oct.

HDCA, 2012. *The Horticulture Validated Report 2012*. HDCA.

Joosten, F.D., Boselie, B. Wolde and L. Desalegn, 2011. *Exporting fruit and vegetables from Ethiopia*. EHDA and EHPEA.

Nyambo, B., 2009. *Integrated pest management plan*. The United Republic of Tanzania: Agricultural Sector Development Program.

Odong, 0., A., B. Chandia, P. Kisambir, T. Hasifah and N. Mununizi, 2013. *Pesticide Regulatory Authority Uganda*. Presented at FAO / Altera Conference “Pesticide management in East Africa”, Muzane, 24-26 Sept

RDB/RHODA, 2010. *Opportunities for Investors in Rwanda’s Horticulture Sector*. RDB and RHODA.

Rikken, M., 2011. The global compettiveness of the Kenyan flower industry. Prepared for the World Bank by Pro Verde.

Sakayoya, E., 2013. *Pesticides management in Burundi*. Presented at FAO / Altera Conference 'Pesticide management in East Africa, Muzane, 24-26 Sept'.

Internet
http://news.bbc.co.uk/2/hi/africa/7354005.stm
http://www.epa.gov/pesticides/factsheets/ipm.htm
https://www.cia.gov/library/publications/the-world-factbook/
http://www.koppert.com
http://faostat.fao.org/
http://comtrade.un.org/
http://ehda.gov.et/
http://data.worldbank.org/
http://www.vision2030.go.ke

Annex 1 List of interviewed stakeholders

Kenya
RNE – Marnix Sanders (policy officer)
Mara Farm - Chris Bernard (owner), Julius (agronomist) & Kinany (agronomist)
Real IPM – Henry Wainwright (owner) & Samuel Ngugi Mwaura (technical manager)
Maridadi Flowers – Jack Kneppers (owner)
De Ruiter Roses East Africa – Sebastian Alix (manager)
Pest Control Product Board (PCBP) – mr. Wanyonyi
Koppert Biological Systems Kenya Ltd. – Charles Macharia (general manager)
Kephis – dr. Esther Kimani (general manager phytosanitary services)

Ethiopia
RNE – Hans van de Heuvel (agricultural councillor)
BASF – Bert Ottens (manager East Africa)
Koppert Ethiopia – Biruk (responsible for import, crop advice)
AQ Roses – Wim Ammerlaan (owner with his brother Frank Ammerlaan)
Jimma University – Derbew Belew (dean Jimma University College for Agriculture and Vet. Medicine)
Florensis – Maarten (production manager)

Rwanda
RNE – Pieter Dorst (head of OS) and Ben Zech (water quality coordinator)
FAO – Laurent Gashugi (assistant programme representative)
Nakumat – Buyer (fruit and vegetables)
Rwanda Development Board (RDB) – Tony Nsanganira (ag. chief operation officer), Immaculee Ugrimbabazi (crops and plant business advisor) & Sebastien Dusabeyezu (environmental analyst)
Balton – Kelvin Odoobo (manager agriculture)
National Agricultural Export Development Board (NAEB, previous RHODA) – Epimaque Nsanzabagangwa (deputy director general in charge of Horticulture)
Ministry of Health – Joseph Katabarwa (environmental health specialist and food safety coordinator)
Rwanda Agriculture Board (RAB) – professor Jean Jacques Mbonigaba Muhinda (director general)
Imbaraga Cooperation – Joseph Gafaranga
Institute Superieur d'Agriculture et d'Elevage (ISAE) – various staff members
Rwanda Best – Jean Claude Ruzibiza (managing director)
Private Sector Federation (FSP) – Narcisse Ndagijimana (capacity building specialist)
Rwanda Agriculture Board (RAB) – Innoncent Musabyimana (deputy director general extension)
Ministry of Agriculture (MoA) – DG of Strategic Planning and Programs Coordination (SPPC)
Agrotech - Evariste Safari (marketing manager)
COLEACP – Guy Stinglhamber (director), Maud Delacollette & Jeremy Knops.
Rwanda Environment Management Authority (REMA) – Eliezer Ndizey Rusakana (Responsible for the implementation of the Stockholm Convention)
Various farmers and farmer cooperation

LEI Wageningen UR
P.O. Box 29703
2502 LS Den Haag
The Netherlands
T +31 (0)70 335 83 30
E publicatie.lei@wur.nl
www.wageningenUR.nl/en/lei

LEI 13-103

LEI Wageningen UR carries out socio-economic research and is the strategic partner for governments and the business community in the field of sustainable economic development within the domain of food and the living environment. LEI is part of Wageningen UR (University and Research centre), forming the Social Sciences Group together with the Department of Social Sciences and Wageningen UR Centre for Development Innovation.

The mission of Wageningen UR (University & Research centre) is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment. With approximately 30 locations, 6,000 members of staff and 9,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the various disciplines are at the heart of the unique Wageningen Approach.

To explore the potential of nature to improve the quality of life

LEI Wageningen UR
P.O. Box 29703
2502 LS Den Haag
The Netherlands
T +31 (0)70 335 83 30
E publicatie.lei@wur.nl
www.wageningenUR.nl/en/lei

LEI 13-103

LEI Wageningen UR carries out socio-economic research and is the strategic partner for governments and the business community in the field of sustainable economic development within the domain of food and the living environment. LEI is part of Wageningen UR (University and Research centre), forming the Social Sciences Group together with the Department of Social Sciences and Wageningen UR Centre for Development Innovation.

The mission of Wageningen UR (University & Research centre) is 'To explore the potential of nature to improve the quality of life'. Within Wageningen UR, nine specialised research institutes of the DLO Foundation have joined forces with Wageningen University to help answer the most important questions in the domain of healthy food and living environment. With approximately 30 locations, 6,000 members of staff and 9,000 students, Wageningen UR is one of the leading organisations in its domain worldwide. The integral approach to problems and the cooperation between the various disciplines are at the heart of the unique Wageningen Approach.