Impacts of Improved Seeds and Agrochemicals on Food Security and Environment in the Rift Valley of Ethiopia: Implications for the Application of an African Green Revolution

By Bezabih Emana, Hadera Gebremedhin and Nigatu Regassa

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Drylands Coordination Group
TØRRLANDS-KOORDINERINGSGRUPPEN
GROUPE DE COORDINATION DES ZONES ARIDES

The Drylands Coordination Group (DCG) is an NGO-driven forum for exchange of practical experiences and knowledge on food security and natural resource management in the drylands of Africa. DCG facilitates this exchange of experiences between NGOs and research and policy-making institutions. The DCG activities, which are carried out by DCG members in Ethiopia, Eritrea, Mali and Sudan, aim to contribute to improved food security of vulnerable households and sustainable natural resource management in the drylands of Africa.

The founding DCG members consist of ADRA Norway, CARE Norway, Norwegian Church Aid, Norwegian People's Aid, The Stromme Foundation and The Development Fund. Noragric, the Centre for International Environment and Development Studies at the Agricultural University of Norway, provides the secretariat as a facilitating and implementing body for the DCG. The DCG's activities are funded by NORAD (the Norwegian Agency for Development Cooperation).

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ACRONYMS AND ABBREVIATIONS

AE	-Adult Equivalent
AGRA	-Alliance for a Green Revolution in Africa
AISE	-Agricultural Inputs Supply Enterprise
ATJK	-Adami Tulu Jedo Kombolcha
ARDO	-Agricultural Rural Development Office
ARDU	-Arsi Rural Development Unit
ATPPSC	-Adami Tulu Pesticide Preceding Share Company
Birr	-Ethiopian Currency (US $1 = 10.0 Birr in 2008)
BoARD	-Bureau of Agriculture and Rural Development
CAADP	-Comprehensive African Agricultural Development Program
CPP	-Comprehensive Package Project
EC	-Emulsifible Concentrate
FCA	-Federal Cooperative Agency
ESE	-Ethiopia Seed Enterprise
FA	-Farmers Association (also named as PA = Peasant Association)
FAO	-Food and Agricultural Organization
FGD	-Focus Group Discussion
GDP	-Gross Domestic Product
HH	-Household
HYV	-High Yielding Varieties
Lt	-Liter
MDGs	-Millennium Development Goals
MoARD	-Ministry of Agriculture and Rural Development
MPP	-Minimum Package Project
NEPAD	-New Partnership for Africa's Development
NGOs	-Non-Governmental Organizations
PADEP	-Peasant Agricultural Development Extension Project
PADETES	-Participatory Agricultural Demonstration and Training Extension System
PASDEP	-Plan for Accelerated and Sustainable Development to End Poverty
PPE	-Personal Protective Equipment
Qt	-Quintal (unit of weight measurement, 1 qt = 100 kg)
SSA	-Sub-Saharan Africa
TLU	-Tropical Livestock Unit
ULV	-Ultra Low Volume
WADU	-Walayita Agricultural Development Unit
WHO	-World Health Organization

EXECUTIVE SUMMARY

This study was conducted with the main objective to examine the impacts of improved seeds and agrochemicals on environment and food security in Adami Tulu Jido Kombolcha (ATJK) and Boset districts in the Rift Valley of Ethiopia. The study used both primary and secondary data. The primary data were collected through a survey of 305 randomly selected rural households and focus group discussions made with groups of farmers, experts and institutions including the Sher Holland Flower Company and Ziway Rose in Ziway town.

The major agricultural inputs used in the area and considered in this study include chemical fertilizer, improved seeds, pesticides and irrigation technologies, which constitute major elements of packages implemented during the previous Green Revolution. About 73% of the sample farmers used fertilizer during the last production year. Fertilizer application is sub-optimal especially during the current year (2008) due to soaring fertilizer prices. About 71% and 68% of the sample farmers used improved seeds and pesticides, respectively. Only 10% of the improved seeds used in the area were supplied through the extension system (new delivery) while the largest proportion of farmers exchanged the seeds of improved seeds reproduced on farm. Since the improved varieties were introduced several years ago, the vigor of some of the seeds has been lost though the farmers still call the variety improved. The application of some of these technologies especially pesticides is made without adequate skill, resulting in poisoning of people and livestock.

The use of improved agricultural technologies resulted in positive and negative impacts. The positive impacts are related to economic and social improvements: increased yield of crops, increased production and income of the beneficiary households, diversification of production, change in food habits particularly of irrigation adopters, improved health, increased asset building and better living conditions. Moreover, the use of improved agricultural inputs enhanced the market integration and induced a high demand for farm activities. Smallholder farms and cut flower companies provide casual work opportunities for labour migrants from Amhara, SNNPR and northern parts of Oromia. The social impacts of improved inputs include increased participation of women in economic activities and decision making, empowerment of women in terms of income utilization, information and knowledge exchange, enhancement of saving culture, etc. Negative impacts are related to the impacts of pesticides on human and livestock health due to misuse and abuse. Other impacts are declining diversity of landraces of crops, declining traditional soil fertility management practices due to reliance on fertilizers and pesticides, increased inequality in wealth of users and non-users, etc.

In view of high soil degradation, the use of improved agricultural technologies should be enhanced. This, however, requires integration of chemical and biological soil fertility treatment, development and dissemination of agro-ecology specific packages of technologies, capacity building for researchers, development agents and farmers, market linkage, etc. Detailed conclusions of the findings and policy implications are given in Chapter 8.

1. INTRODUCTION

1.1 BACKGROUND

Agriculture is the backbone of the Ethiopian economy. Current GDP composition by sector shows that agriculture accounts for 47.5% (World Bank, 2007). The agricultural sector provides over 60% of foreign exchange earnings, and employs 80% of the labour force. About 44% of the population lives below the poverty line based on the conventional measure of poverty (US$1 per person per day). According to the World Food Program, there are over 6 million people in Ethiopia who are permanently food insecure. In March 2007, about 8.6 million rural people in Ethiopia were in need of humanitarian assistance. According to the information obtained from the Food Security Bureau, about 7.3 million chronically food insecure people were in need of cash or food assistance through the Productive Safety Net Program in 2007. With the soaring food prices, the number of people in need of food assistance significantly increased. The problem is crucial in the drylands where the use of agricultural technologies is constrained by many factors.

The performance of agriculture depends on natural factors and it suffers from recurrent drought. The GDP growth rate was 8.9% in 2007 (World Bank, 2007). The low agricultural growth is also attributed to low intensity of agricultural inputs. With an increasing population which fuels higher demand for food and other utilities, intensification of agriculture is becoming the rule of the day, and is said to affect the human and physical environment. In order to ensure food security and stimulate growth, the Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) puts high emphasis on agricultural intensification through the use of improved agricultural technologies and commercialization of agricultural production.

The farming system in Ethiopia is dominantly smallholder agriculture which supplies approximately 95 percent of the food production in the country. The smallholder agricultural production system is mainly based on traditional inputs. Land preparation is done by oxen-drawn plough or by manually operated tools. Seeding is done by broadcasting and weeding largely depends on intensive family labour. Intercropping and multiple cropping are practiced to cope with the problem of small land size which is currently averaging below 1 ha per household.

In Ethiopia, particularly in the Rift Valley area, there are series of emerging and interrelated problems affecting the biodiversity, water and soil resources which are threatening the medium and long-term functional integrity of its ecosystems. Many of these problems are associated with recurrent drought, fragmented and small farm size due to high population pressure and agricultural intensification. The Rift Valley is known for housing lake belts. It is exposed to erosion hazards and extensive use of agro chemicals due to the establishment of commercial farms including vegetables and floriculture. The water bodies are also affected by harmful practices and over-fishing. Recently, the Rift Valley areas are becoming hot spots for private investors in agriculture (especially horticultural crops and flowers) which require intensive agrochemicals and irrigation. Although irrigation contributes significantly to poverty alleviation, food security, and improving the quality of life for rural populations, the sustainability of irrigated agriculture is being questioned, both economically and environmentally. The increased dependence on irrigation has not been without its negative environmental effects.

Currently small-scale agriculture in Africa is getting the attention of civil society and international organizations as a means to improve food self-sufficiency, and fight against rural poverty and hunger as part of the MDGs. Institutions like the Rockefeller Foundation, the World Bank, and the New Partnership for Africa's Development (NEPAD) and the Food and Agriculture Organization (FAO) and individuals like Bill Gates and Jeffrey Sachs are interested in enhancing the role of small-scale agriculture to address food security in the Sub-Saharan Africa (SSA).

These institutions and individuals are emphasizing the need for a new Green Revolution for Africa, highlighting the role of improved seeds and fertilizers as key to unlocking the productive capacity of African Agriculture. Concerns about the environmental effects of agricultural inputs have prompted a number of studies in the recent years. The anticipated environmental consequences are multi-dimensional. Most environmentalists agree that there are certain serious environmental costs to be concerned about, especially in terms of chemical input use (Islam, 1993; Anderson, 1998; Pingali, 1999). In addition to the environmental costs, there are also acute and chronic human health hazards that need to be considered. Although some of the literature have focused on the theoretical aspects of links between agricultural input and environment, empirical evidences on this subject remains rather thin due to lack of reliable data, especially in the case of developing countries (Wedin and Tilman, 1996). This study, therefore, examines the impacts of the use of improved agricultural inputs and agrochemicals on food security and the environment in selected areas of the Rift Valley of Ethiopia.

1.2 OBJECTIVES OF THE STUDY

The overall objective of the study is to assess the impacts of the use of improved seeds, mineral fertilizers and pesticides on food security, human and animal health and environment in the Rift Valley of Ethiopia.

The specific objectives are:

1. To assess the impact of the use of improved seeds, chemical fertilizers and pesticides on food security of the rural poor;
2. To assess the extent to which the use of chemicals resulted in environmental hazards which can be expressed in terms of abuse and misuse, poisoning and death of people and livestock in the study sites;
3. To assess the changes in social institutional factors brought about by the introduction of agro-chemicals and the effect on food security;
4. To draw conclusions to be used for policy advocacy in relation to the new African Green Revolution.

1.3 ORGANIZATION OF THE REPORT

This report is structured into eight sections. Section One introduces the background and objectives of the study. Section 2 discusses the methods of data collection and analysis. In section 3, a review of the Green Revolution as an international phenomenon, its impacts and the ideas of the New African Green Revolution is made. Section 4 presents the findings on the socio-cultural and demographic situation of the study area. Section 5 describes the current status of resource use in the study areas and the economic activities and means of livelihood and crop management practices. The economic, environmental and social impacts of introducing improved agricultural technologies are concerns of section 6. Critical factors of production and opportunities are highlighted in section 7. Finally, the conclusions and policy implications are given in section 8.

1.4 LIMITATIONS

The secondary data needed for impact assessment is fragmented and not complete. The study was conducted when the government institutions' Business Process Re-engineering was in progress which resulted in staff reshuffling and setting up of a new management system, making it difficult for the team to obtain authenticated information at the time of the field visit. The study, therefore, heavily depended on the primary data collected through interviews and group discussions. Thus, the data quality can be affected by the memory and willingness of the respondents. Environmental and health impact studies require clinical and experimental data, which are not lacking in this study. The study was also confined to the Rift Valley area and it has only limited representation of wider agro-ecology of the country.

2. METHODOLOGY

2.1 THE STUDY AREA

The study was conducted in Adami Tulu Jedo Kombolcha and Boset districts of East Shewa Zone of Oromia regional state. The two study districts are located within 200 km radius from Addis Ababa, the capital city of the country. The main asphalt road connecting Hawassa town to Addis Ababa bisects Adami Tullu Jido Kombolcha district while the main port route to Djibouti bisects Boset district. The road network and access to cell phone in some of the sample Farmers Associations (FAs) enable the farmers to access market information for their outputs and also induce increased use of agricultural inputs. Moreover, the two districts are relatively better positioned due to their access to research centers such as Adami Tullu Agricultural Research and Melkassa Agricultural Research Centers, which creates a good opportunity for accessing research based knowledge, varieties and crop management practices.

The study site was selected to represent different agro-ecologies and production systems. Adami Tullu Jido Kombolcha (ATJK) was selected to represent dryland, irrigated and rainfed agriculture while Boset district was selected to represent the low to midland and rainfed agricultural system. Both districts are characterized by the high intensity use of agro-chemicals and fertilizer.

2.2 PRIMARY DATA SOURCE AND DATA COLLECTION

The primary data were collected through household survey and focus group discussions held with farmers and local development agencies during August 2008. Farmers Associations (FAs) in both districts were classified into three homogeneous groups using a set of criteria such as proximity to urban areas, availability of irrigation facilities and cropping system. In ATJK, Golba Aluto, Bochessa and Ido Gojola FAs were selected from FAs with irrigation facilities, Hurufa Lole FA represents rainfed agriculture and Garbi FA represents FAs adjacent to Ziway town where commercial farms including Sher Holland Cut Flower Company are located. Similarly, four sample FAs were selected from Boset for the survey. These were Digalo Wanga, Xiyyo, Qacacile Guji and Sara Arada FAs.

A total of 305 farm households were included in the survey with nearly equal distribution between the two districts. About 19% of the surveyed households were female headed (Table 1).

Both qualitative and quantitative data were collected using a structured questionnaire. The questionnaire covers a wide range of questions including crop production, livestock rearing, use of fertilizers, chemicals, irrigation water, sources of inputs, impacts of use of agricultural inputs, demographic and institutional factors, etc. during the 2007 production year. The crop production and inputs data collected include the main rainy season (*Meher season*) for all relevant crops and dry season and short rain season (*belg season*) for vegetables and irrigated maize. In order to complement the survey data and conduct an in-depth assessment at community level, Focus Group Discussion (FGD) and key informants' interviews were conducted at some of the FAs selected for the household survey. FGDs were guided by checklists prepared for the purpose.

Table 1: Distribution of sample households in the survey by FA and districts

Sr. No.	District	Farmers Associations	Male	Female	Total	% Female
1	ATJK	Hurufa Lole	25	6	31	19.4
		Bochessa/Dodicha	40	9	49	18.0
		Golba Aluto	29	5	34	14.7
		Ido Gojela	9	1	10	10.0
		Garbi Widana	20	11	31	35.5
		Sub-total	**123**	**32**	**155**	**20.6**
2	Boset	Tiyo	31	9	40	22.5
		Digalu Wanga	28	12	40	30.0
		Qacacile Guji	24		24	-
		Sara Arada	41	5	46	10.9
		Sub-total	**124**	**26**	**150**	**17.3**
		Total	**247**	**58**	**305**	**19.0**

2.3 SECONDARY DATA

Secondary data were also collected from NGOs, cooperative unions, private farms, and government institutions that are involved in agricultural development endeavors at district, zone, regional and federal levels. In addition, visits and key informants interviews were conducted at Sher Holland Flower Company, Rose farm in Ziway, and Adami Tullu Agro-Chemicals Processing Plant.

Literature on the elements and impacts of the first Green Revolution, implementation models, attempts made in Ethiopia to intensify and develop the agricultural sector was reviewed. Moreover, the elements of the New African Green Revolution have been reviewed.

2.4 DATA ANALYSIS

The survey data have been coded, entered into SPSS software, cleaned and checked for consistency. Descriptive statistics such as mean, percentage, cross-tabulations, charts and graphs were used to present the results. Mean difference tests have been used to estimate the significance of the key variables included in the Green Revolution package, namely fertilizer, chemicals, and improved seeds, on the household food security. Qualitative information collected from the FGD and key informants were used to describe the finding from wider community prospective to complement the survey data.

3. REVIEW OF LITERATURE

3.1 FUNDAMENTALS OF THE GREEN REVOLUTION IN THE INTERNATIONAL ARENA

The history of Green Revolution dates back to 1941 and it was started in Mexico with wheat and latter extended to maize, rice and beans. The original Green Revolution was a product of philanthropy, in a carefully negotiated partnership with the governments. The result of the Green Revolution as many puts it was life-altering and lifesaving of the small farms. The roots of the achievement were a combination of venturesome philanthropy, astute agricultural research, aggressive recruitment and training of scientists and farmers in the developing world, and relevant government agricultural and water policies. The major policies and strategies used, packages employed and institutional aspect of the Green Revolution are presented in the following paragraphs.

3.1.1 Major policies and strategies

The basic elements of the first Green Revolution are scientific development of more productive crops and fertilizers, agricultural policy, building markets for the inputs and outputs of the farm sector, strong commitment from national governments and public-private collabouration on infrastructure, water and irrigation, and the environment.

The key policies used during Green Revolution by countries like India for instance were:

- Agricultural policy centered on food production and distribution;
- Food policy geared to food self-sufficiency (to tackle shortage of foreign exchange); and
- Making food available at affordable prices and benefit a large number of poor;

The key strategies used were:

- "Grow More Food " campaign (to increase food grains supplies);
- Intensive Agricultural Program in selected potential districts in the country;
- Food grain production centered on high yielding varieties (HYV);
- Expanding HYV to assured water supply areas and accompany it with adequate application of fertilizer;
- Community development and agricultural extension program; and
- Land reform program.

The success of Green Revolution in India hinges on HYV technology. Enlargement of the area under irrigation, continuous adoption of old HYV and release of new varities, provision of modern inputs (fertilizer) and provision of agricultural credit to producers were success factors for HYV during the Green Revolution.

3.1.2 Packages employed

Agricultural intensification has been defined as 'increased average inputs of labour or capital on a smallholding for the purpose of increasing the value of output per hectare' (Tiffen *et al.* 1994:29). Agricultural intensification may occur as a result of an increase in the gross output due to inputs increase without technological changes or a shift towards more valuable outputs or technical progress that raises land productivity. The processes associated with agricultural intensification

include an increased frequency of cultivation; an increase in labour inputs; or a change in technologies such as increased use of natural or artificial fertilizer, improved seeds, animal traction, mechanization, multi-cropping; or series/relay-cropping and changes to the landscape such as irrigation, or soil conservation measures.

The Green Revolution was made successful in bringing about the high production results due to a comprehensive package of inputs used. Production was based on intensive packages composed of inorganic fertilizers, improved seeds, agricultural chemicals and irrigated water to facilitate structural transformation of agriculture and fuel economic growth. In effect, rather than the role of the extension system, the technology power which drastically increased the output fueled the expansion of agricultural technology use in India.

3.1.3 Institutional aspects

One of the success factors for the first Green Revolution was the harmony and perfect alignment of institutions such as philanthropic organizations, government, private sector, scientists, universities and farm communities. The lead was taken by philanthropists and backed by strong government support. At the core of the institutional aspect of the Green Revolution is the organization of research institutions. The structure of research organization, skilled human development and retention, research extension system were very crucial in developing high yielding varieties (HYV) which were the core elements of Green Revolution. The coordination among agricultural input suppliers, transport dealers, financial institutions and other input regulatory bodies were also worth mentioning. These partners had a stake in achieving coordinated agricultural development. A similar institutional arrangement suitable for the African condition is needed for the African Green Revolution to succeed.

3.2 IMPACTS OF AGRICULTURAL INTENSIFICATION IN SOME ASIAN/AFRICAN COUNTRIES

3.2.1 Economic impacts

The most significant impact of the first Green Revolution was increased agricultural productivity and making food supply available. In terms of food security pillars, intensification of agricultural inputs use increased food availability in India and other Asian countries. The impacts on job creation of the Green Revolution are mixed. Apparently, intensive crop production requires a large input of labour. But the use of agro-chemicals and farm mechanization could easily erode the employment benefit. The implication of farm mechanization on jobs is significant. In India and Bangladesh, the employment elasticity of HYV based yield expansion has fallen critically affecting the livelihoods of the employees.

The Green Revolution has had a limited impact in SSA, and on rainfed production systems (Hazell and Ramasamy, 1991). The majority of agricultural production systems in SSA remains low input, and only minimally intensified.

3.2.2 Environmental impacts

There is evidence that yield deterioration (and in some cases reversal) has been experienced and with it the rate of growth of intensification slowed down (Rosegrant and Livernash, 1996). This could be a result of environmental problems associated with intensification such as the loss of micro nutrients, problems with water table, or low level pest build up (Magnus, 1996). The reduced genetic diversity of HYV crops means that there is a greater risk of pests or diseases due

to falling resistance. Environmental problems and reduced genetic diversity may have a negative impact on the quantity and quality of livelihoods as well as their sustainability.

Agricultural intensification creates monoculture and encourages resistance leading to a pesticide treadmill. The need to apply large quantities of more expensive and more toxic chemicals in order to sustain agriculture or vector control has side effects. Examples of the pesticide treadmill are plentiful in the Third World. The brown plant hopper in Sri Lanka illustrates this problem. In many areas of South and South-east Asia the new varieties of rice that have been introduced as a result of the 'Green Revolution' are not as resistant to the plant hopper as were their predecessors (Hansen 1988). Further applications of pesticide have failed to curb the losses to farmers caused by plant hopper attacks. The greater applications of pesticides have led to increases in pesticide poisoning. In addition, poor farmers found it increasingly difficult to pay for the costs of pesticides.

The use of pesticides in public health programs has followed a similar course. Bull (1982) on the history of anti-malaria programs, and in particular the global malaria eradication policy adopted by WHO in 1955. In the mid-1960s, the growth of resistance among malaria-carrying mosquitoes led to a resurgence of the insect population.

By 1980, there were 171 species of insects and mites of medical or veterinary importance resistant to at least one, and often several, pesticides. More pesticides were used in agriculture than in malaria control, and the agricultural use of pesticides encourage the development of resistant strains (Bull, 1982; FAO, 1981). Studies conducted in rice growing Philippines on the ways farmers use pesticides shows that farmers often applied agricultural chemicals at 35-40% of the recommended application rate. No correlation was found between insecticide amounts and yield, but correlation was found between insecticide and disease infestation; farmers sprayed more insecticides when they saw disease damage, which may not have been caused by insets. The strongest correlation, however, was between insecticide use and access to loans and credit (Farmers Weekly, 1991). All studies revealed that farmers misused insecticides and frequent insecticide use was not solving the insect problems.

The recorded damage to human health from pesticides is very frightening depending on whether this is acute, sub–acute or chronic and this includes retinal damage, dizziness, loss of memory, miscarriages, intestinal problems, delayed neurotoxicity, sterility and birth defects not to forget cancer risks or suppressed immune system (Srivastava and Patel, 1990). An estimated 10,000 died in China during 1993 from pesticide poisoning due to neglect in following safety procedures and overuse (Ann and Devid, 1994). In the Philippines, there were reports of 1,303 cases of poisoning from January 1992 to March 1993 and another study showed 27 percent increase in mortality or nearly 900 farmers dying every year in Central Luzon (Quinn, 1994).

3.2.3 Social impacts

Traditionally, women's work has always been considered significant for the household's food and nutrition requirement. But culturally women have always been conceived of as dependents and legal minors. This contradiction has often curtailed the full potential of women's participation in the food chain with serious repercussions on the nutritional status of their families and on their own well being. As one United Nations study put it, "While women represent half the global population and one –third of the labour force, they receive only one percent of world property. They are also responsible for two thirds of all work.

Intensive agricultural production requires involvement of women and increases their work burden. In this dichotomy, the women usually lose out because of their inferior status with respect to cultural practices that associate land rights with control and disposal of the product. Cultural practices and patriarchal relations tend to sharpen as the male head of household tries to exert greater control of the labour product of the other members of the family. This aspect becomes even more dominant where the labour product from the fields or livestock is small and the control has, therefore, got to be tighter (Mascarenhas, 1983). Equity in distribution is not necessarily better among wealthier households, but at least the women's share is sufficient to meet needs and there is more opportunity to intensify production and diversify activities (Cheater, 1981).

3.3 REVIEW OF THE NEW AFRICAN GREEN REVOLUTION INITIATIVE

Two USA charities have launched a new alliance to help increase food productivity and fight poverty in Africa. The Bill and Melinda Gates Foundation teamed up with the Rockefeller Foundation forming the Alliance for a Green Revolution in Africa (AGRA). In the following subsections, the background for the initiative, some of the implementation strategies, perceptions of Africans on the initiative and the Ethiopian context are briefly described.

3.3.1 Background of the initiative

The majority of smallholder farmers in Africa produce on one hectare of land or less. The food security of households largely depends on land size and soil fertility. The vast area of Africa in general and Ethiopia in particular is characterized by low land fertility, high soil degradation, rain-fed and fragmented land holding, extremely low external inputs such as fertilizer and agrochemicals, and the use of traditional farming techniques. Lack of access to improved seed varieties and other inputs; low levels of crop management skills; poor market linkages for agricultural outputs; declining public funding; and limited access to credit at all stages in the value chain are major bottlenecks. In terms of enabling environment there are no well developed warehouses and agro-processing industries that process at surplus production and add value through sale during bad times. Transportation of small excess produce to large consumption areas is costly and time consuming owing to poor road infrastructure. Due to these and other structural problems, the majority of smallholder farmers in Africa have hard lives.

To reverse the situation many kinds of interventions have been launched in Africa, particularly in Sub-Saran Africa one of which is the New African Green Revolution Initiative. The initiative aims at making better seeds reach farmers, along with techniques for using them effectively and reduce or eliminate the risk of food shortages. But the challenge of bringing higher-yielding seeds to Africa's small farms is more complicated than it was in the earlier Green Revolution. Among other factors, Africa's climate, soil, and range of suitable crops are all far more diverse than in Asia or Latin America. In addition, irrigation was far more widespread in Asia than it is in Africa, and there are fewer teams of trained scientists available to work in large breeding programs.

3.3.2 Implementation strategies

All the strategies used by the first Green Revolution countries are valid for the New African Green Revolution if fine tuned to the African context. The following are some of the implementation strategies that are being pursued in African's Green Revolution:

- Strong commitment and support from the government side;
- Increasing agricultural productivity through developing HYV suitable to Africa.
- Creation and/ or strengthening coordination among institutions involved in agricultural development
- Establishing an appropriate and competent institution that lead, coordinate, monitor and evaluate the performance of a set agricultural policy and/or strategic objectives
- Put in place efficient and effective agricultural extension system
- Take some form of land reform measures including at least certification
- Price stabilization policy, when the free interplay of supply and demand are extremely tilted to either producer side or consumers side, accompanied by strategies such as minimum price at time of surplus production
- Increase smallholders access to financial services through establishing microfinance institutions and or specialized Banks to provide credit for stallholders
- Provision of key modern agricultural inputs
- Irrigation development where applicable and linking HYV.

Output side policy measures that should be taken include (Dejene, 2003):

- Price stabilization policy to increase farm income stability
- Warehousing
- Insurance (Recent engagement of EIC to insure agricultural production)
- Take measures to improve agricultural marketing including improving the value chain and product quality management
- Encouraging the establishment of agro-processing plants

The African Green Revolution as published on the AGRA Website (November 2008) implements several programs such as the program for seeds systems, restoring soil health, water development, market, policy, exploring African farmers' knowledge, and monitoring and evaluation. The first three are major focuses involving crucial factors of production:

i) **Program for Africa's Seeds Systems (PASS):** which has the mission to increase income, improve food security and reduce poverty by promoting the development of seed systems that deliver improved crop varieties to small-scale farmers in an efficient, equitable and sustainable manner. In 10 years, it plans to have introduced more than 1,000 new varieties of at least 10 staple crops that increase the productivity of Africa's small-scale farmers and contribute to the alleviation of the hunger and extreme poverty of 30 to 40 million people. The program will focus on (i) education for African crop improvement, (ii) funds for the improvement and adoption of African crops (iii) private and public seed production initiatives and (iv) Agro-Dealer Development Program which provides training, capital and credit to establish certified agro-dealers who are a primary conduit of seeds, fertilizers and knowledge to smallholder farmers to increase their productivity and incomes.

ii) **Restoring Soil Health in Africa:** This program aims at improving the soil fertility. In order to increase yield in an environmentally sustainable and economically viable manner, the program focuses on soil management practices to maintain soil quantity, structure, nutrients, and proper chemistry. This can be a partial alternative to the use of mineral fertilizers but alone cannot meet nutrient demands. In combination, however, organic methods increase the efficiency of fertilizer and fertilizer helps increase the returns on

organic methods through positive interactions on soil biological, chemical and physical properties.

iii) **Water:** Water scarcity and inefficient water use is a major problem for African farmers. Over 90 percent of Africa's poor farmers depend on rainfall, which is unpredictable at best, to sustain their crops. Few small-scale farmers have access to irrigation -only 4 percent of farm lands in sub-Saharan Africa are irrigated compared to 37 percent in Asia. AGRA is exploring easily adaptable "micro" irrigation techniques that use simple methods like foot-operated treadle pumps and low-cost drip irrigation systems to ensure that crops continue to thrive during periods of drought.

3.3.3 Perception of the Africans on the Initiative

In many Sub-Saharan African countries, a Green Revolution type of technology should be the basis of an agriculture-led growth strategy that includes a delicate mix of policy and institutional reforms (Mulugeta, 1995). The African governments look into improved agricultural intensification as a way forward. The NEPAD countries established Comprehensive African Agricultural Development Program (CAADP). The program coordinates development efforts, commit governments to invest 10% of their GDP in agriculture and take measures to register agricultural growth rate of 6%. CAADP envisages benefiting from the efforts of AGRA. For instance, the African leaders agreed in the 2006 Summit to adopt policies that make the rural African farmers affordably access soil nutrients. AGRA's Soil Health Initiative builds on the 2006 African Fertilizer Summit. In general, it appears that the African governments welcome programs and initiatives that aim at increasing agricultural production and productivity.

3.4 POLICIES AND STRATEGIES USED TO INTENSIFY AGRICULTURAL PRODUCTION IN ETHIOPIA

3.4.1 Historical policy review

The Ethiopian government has been pursuing different kinds of agricultural policies and strategies to boost agricultural production. All policies that have been used by Green Revolution practicing countries have more or less been attempted in Ethiopia. During the Emperor regime, the government pursued an export led development strategy and expansion of rural road networks to promote export of cash crops. Following the Green Revolution of Mexico and India, different agricultural development projects were implemented. The most peculiar projects were the Comprehensive Package Project (CPP) and the Minimum Package Projects (MPP).

The CCP was initiated in the late 1960s and early 1970s to raise agricultural production and productivity in selected high potential areas of Chilalo, Walayita and Ada'a. The three CCPs were named after the locations as Chilalo Agricultural Development Unit (CADU) (later renamed as Arsi Agricultural Development Unit (ARDU)) initiated in 1967, Walayita Agricultural Development Unit (WADU) and Ada'a District Development Project both launched in 1970. The projects aimed at integrating agronomic research and dissemination of improved seeds, chemical fertilizers, improved farm tools and provision of marketing and credit facilities and promoting rural road construction and the supply of potable water (Tadesse, 2008).

Based on the lessons learnt, MPP was designed in different phases to disseminate new proven improved methods of agricultural production at a broader scale. The MPP1 was implemented during 1971-1974 while MPP2 was implemented in 1981-1984. The MPP2 was administered by

the Extension Project Implementation Department (EPID) of the Ministry of Agriculture. The key packages include farm implements, fertilizer and improved seeds developed by CPP.

During the socialist regime (1975-1991), the major agricultural and rural development policies and strategies focused on:

- Mechanization of state farms and collective farms and marginalization of small farms;
- Expanding cooperative services instead of the private sectors;
- Controlling the agricultural inputs and outputs marketing systems by setting quotas and prices at non-competitive levels;
- Subsidizing farm inputs especially for state farms and cooperatives.

The Peasants Agricultural Development Extension Project (PADEP) was initiated in 1980s to implement the rural development strategies. Emphasis was given to high agricultural potentials in the country to disseminate agricultural technologies. Collectivization of farmers into producers' cooperatives was an important instrument used.

Currently the Ethiopian government is following Agriculture Development-Led Industrialization (ADLI) strategy. The strategy focuses on improvements in the productivity of smallholder agriculture by relying on the generation, transfer, adoption and diffusion of improved agricultural technologies, and provision of credit and other public services. In order to promote rapid growth in the agricultural sector, a new extension system referred to as Participatory Agricultural Demonstration and Training Extension System (PADTES) was formulated in 1994/95. It was implemented massively covering almost all agro-ecologies. Emphasis was given to raising farm productivity and agricultural production of smallholders through intensification of the use of fertilizer, improved varieties of grain, application of chemicals for weed and pest control. The system continued until 2001 when the price drop halted the motivation for increased production. Moreover, blanket recommendation of the use of agricultural technologies was criticized.

In response to the critics of the PASDTES on blanket recommendations, a new extension approach known as "Menu-based" technological dissemination was introduced in 2004. The approach assumes availability of a list of technologies for the farmers to choose. The system highly encourages the private sector to engage in large scale agricultural production.

Currently Ethiopia is implementing PASDEP that has agricultural input intensification as a means to increasing agricultural production. In the PASDEP, it is indicated that the country has planned to increase annual supply of chemical fertilizers such as DAP from 320,200 tons in 2004/05 to 470,000 tons by 2009/10 and Urea from 160,000 tons in 2004/05 to 350,000 tons by 2009/10. There is also a plan to increase the seed and farm implements supply. Yet, the practice shows that farming in Ethiopia is mainly based on traditional systems, with local farm tools, use of local seeds and low fertilizer application rate. It is also planned to increase supply of improved seed from 131,620 qt to 180,000 qt during the PASDEP period. There was no explicit plan to increase the use of pesticides.

3.4.2 Elements of Green Revolution in Ethiopia

Ethiopia coincidentally or with deliberate guide has been applying all the principles of the first Green Revolution with different scopes. Some elements of the Green Revolution are being aggressively applied and others a little bit lethargically. Among elements and or policies

aggressively pursued by Ethiopian government is HYV development effort through research and development. Maize, wheat, sorghum and barley are among HYV of cereal crop varieties developed and released. HYV of pulses, vegetables and fruits, and horticulture crops have also been released by research centers. Many regional and national research centers have been established and are developing a wide range of HYV depending on the agro-ecology the research institutes are situated in. The important weight government has given to research can be deduced from expenditure on agricultural research though Donors supported. The expenditure on agricultural research increased from 0.75% agricultural GDP in the late 1990s to 3% of agricultural GDP by 2002/3 (Tadesse, 2008).

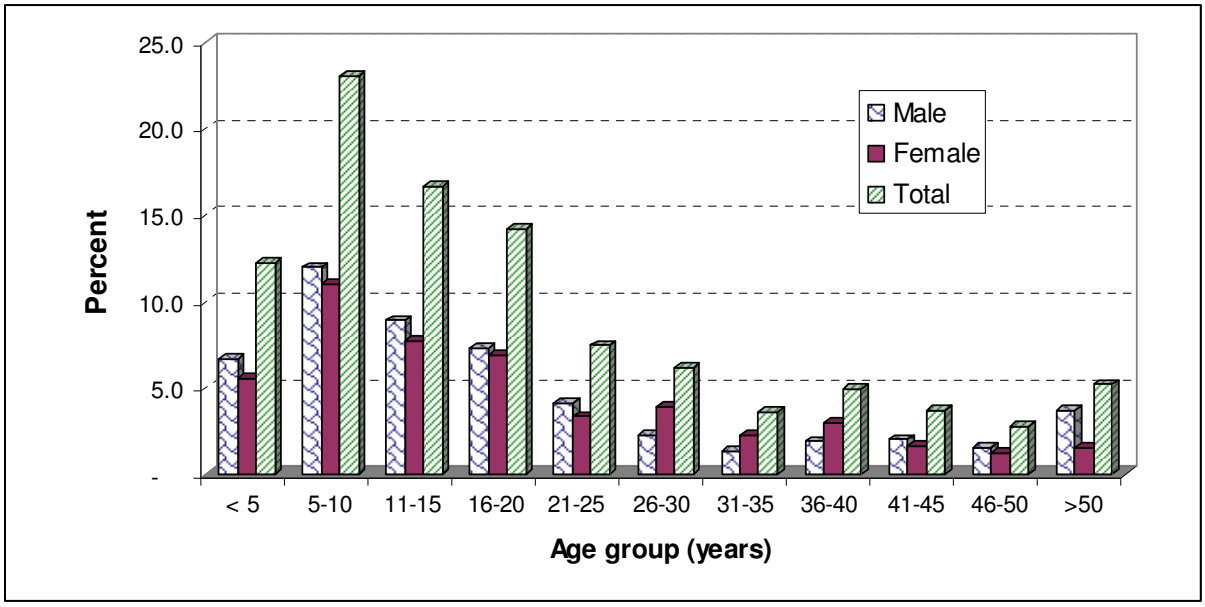
In terms of research and the development of human capacity the country has formulated and implemented a ten years program known as the Agricultural Research Training Program. Though many believe that the country has a large potential for irrigation based agricultural production, its use is currently at a rudimentary stage. Land under irrigation is less than 10% of potential irrigable land.

4. SOCIO-CULTURAL ASPECTS AND DEMOGRAPHY OF THE STUDY AREA

4.1 HOUSEHOLD COMPOSITION

The average family size of the respondents is 5 which is almost equal to national average and ranges from 1 to 16. The age of the respondents ranges from 18 to 85 with an average of 43 years. The survey result shows that the sex ratio in the study area is 51.8% male and 49.2% female. There is no significant difference between the ages of respondents in the two study districts. Children of age below 5 years account for 12.2% of the population of the sample districts whereas all children of age up to 15 years account for 51.1% of the population. In the study areas, the age composition shows that there are more dependant people of age below 18 years (56%) than the working age of 18 to 64 (42%). Only a few people (2%) enter into the retirement age of above 64 years. As shown in Figure 1, the largest proportion of the household members falls in the age 5-10 years followed by 10-20 years. The age distribution has great implications in ensuring household level food security since a large number of people depend on a few working people to access food.

Figure 1: Distribution of people by age and sex (%)



Source: Own survey (August, 2008)

In terms of marital status, 84% of the respondents are married while 9% are widows and 3% divorced. The survey result reveals no significant difference between the marital statuses of the respondents in the two districts.

4.2 EDUCATION

Education is an important instrument for good decision making. The survey result shows that 45% of the respondents did not attend formal education (Table 2). The proportion of female

headed households with no formal education is higher than that of male headed households. About 17% of the respondents attended secondary school and only 1% attended education programs beyond secondary school.

Table 2: Distribution of respondents by education level (%)

Education level	ATJK	Boset	Total
No formal education	40.0	50.3	45.1
Grades 1-6th	38.1	34.9	36.5
Grades 7- 12th	21.3	13.4	17.4
Certificate	0.6	0.7	0.7
Diploma		0.7	0.3
Total	100.0	100.0	100.0
N	155.0	150.0	305.0

Source: Own survey (August, 2008)

The future is promising as a large number of children are attending school. Out of all household members, about 26% have no formal education while about 36% are attending or attended the first cycle primary education and another 26% attended/attending the second cycle primary education of grades 5-8.

Table 3: Distribution of household members by education level (%)

Education level	Male	Female	Total
No formal education	20.3	31.6	25.7
1-4	35.7	36.1	35.9
5-8	28.4	24.1	26.4
9-10	11.7	6.6	9.3
11-12	3.2	1.1	2.2
>12	0.6	0.5	0.5
Total	100.0	100.0	100.0

Source: Own survey (August, 2008)

4.3 RELIGION

Religion is a social factor determining the ways of life of a society. Religious norms govern the food habit and working conditions. The orthodox faith is dominant in the study area, but this is much more pronounced in Boset district than at ATJK (Table 4). In ATJK district, 75.5% of the sample respondents were followers of Islamic faith. Protestant accounts for only 2.7% of the respondents.

Table 4: Distribution of respondents by religion (%)

Religion	**ATJK**	**Boset**	**Total**
Orthodox	22.6	91.8	56.1
Islam	75.5	4.8	41.2
Protestant	1.9	3.4	2.7
Total	100.0	100.0	100.0
N	155	150	305

Source: Own survey (August, 2008)

4.4 TRADITIONAL INSTITUTIONS

There are many kinds of local self support institutions in the study area. They are established for different purposes. Some are meant for solving financial problems, to extend a hand at hard times such as death, and others for ritual purposes. Some of them are organized by gender and others are time specific and based on religion. The most common traditional mutual self support institutions identified in the study area as shown in Table 5 are *Idir* (77%), *Daboo* (38%), *Iquib* (35%) and *Mahiber* (32%). These institutions provide reciprocal services both in terms of physical and financial supports needed for consumption, investment or insurance in the case of illness or death. *Mehaber* is sometimes used for entertainment. The Elder Council for conflict resolution has been recognized by 28.5% of the respondents, while labour exchange associations (25%) are also important means of overcoming peak labour requirements. These traditional local institutions have endured many changes over time as discussed in the impact section below.

Table 5: Significance of traditional institutions (% of respondents)

Traditional institutions	ATJK	Boset	Total
Iquib	40.6	28.4	35.1
Idir	73.5	78.7	77.4
Daboo	42.6	32.3	38.0
Labour exchange Association	28.4	21.3	25.2
Mahiber	29.0	34.2	32.1
Elders council for conflict resolution	25.8	30.3	28.5
Fertilizer group	0.6		0.3
Home economics (Baltina) for females		3.9	2.0

Source: Own survey (August, 2008)

5. ECONOMIC ACTIVITIES AND FACTORS OF PRODUCTION

5.1 MEANS OF LIVELIHOOD OF THE RESPONDENTS

Knowledge of the livelihood of smallholders helps to design appropriate farm household income stabilization policies and strategies. It can also assist in determining the kind of technology or intervention needed in the area. The farming communities included in the survey make their livelihood mainly from farming (93%) and some from petty trading (0.6%) (Table 6). About 78% of the female headed households are engaged in farming while the remaining 22% involve in household activities and depend on the members of the households (their children) for income generation.

Table 6: Proportion of household heads by primary occupation (%)

Major occupation of the HH head	Male	Female	Total
Farming	96.7	77.6	93.1
Household work	2.4	22.4	6.3
Petty trade	0.8	-	0.6
Valid No. of cases	245	58	303

Source: Own survey (August, 2008)

The major source of income for farmers in the study districts is crop production (90%) followed by livestock production (67%). About 89% of the sample respondents generate their livelihood from crop production as the first means of livelihood. About 18% of the respondents generate income from production of vegetables, whereas 11% consider the income from vegetables as the second major source of livelihood. Overall agriculture is the main source of livelihood of the farming communities showing limited alternative income sources in the areas.

5.2 FACTORS OF PRODUCTION

The livelihood strategy of the farm households is determined by the resources and knowledge available to exploit the opportunities. The use of chemical fertilizers, improved seeds, chemical pesticides and irrigation packages are considered important elements of the Green Revolution. The extent and magnitude of use of these inputs determine the yield level. Land, labour, capital (in the form of seeds, fertilizer, irrigation facilities, livestock, etc) are considered as capital that affects the level of productivity gain and hence the living standards of the community. This section discusses the current status of these resources.

5.2.1 Land

Land is the most valuable resource for agricultural production. Land is a public resource and cannot be sold and exchanged by the farmers in Ethiopia. Owners have only use right and the right to lease it for short and medium term and the right to transfer to children. In the study area, land is highly needed by investors in floriculture and vegetable production. Because of this and the impacts of population growth, land size is shrinking over time. The landless population is rising in rural areas. There is s significant difference in land holding size between the two study areas. The average crop land area is about 1.5 ha at ATJK and about 2.2 ha at Boset district, which is much higher than the national average of 1 ha. The survey data also shows that 96% of

the sample respondents have a crop area while only 19% have an irrigable area. Moreover, 14% of the households own a grazing area while 1.6% reported having plots of forest/wood area.

The cropland holding ranges from 0 to 6.5 ha with an overall mean of 1.8 ha (Table 7). The mean irrigable land which is part of the cropland is higher in ATJK than in Boset. Moreover, about 33% of the sample respondents at ATJK district have some irrigable area while the proportion is only 4% at Boset, with an average of 18% irrigation practitioners in the area.

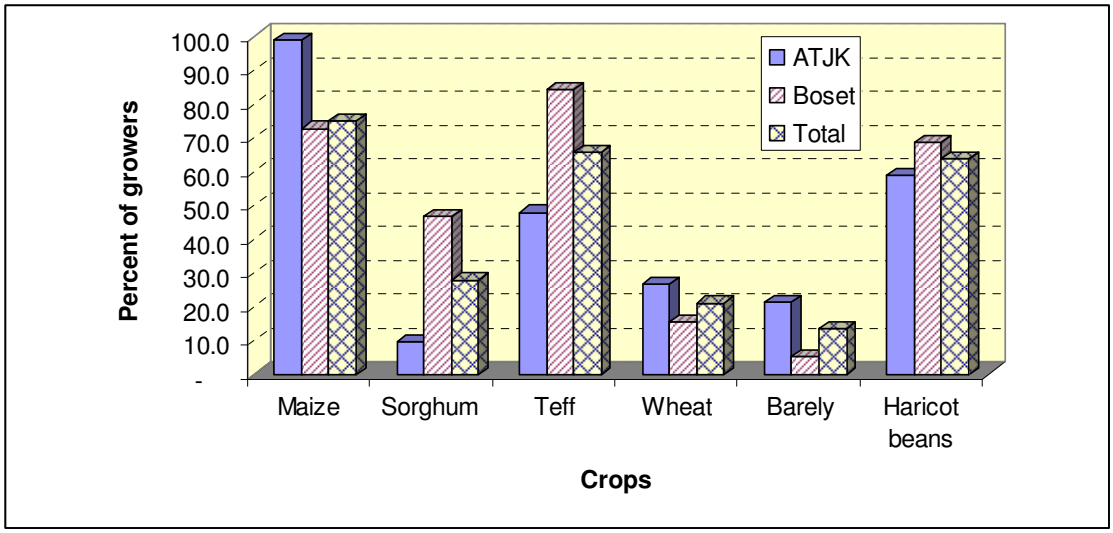
Table 7: The size of land owned now in ha

	ATJK			Boset			Total		
Land type	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Cropland	-	6.3	1.5	0.3	6.5	2.2	-	6.5	1.8
Irrigated area	0.1	1.3	0.5	0.1	1.0	0.4	0.1	1.3	0.5
Grazing area	0.1	2.0	0.6	0.1	3.0	1.1	0.1	3.0	0.6
Forest area	0.3	0.8	0.5				0.3	0.8	0.5

Source: Own survey (August, 2008)

Farmers usually allocate the available land to different crops depending on land suitability and household preference. Cereals such as maize, sorghum, wheat, barley, and teff are grown in a rainfed system. Moreover, haricot beans are grown with rain. Only 4 and 1.3% of the respondents indicated that they produced maize and haricot beans using irrigation, respectively. The relative importance of crops grown was determined by the proportion of growers (Figure 2) and area allocated to them (Table 8). Maize is the most dominant crop in ATJK district where about 98% of the farmers produce it. Haricot beans (59%) and teff (48%) are also major crops grown in the area. In Boset, however, Teff stands first (84%) while maize (73%) and haricot beans (68%) are the second and third widely grown field crops, respectively.

Figure 2: Proportion of households growing field crops (%)



Source: Own survey (August, 2008)

In terms of area allocation, maize stands first by occupying an average of 1 ha per household in both districts. Teff also occupied about 1 ha per household in Boset and only one third of a hectare in ATJK. The area allocated to haricot beans is also relatively high (Table 8).

Table 8: Area allocated to major crops, rainfed (ha)

Crop	ATJK	Boset	Total
Maize	1.02	1.12	1.06
Sorghum	0.28	0.65	0.58
Teff	0.37	1.06	0.81
Wheat	0.35	0.30	0.33
Barely	0.27	0.42	0.71
Haricot beans	0.43	0.96	0.71

Source: Own survey (August, 2008)

Despite the irrigation potential in the Rift Valley area where the study districts are located, the sample respondents have limited access to irrigation facilities. Table 9 shows that the proportion of the sample farmers who have produced crops using irrigation during the last production season was 20%. Vegetables can be planted and harvested two times a year. The first cycle of production usually takes place between November/December and February/March. The second production cycle starts in February/March and benefits also from the early rain onset. The result shows that most of the vegetables production takes place during the first cycle since the farmers feel that they can get good prices when they produce it during the dry seasons. Vegetable production is intensive in terms of fertilizer and pesticides requirement.

Table 9: Proportion of HH involved in irrigation based farming (%)

Irrigated crops	ATJK		Boset		Total	
	Cycle 1	Cycle 2	Cycle 1	Cycle 2	Cycle 1	Cycle 2
Onion	11.6	8.4	10.0	1.3	10.8	4.9
Tomato	5.8	5.8	8.0	1.3	6.9	3.6
Cabbage	9.7	8.4	2.0	1.3	5.9	4.6
Maize	8.4				4.3	

Source: Own survey (August, 2008)

The farmers who produce vegetables allocate only a small part of the farm to this activity due to lack of irrigation facilities. A relatively large area is allocated to onions and the smallest area is allocated to cabbages (Table 10).

Table 10: Area allocated to most commonly grown irrigated crops (ha)

Irrigated crops	ATJK		Boset		Total	
	Cycle 1	Cycle 2	Cycle 1	Cycle 2	Cycle 1	Cycle 2
Onion	0.32	0.28	0.37	0.19	0.34	0.27
Tomato	0.22	0.25	0.24	0.25	0.23	0.45
Cabbage	0.15	0.24	0.08	0.13	0.14	0.23
Maize	0.40				0.40	

Source: Own survey (August, 2008)

5.2.2 Improved inputs

5.2.2.1 Fertilizers

DAP and urea fertilizers are imported by the Cooperatives Unions and Agricultural Inputs Supply Enterprise (AISE). According to information obtained from FCA's annual magazine, cooperatives accounted for 67% of the total amount of chemical fertilizer the country imported during 2000 to 2007/08. In terms of actual figures, 14 unions have imported a total of 906.2 MT chemical fertilizers in this period. Cooperatives distributed 75% of the total chemical fertilizer distributed to farmers during the same period. The major fertilizer suppliers in the study area are Lume-Adama Farmers cooperative Union, Meki-Batu Vegetable & Fruits Growers Cooperative Union, District Agriculture and Rural Development Office Inputs Supply Teams and other cooperative unions and private merchants. The input supply flows from cooperative unions/AISE to primary cooperative societies and then to farmers. In some instances, merchants purchase and sell inputs to the producers.

Oromia Bureau of Agriculture and Rural Development (BoARD) has a stake in the fertilizer distributed through cooperative unions in the region. According to the data collected from BoARD (2008), the trend of fertilizer distributed in the region by the cooperative unions increased from 1.11 million qt in 2003 to 1.66 million qt in 2006, and then declined to 1.52 million qt in 2008 (Annex 1). The reduced fertilizer consumption is due to the drastic increase in fertilizer price (e.g. DAP price increased from about Birr 480 in 2006 to Birr 900 in 2008). The discussions held with farmers indicated that the Boset farmers reduced the purchase of fertilizer during 2008 by 40% due to the soaring fertilizer price. With the food grain price increasing drastically, the farmers could have waited for the high price to sell their produce. Lack of preparedness and poor market information made the farmers victims of the change in input and output prices. In effect, farmers reduced the fertilizer use intensity, which will have implications on the yield levels.

The sample farmers report that a good harvest cannot be expected without application of fertilizer. On pocket fertile plots, however, farmers apply manure and produce grain without the need for mineral fertilizer. Three classes of land were observed based on farmers' assessment of soil fertility: Class A is so fertile and can be used without mineral fertilizer. Soil Class B is medium in terms of fertility and application of fertilizer will increase its productivity to the level of Class A. The third class of soil is infertile and fertilizer application can result in high productivity to a level of Class B. Such an indigenous knowledge of the farmers is essential for calibrating soil fertility and optimization of fertilizer use.

The survey result shows that fertilizer is applied to common staple food crops such as maize, sorghum, teff, wheat, haricot beans, and vegetables. A relatively large number of producers use fertilizer for the production of cash crops i.e. teff (61%), haricot beans (46%) and wheat (37%) (Table 11). Maize is a staple food crop which is grown on relatively fertile soil. It occupies about 50% of the cropland in some FAs in Boset district (e.g. Xiyo FA) and almost all farmers produce it. Barely and sorghum were given the least attention in terms of fertilizer application.

Table 11: Proportion of agricultural technology users (%)

Type of technology	Maize	Sorghum	Teff	Wheat	Barely	Haricot beans
Fertilizer	26.7	9.4	61.0	37.5	12.2	45.9
Local seed	51.5	89.4	90.0	85.9	95.1	77.3
Improved seeds	51.5	9.4	11.0	17.2	7.3	26.8
Manure	52.7	23.5	7.5	23.4	14.6	14.9
Pesticides	15.6	5.9	57.0	54.7	34.1	3.6

Source: Own survey (August, 2008)

The blanket fertilizer recommendation at farm level is 100 qt of Urea and 100 qt of DAP per ha. The study reveals that except in a few cases, DAP is the only chemical fertilizer applied by smallholders. Table 12 shows the intensity of use of inputs in the study area. The result reveals that the rate of application of fertilizer is sub-optimal for teff (59 kg per ha) and maize (64 kg per ha).

Table 12: Intensity of agricultural inputs use for field crops

Input type	Maize	Sorghum	Teff	Wheat	Barely	Haricot beans
Cropped area (ha)	1.1	0.6	0.8	0.3	0.3	0.7
Fertilizer (kg/ha)	63.6	100.4	58.7	100.8	160.0	60.1
Local seed (kg/ha)	42.9	19.8	50.1	153.3	218.2	95.1
Improved seed (kg/ha)	36.7	20.0	40.5	163.2	117.3	94.4
Pesticide (Birr/ha)	56.7	51.6	58.2	72.4	64.3	43.7
Manure used (joniya*/ha)	12.0	17.4	15.2	39.3	15.2	15.3

* Joniya is a sack equivalent to 100 kg of grain. The weight of manure depends on the moisture content.

Source: Own survey (August, 2008)

Apparently, a more intensive and regulated fertilizer application is practiced in the commercial Cut Flower Farms. For instance, Zeway Rose Farm applies 41 different agricultural fertilizer products to 13 flower varieties grown on 9 ha of greenhouses. The fertilizers are applied in a solution using drip irrigation system. Moreover, 16 different plants growth regulators, preservatives and disinfectants are applied (Table 13). The farm makes analysis of the soil fertility and provides necessary nutrients to the plants on a continuous basis.

Table 13: Agricultural fertilizers and support materials used in Zeway Rose Farm

No	**Types of Materials**	**Products Number**	**No.**	**Types of Materials**	**Products Number**
1	Agriculture fertilizers		2	Crop defense promoter	1
1.1	Field grade fertilizer	12	4	Flower preservatives	3
1.2	Foliar fertilizer	3	5	Horticultural disinfectant	2
1.3	Greenhouse fertilizer	10	6	Horticultural detergents	2
1.4	Micro-elements	16	7	Adjuuant (sticker + spreader)	4
3	Plant growth regulators	4			
Total		57			

Source: Zeway Rose Farm (August 2008)

5.2.2.2 Improved seeds

With the exception of local seeds, all vegetable seeds and floriculture cutting materials are imported with import permit licenses and production permits. In Ethiopia there are 26 registered seed importers, 31 producers, 40 distributors and 4 processors. The Ethiopian Seed Enterprise (ESE) is a major supplier of selected seeds in both districts in the study area through its supply lines (own centers, branches and through cooperatives). Cooperatives also multiply seeds. Farmer to farmer exchange of seeds of maize, haricot beans and teff is common throughout the Rift Valley, while seeds of onion and tomato are mainly obtained from authenticated suppliers. According to the Oromia BoARD (2008), the quantity of improved seeds distributed in the region steadily increased between 2003 and 2007, from 58,408 qt to 188,964 qt respectively. Similar to fertilizer distribution, the supply of improved seeds distributed in the region declined to about 140,327 qt in 2008 (Annex 2).

In the study area, only a few farmers get improved seeds directly from the office of agriculture or cooperatives. The most common source of accessing improved seeds at ATJK is through exchange with farmers who received improved seeds during the previous years. At Boset district, about 10% of the farmers received the Awassa 511 maize variety directly through the office of agriculture. More than 80% of the farmers' access improved maize through exchange with the neighboring farmers. On the other hand, teff seed is obtained mainly from the market. Farmers, private merchants and cooperatives are involved in seed marketing. The volume, quality and the market share of each seed source is established from the existing data (Table 14).

Table 14: Source of improved seeds of crops

	Districts (%)	
Sources	ATJK	Boset
Farmer's exchange	60	20
Private (market)	30	60
Agricultural extensions system and cooperatives	10	10

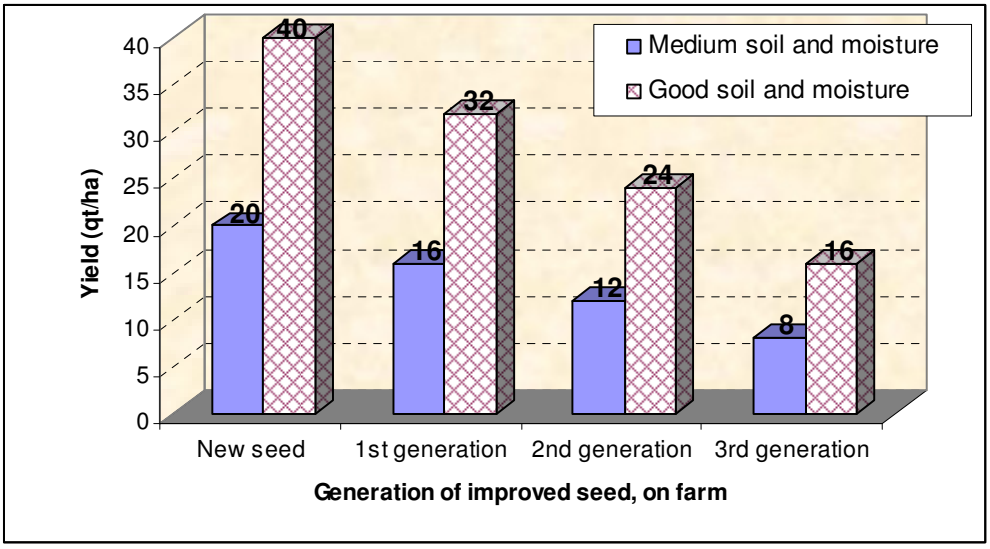
Source: Own survey (August, 2008)

Improved variety of maize is the most widely used improved variety where about 51% of the maize growers have adopted it. It is, however, important to note that the indigenous local

varieties have been grown in mixture with new varieties and the varieties introduced a long time ago that have lost the vigor of high yielding varieties. Hence, farmers consider them as local, without means to trace them. Different varieties of haricot beans have been disseminated to promote export. The survey result shows, however, that only 27% of the producers grow the improved varieties of haricot beans. It is also interesting to note that Teff which has been researched at Debre Zeit Agricultural Research Center, adjacent to the study districts, is reported to be adopted by only 11% of the sample farmers. This is mainly due to lack of appropriate seed multiplication and dissemination systems. The intensity of seed use is given in Table 12, above.

The seed transfer from farmer to farmer continues up to 3-4 generations, which implies a significant loss of vigor resulting in a low yield. The FGD result shows that the yield of improved seeds is highly dependent on the soil fertility, rainfall condition and the improved seeds supplied. The trend of the yield in both conditions is affected by the seed quality. The new seed is received from the extension or research system. Due to seed shortage, farmers select from the harvests of the new seed and use it during the subsequent years, with the consequence of reduced harvest (Figure 3).

Figure 3: Declining yield of improved seeds of subsequent generation



Source: FGD at Sara Arada and Xiyo FAs, Boset (August, 2008)

5.2.2.3 Pesticides use by smallholders

The provision and availability of pesticides, especially for the production of onion and tomato, plays an important role in successful irrigated vegetable production. These vegetables have been introduced recently and are mainly accompanied by irrigation facilities. The intensity of pest severity warrants heavy use of pesticides. Moreover, teff and wheat production requires these days the application of herbicides. The pests are insects, disease pathogens and weeds. The available data from Oromia BoARD show that about 170,000 lt of pesticides were distributed to smallholder farmers in Oromia in 2006 while the usage declined during the last three years (Annex 3).

The farmers in the study area access pesticides through the agricultural extension system (10%) and direct purchase from vendors (90%). It was also noted that the government finances widespread spraying of pesticides when a large scale infestation is reported. In the focus group

discussions, farmers bitterly complained about the quality of pesticides sold by the vendors who were considered to be fraudulent. Most of these profiteers include fellow farmers; mobile and small shop pesticide vendors. The trend in pesticides use is increasing due to the increased pest infestation. Pesticide use is found to be highest among teff producers (57%), followed by wheat growers (54%). These farmers use herbicides for weed controlling (Table 11). Farmers spend on average about 43 Birr/ha to 72 Birr/ha on pesticide depending on the crop type (Table 12).

Chemical control contains four major groups of pesticides. These pesticides are insecticides, fungicides, herbicides and avicides. Twenty four pesticides and target pests are indicated in Annex 5. Seven of the 24 products are Class 1 according to WHO classifications that should be used under strict professional supervision. However, farmers are using them without supervision and proper personal protective equipment. These pesticides are used for different pest targets which are affecting different crops (Annex 4). The pesticides used include 16 for insecticides, 5 for fungicides, 2 for herbicides and acaricides (Annex 5).

In the field survey 118 households in Adami Adami Tulu Jedo Kombolcha and 126 household heads in Boset wereda responed about DDT use for agricultural purposes. The pesticides are used against insect pests, fungicides to control diseases and pathogens while herbicides are applied to weeds and Avicides are used to control birds.

For the ease of application and safe use of pesticides, active ingredients are mixed or formulated in several ways with inert material as a carrier. The five most common formulations are dust, emulsifiable concentrate (EC), wettable powder, ultra low volume (ULV) and granules. Spray application machines (motorized, knapsack and ULV) are used for the spraying of pesticides to protect crops from pests. Personal protective equipments and other accessories are used for the safe application of pesticides. Overalls, gloves, goggles, boots and caps constitute the complete personal protective equipment. This standard and safe application of pesticides is lacking in the study areas.

5.2.2.4 Pesticides use by Zeway Rose farm

The intensity of pesticides application is much higher in the Commercial Greenhouses of the Cut Flower farms. The Zeway Rose Farm is one of the Cut Flower producing companies operating under the Sher Holland Flower Company's greenhouses in Zeway Town. It operates on 9 ha of greenhouses and produces 13 different flower varieties. The farm applies 114 active ingredients of insecticide to control 8 types of insects, nematodes and mites. It also controls 10 disease pathogens using 104 products (Table 15).

Table 15: Pesticides used to protect pests in Zeway Rose Farm

Types of pests	**No of pests**	**Control methods**		**No. of products applied**
		Protective	**Curative**	
1. Disease pathogens	10	24	80	104
2. Insects, nematodes and mites	8	160	-	160
Total	18	184	80	264

Source: Zeway Rose Farm (August, 2008)

Annexes 6, 7 and 8 are organized from the raw data obtained from Zeway Rose Farm. Out of the 114 pesticides only 26 (23%) are registered (Annex 6). As shown in Annex 6, with the exception of eleven, all are classified under WHO standard into five levels of toxicity. Moreover, of the 114

active ingredients in use in Zeway Rose Farm, according to EU directive 91/414/ECC declaration Annex 1, 55 (48%) are approved for use, while 59 (52%) are not approved for use as indicated in Annex 7. Of the 59 pesticides not approved for use, 43 are hazardous to the environment and health by EU standards while the environmental and health hazard is not known for 16 pesticides.

Based on WHO, USEPA and EU Risk and Safety classifications, 60 pesticides are categorized as unauthorized (Annex 8). The keys to the EU safety classification are given in Annex 9.

According to the special decree No 20/1990, it is illegal to manufacture, import, sell or use pesticide that are not registered by the Ministry of Agriculture and Rural Development (MoARD). In 1996, MoARD established a National Pesticide Advisory and Technical Committee to facilitate the registration procedure and imports of pesticide to Ethiopia. Pesticides are first registered and imported to the country according to the existing law. Presently, 191 types of pesticides have already been registered by 22 registrants. These are 88 Insecticides, 47 herbicide, 32 fungicide, 5 rodesticide, 5 miticide, 1 avicide, 2 nematicide, 8 household pesticide, 2 ajuvants, stickers and plant growth regulators. From the 114 active pesticide ingredients, 26 (i.e. 23%) were among the permitted pesticides. However, 88 of the 114 pesticides used in the floriculture industry are not among the list of pesticides permitted for import. The flower farms import pesticides without following the regular channel of importing pesticides. According to the weekly news paper Fortune (July, 2007), the flower farms import pesticides by special permission from the office of the Prime Minster.

5.2.2.5 Irrigation

One of the critical elements of the first Green Revolution was the intensive use of irrigation with HYV and chemical fertilizers. Irrigation enables farmers to produce crops more than one time on a given plot of land per year. Besides, the use of irrigation minimizes the risk of crop failure due to recurrent drought which is a common phenomenon under rain-fed farming. The availability of irrigation also helps farmers choose crops that are less drought resistant but high yielding varieties. Usually there is a trade-off between yield and drought tolerance in plant breeding. In the study area farmers were asked whether they use irrigation or not; what type of crop they grow using irrigation and area under irrigation. The result revealed that about 20% of farmers use irrigation for crop production. Those who used irrigation grow mostly cash crops particularly vegetables (cabbage and onion). The major source of water for irrigation is springs and rivers (Table 16). Water harvesting is also increasingly used where about 28% of the onion production in the survey area was made through rain water harvesting.

Table 16: Proportion of irrigation users by source of irrigation

	Crops irrigated		
Source of water	Onion	Tomato	Cabbage
Rain water	28.1	50.0	10.0
Pond	6.3	-	10.0
River/spring	53.1	50.0	70.0
Lake	6.3	-	10.0
Pipe water	6.2	-	-
Valid No. of cases	32	12	10

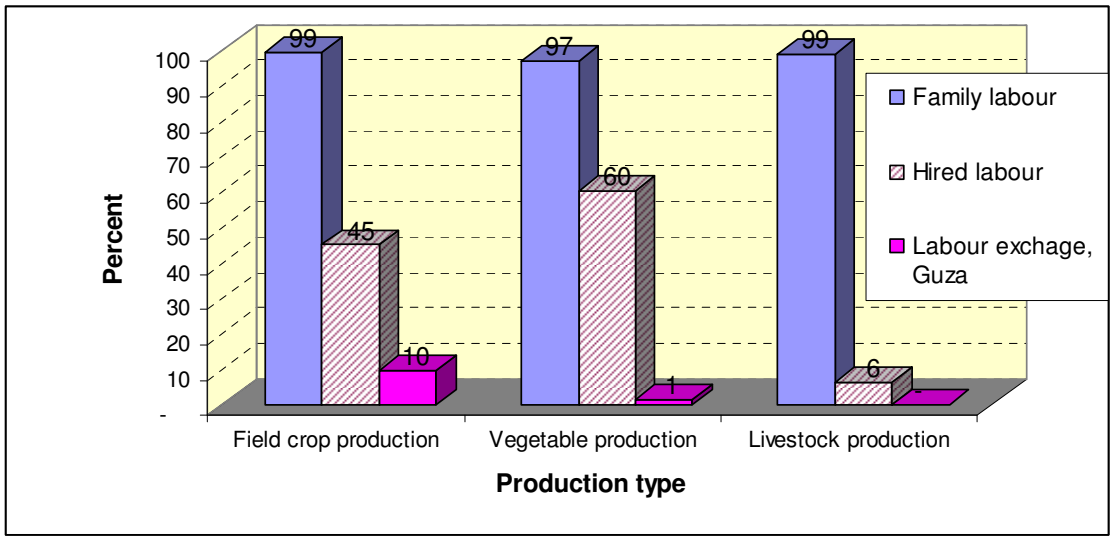
Source: Own survey (August, 2008)

Onion was irrigated up to 30 times at a given interval. The modal irrigation frequency for tomato, onion and cabbage lies between 11 to 16 times, respectively.

5.2.3 Labour

The sample farmers were asked about the source of labour for farm activities such as field crop production, irrigation farming and livestock herding. Three sources of labour were identified, namely, family labour, hired labour and labour exchange. For all the production systems, family is the major source of labour (Figure 4). In addition to the family labour, hired labour is often used for crop production. For instance, 45% of the field crop growers employed labour during the last production season while the proportion increases to 60% during the critical time of planting and harvesting. Irrigation technology increased labour engagement.

Figure 4: Proportion of crop producers by source of labour



Source: Own survey (August, 2008)

5.2.4 Knowledge of improved inputs use

One enabling factor that favored the success of first Green Revolution was the strong agricultural research extension backup for dissemination of HYV to widely dispersed smallholder farmers. The importance of agricultural technology information transfer to farmers cannot be overemphasized in Africa as well. Agricultural technologies in Ethiopia are generated mainly by research institutions. The technology release includes a long process and is coordinated by the Ministry of Agriculture and Rural Development. The released agricultural technologies are publicized through on farm demonstrations, farmers' research groups, and the extension system. In the sample study areas, farmers get information mainly from development agents. Some reported they get information from agricultural research centers and others from their fellow farmers. There are also farmers who have reported obtaining the information from mass media.

Except farmers who live nearby the research centers the majority of farmers in Ethiopia did not know the source of the technology they use. The development agents who closely assist farmers simply guide on agronomic practices without paying much attention to sources of the technology and full information about the technology. The knowledge gap is wide in the case of application of chemicals. The development agents have little knowledge of pests and pesticide management to guide the use of pesticides. Misuse and abuse of pesticides are common at all levels.

Pesticides are not properly handled and the use is not professionally calibrated. Calibration of pesticide at the grass roots level has taken traditional approaches. Usually pesticides are sold in bulk quantities, the smallest being one-liter plastic bottles and 5 litter capacity jerrycans. Farmers buy either individually or in group to later share it with needy neighbors. Farmers use household items like coffee cups and other measuring glasses for liquids, and mach boxes for powder. One liter contains 12 coffee cups or 22 measuring glasses. These are the smallest measurement units and many development agents and staff of the MoARD has accepted them. In this case farmers' practice is dominating. Farmers calibrate spray mixture like for example one coffee cup of herbicide per 20 liter of water. Although the dose has never been gauged, it has become the standard norm.

5.2.5 Livestock

The study area is characterized by a mixed farming system where livestock as well as crop production are practiced as complementary activities. Ownership of livestock has great implication on the food security status of farm households in Ethiopia. Especially ownership of oxen has direct correlation with food security since oxen provide traction power for the crop production. Livestock is also a source of food, income, a live-bank, an insurance against risks, serves as prestige and it gives other social and economic values. Livestock provide manure for crop production. Under the current soaring price of chemical fertilizer, manure and compost are increasingly becoming important means of organic production.

The major types of livestock raised in the study area are cattle (ox, cow), goat, sheep, donkey, mule and poultry. From the sample households, 8% do not have any sort of livestock while 5% have less than one TLU. On the other hand, 10% of the respondents have more than 12.7 TLU with an extreme case of 50 TLU. In general, the mean livestock holding in ATJK and Boset is 5.3 and 6.7 TLU, respectively, which is statistically significant at 5% level (Table 17).

Table 17: Average livestock holding (TLU[1])

Livestock type	ATJK	Boset	Total
Oxen	2.1	2.9	2.5
Cows	3.2	3.2	3.2
Goats	0.7	1.7	1.0
Sheep	0.5	1.1	0.9
Mule/horse	1.1	1.3	1.2
Donkey	1.4	1.5	1.4
Poultry	0.1	0.1	0.1
Total	5.3	6.7*	6.0

* The mean is statistically different at 5% significance level
Source: Own survey (August, 2008)

The proportion of sample households who own different livestock types in the two districts (Table 18). Donkeys are important asset for traction of cart, which is used for income generation and transporting goods and people.

[1] TLU is a standard unit of measuring herd size as equivalent to an ox or a cow (see Storck et al., 1991)

Table 18: Livestock owners (% of HH)

Livestock type	ATJK	Boset	Total
Oxen	78.1	84.7	81.3
Cows	76.8	68.0	72.5
Goats	55.5	28.0	42.0
Sheep	21.3	42.7	32.1
Mule/horse	1.9	3.2	2.6
Donkey	47.1	64.7	55.7
Poultry	49.7	47.3	48.1

Source: Own survey (August, 2008)

5.3. PESTS AND PESTICIDES MANAGEMENT

5.3.1 Prevalent pests in the area

Eleven insect pests, six disease pathogens, six weeds and one vertebrate pest are reported in both study districts and their surroundings (Annex 4). Some of these pests were observed on cereals and vegetable crops during the field visit.

i. Insect pests: Of the eleven insects reported to have occurred or been observed in the study sites, African armyworm and desert locust are migratory pests and the others are non-migratory pests.

ii. Disease pathogens: Six diseases caused by various pathogens were reported to occur in the study sites. Among these early blight, late blight, downy mildew and purple blotch are serious diseases caused by fungi. Diseases and insect pest incidences are severe on vegetables as reported by small holder farmers and commercial farmers.

iii. Weeds: Six economically important weeds were observed in the study sites. All are observed both in cereals and vegetables with the exception of congress weed, parthenium hysterophous, which was observed along the roadsides and pathways.

iv. Vertebrate pest: One vertebrate pest, known as grain-eating bird (Quelea quelea), was reported and observed on sorghum and other cereals. Quela quelea is a migratory pest.

5.3.2 Crops affected and estimates of crop losses due to pests

Although fourteen types of crops are grown in both districts, five major crops (maize/sorghum, tef, haricot bean, onion and tomato) are the main target of this study. According to the national estimate, pests cause 30% loss of the potential annual crop production (Furtick, 1976. Case studies on loss assessment in the study area are not available. The survey data reveals 15-52.5% loss depending on pest type (Table 19).

Table 19: Reported pest load per crop in the study site

S/No	Crop types	Number of pests observed on each crop			Total	%
		Insects	Disease pathogens	Weeds		
1	Maize	3	-	5	8	20
2	Teff	5	-	5	10	25
3	Haricot bean	2	1	3	6	15
4	Onion	1	2	4	7	17.5
5	Tomato	2	3	4	9	22.5
Total		13	6	21	40	100
Percentage of pest load		33	15	52		

Source: Own survey (August, 2008)

5.3.3 Current pest control practices

Different pest control practices are used in the study sites. These include chemicals, physical, cultural, use of resistant varieties and biological control. These pest control practices are used as a package or as a single method. The effect of the chemical control method is felt immediately since it is a poison. As a result, the non-chemical pest control practices are being replaced or surpassed by chemical control.

Two insect pests (desert locust and African armyworm) and one grain-eating bird (Quelea quelea) are migratory pests. The entire material expenses for the control of migratory pests like pesticides, application equipment and air craft for sprayings, personal protective equipment and the provision of technical advice is the responsibility of the government. The cost of pest control inputs for all other non-migratory pests is the responsibility of the farming community with the support of technical advice from the government, which is currently inadequate.

There was an African armyworm outbreak in both districts in the 2007/8 crop season. In ATJK district 3,675 ha of crops were sprayed with 4,176 lt of Malathion, Fenitrothion and 576 kg of Sevin. The outbreak of the pest in Boset district was half of that in ATJK and 1,345 ha of crops were sprayed with 525 liter/kg of Malathion and Sevin from WARDO, in addition to an unknown quantity of pesticides and 36 spray machines contributed from NGOs and the farming community. In the same period, there was also Quelea bird outbreak mainly attacking sorghum crop where 650 lt of Fenthion 60% UIV was sprayed by air craft over selected foci of 325 ha in Eastern Show Zone which includes both study districts. An estimated 14.5 million birds were killed in this operation while the death of domestic animals and wildlife was reported though difficult to quantify. The individual farmer's pesticides use is mainly for the non-migratory pests and the extent of the use has been discussed under section 5.2.

5.3.4 Pesticides storage

At the community level, individual farmers buy and use small quantities of pesticides especially insecticides, fungicides and herbicides. The majority of the farmers store pesticides at home and about 15% of them store it in a living room (Table 20). Besides, a large number of one liter and five-liter capacity empty containers used for making solutions of chemicals are not properly disposed. These empty containers are used for domestic purposes to store food items, water, kerosene, and sometimes oil and local drinks. Others are thrown at the edge of the field and riversides.

Table 20: Pesticide storage in the farming community in percentage of both districts

Store place	District	
	ATJK (N=80)	Boset (N=112)
At home	59	70
Living room	15	14
In the compound	26	16

Source: Own survey (August, 2008)

5.3.5 Misuse and abuse of pesticides

Although most farmers are expected to spray their own crop with the technical assistance of development agents, twenty farmers in Garbi Farmers' Association (FA), one farmer each from Hurufalable and Gulba FAs are currently engaged in pesticide trade in violation to the special decree No. 20/1990. Farmers in ATJK purchase the pesticides from pesticide dealers to control household pests, bedbug and fleas, crop pest and livestock pests (ticks and mites). In the process they are exposing themselves and causing damages to others. These farmers have no prior knowledge, skill, experience and training to be full-fledged practitioners. One farmer in Gulla FA treated 20 heads of cattle against ticks (an ectoparasite) after which 4 recovered from poisoning and 6 died. Another farmer offered his services to a fellow farmer to control weeds, but it proved to be ineffective.

Farmers in three FAs are using phostoxin tablets to control weevils. This product is a fumigant and dangerous to be handled without proper expert advice. Some farmers are also using cattle tails, handkerchiefs and twigs to spray cattle with mixture of pesticides against ectoparasites (ticks). In two different FAs deliberate wild life poisoning was carried out. When a hyena attacked an animal and killed it, the owners became furious and applied Malathion to the remains of the dead animal as a revenge. Several hyenas, dogs, foxes, cats and birds died after eating the poisoned animal remains. Farmers in Abine Germami FA are preparing concoctions using different products indicated as follows*: Malathion + Thionex; Thionex + Mancozeb; Selecron + Ridomil; Bayleton + Curzate; Malathion + Karate*.

These farmers are attempting to increase the potency of the combined products as a prophylatic blanket application to control pests on vegetables, mostly onion and tomato. It was also found out that one farmer bought DDT from a vendor in Zeway town and kept it in his home in which a member in the house unknowingly used it to supplement dwindling maize flour for baking. The owner and the labourer ate DDT baked with maize flour, unknowingly poisoning themselves. They drank milk antidote and survived.

6. IMPACTS OF USING AGRICULTURAL TECHNOLOGIES

6.1 ECONOMIC IMPACTS

6.1.1 Perceptions of economic impacts

The introduction of improved varieties and agrochemicals in many of the localities, where these have been used during the last couple of years, has dramatically changed the value and perceptions of people on land and other resources. Vivid impacts of improved agricultural technology use were identified in the study area. The most important impacts indicated by the focus group participants include:

i) Increased competitiveness in production: This shows that the farmers observed the productivity gain from the use of improved agricultural inputs which motivated them to adopt the technologies. The recent government award for successful farmers is often related to the use of modern agricultural inputs such as fertilizers and seeds.

ii) High market integration due to introduction of cash crops. This is mainly attributed to the introduction of irrigation facilities and new varieties of fruits and vegetables which are mainly produced for the market. Moreover, the use of improved seeds of maize, teff, wheat and haricot beans together with chemical fertilizers enabled farmers in the area to produce for the market.

iii) Increased productivity of land and labour is also an important impact of the use of improved agricultural technologies. The focus group participants revealed that the use of improved seeds and fertilizers resulted in more than double the yield they used to harvest. The survey data shows that all of the respondents indicated increased productivity due to fertilizer use. Fertilizer is also used in irrigated farming and the contribution to household income depends on marketing facilities and the price of the products. The perishable nature of vegetables also determines the income level.

iv) Diversification of crops such as vegetables and fruits in the irrigation farms has reduced the risk of crop failure, and promoted more intensive use of land and increased income. Of course the increase in income has also been affected by the type of crop activities, rather than irrigation per se. The income impact is discussed in more detail in the following sub-section.

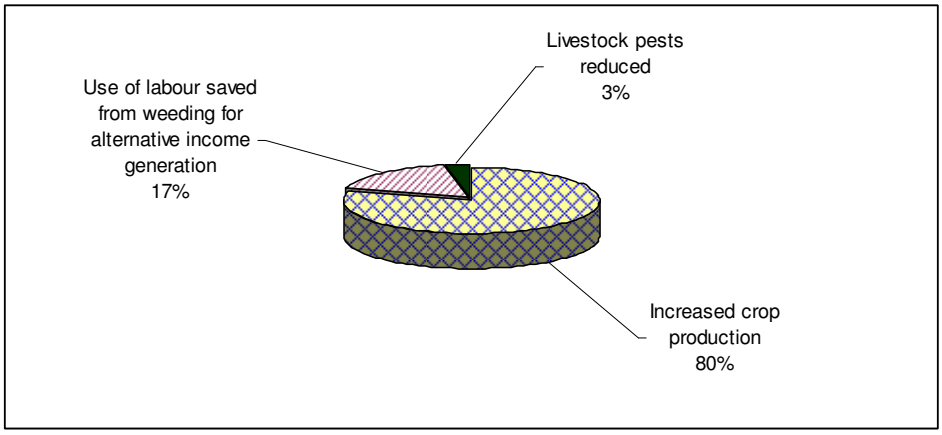
v) Change in consumption pattern and health: Farmers reported that the use of irrigation induced the introduction of vegetables and fruit productions. These farmers used to grow mostly grains such as maize, teff, wheat, haricot beans and sorghum. The introduction of vegetables and fruits and increased income resulted in changed consumption patterns of households in the study area. The qualitative assessment made by the FGD participants show that the consumption of vegetables such as cabbage by households has increased which improved the nutrition and health status of the household members especially children.

vi) Increased food security through increased access and food supply enabled the technology users improve nutritional status mainly for children, access to a balanced diet; hence improved health condition.

vii) Asset creation/building: the users of improved agricultural inputs could purchase household items and productive assets like oxen, water pumps and constructed better houses. It was also interesting to note that successful farmers started to participate in other income generating activities such as constructing houses for renting, purchasing carts for transportation, etc. The farmers' engagement in the non-farming rural economy had the prospect of releasing the pressure on cultivated land.

Most of the users (63%) do not see any negative impacts of using chemical fertilizers. On the other hand some 26% of the farmers feel that once they started to use chemical fertilizer, the opportunity to produce without it became insignificant due to a sort of adaptation. The farmers were also inquired about the positive and negative impacts of using pesticides. Figure 5 shows that 80% of the respondents feel that application of pesticides increased productivity by of course reducing yield loss which would have occurred by pests. It also has labour saving advantages for alternative income generating activities. The use of pesticides also reduced livestock pests.

Figure 5: Proportion of respondents expressing positive impacts of pesticides



Source: Own survey (August, 2008)

6.1.2 Change in production method and labour demand

Agricultural production requires a certain amount of labour. But the amount and type of labour input a given technology requires vary. Farm machineries have the tendency to replace labour. Most agricultural technologies currently in use by smallholder farmers in Ethiopia and in Africa in general demand moderately skilled labour. Yet, the use of agricultural technologies can have some impact on labour demand in rural areas. Some have downsizing effect and others raise labour demand. The survey results and the focus group discussions made with farmers show that the use of chemical fertilizers, improved seeds, pesticides and irrigation increase the demand for farm labour.

The use of agricultural technology would likely change farm production methods. Especially the use of irrigation can bring drastic change in the production method. It changes the crop choice from low to high value crops, increased crop diversification through introduction of vegetables, double cropping, and pest management practices. For instance, the introduction of new

agricultural technologies such as fertilizer, improved seeds and irrigation resulted in raw planting which increased labour use intensity.

Irrigation technology introduced a shift from food crop production to cash crop production and increased market integration. The introduction of vegetables such as tomato and onion resulted in the application of high intensity of pesticides use. The production frequency also increased from one time harvest per season to two when irrigation is used.

6.1.3 Household income

Agricultural production supported by appropriate technology increases productivity thereby increasing farm income. The agro-ecology determines the suitability and comparative advantage of crops grown. The choice of crop enterprise among the feasible set of options depends on demand, price and taste. For instance, Boset district is favourable for teff production which attracts a good price in the market. The land can also be used to produce other crops, especially maize. As a result, sample households at Boset district generate higher income than those at ATJK which is attributed to the income from field crops (Table 21).

Table 21: Mean household and per capita income from different sources (Birr)

Income source	ATJK	Boset
Field crops	9,466	23,732*
Fruits and vegetables	6,495	4,247
Livestock	1,320	1,495
Non-farm income	62	166*
Total household income	11,835	25,536*
Net income per AE	1,985	5,087*

* Implies a statistically significant mean difference between the two districts at 1% probability level

Source: Own survey (August, 2008).

In order to assess the impacts of adopting irrigation, chemical fertilizers, pesticides, and improved varieties on the food security of the sample households, the income per capita was computed and independent t-test was made to evaluate the significance of the differences. The household income is an aggregate income from field crops production, vegetables and fruits production, income from livestock and non-farm rural economy such as petty trading, selling firewood, and other income generating activities. The net income was computed by deducting the costs from the income generated. The per capita income calculation requires standardization of the household size based on subsistence requirement. For this purpose, the Adult Equivalent (AE) was computed based on Storck et al., 1991. Then the household income was divided by AE to derive the per capita household income.

The comparison of per capita income of irrigation users and non-users shows that farmers who use irrigation technology could generate higher income from vegetables and fruits production which is significant at 1% probability level but earned significantly smaller income from field crops production (at 5% significance level). Overall, the per capita income of irrigation users and non-users is not statistically different (Table 22).

Table 22: Comparison of mean income of irrigation adopters and non-adopters

Income source	Without irrigation (N=237)	With irrigation (N=68)	Significance
Field crops	17,398	13,251	0.0840
Fruits and vegetables	3,046	7,022	0.0254
Livestock	1,280	1,721	0.1586
Non-farm income	117	91	0.6016
Total household income	18,520	18,761	0.9279
Total cost of production	1,217	3,078	0.0000
Net income	17,249	15,683	0.5210
Net income per AE	3,634	3,080	0.2981

Source: Own survey (August, 2008)

Moreover, the adopters of chemical fertilizer obtained more per capita annual income than those who did not apply fertilizer which is statistically significant at 1% probability level (Table 23). Farmers who applied fertilizer obtained on average Birr 4,185 per AE per year while the non-adopters generated per capita income of less than Birr 2,000. The difference comes mainly from productivity gain that is attributed to fertilizer use. Almost all (99%) sample farmers have indicated that productivity of crops increased with fertilizer. The implication is that agricultural production of small farms must be technologically supported.

Table 23: Comparison of income of fertilizer adopters and non adopters

Income source	Non-adopters	Fertilizer adopters	Significance
Field crops	8,330	19,455	0.000
Fruits and vegetables	3,239	5,507	0.491
Livestock	879	1,536	0.049
Non-farm income	111	113	0.976
Total household income	9,036	22,022	0.000
Total cost of production	687	1,971	0.000
Net income	8,349	20,051	0.000
Net income per AE	1,646	4,185	0.000

Source: Own survey (August, 2008)

Similarly, the impact of using pesticides on the overall income of the household was analyzed. Table 24 shows that pesticides users could generate significantly higher household income (at 1% probability level) compared to the non-users, though the difference in per capita income is not significant. Though the income difference cannot be attributed to a single intervention, the role of reduced yield loss due to proper pest management is apparent.

High yielding variety is a crucial component of the Green Revolution. The results of the study show that the users of improved seeds generated statistically significant income from field crops and livestock at 1% and 10% probability level, respectively (Table 25). As a result, the household income and per capita income are statistically higher for the improved seeds users.

Table 24: Comparison of income of pesticide users and non-users

Income source	Non-adopters	Pesticides adopters	Significance level
Field crops	12,476	18,338	0.0060
Fruits and vegetables	6,894	4,755	0.2887
Livestock	807	1,599	0.0113
Non-farm income	100	118	0.6749
Total household income	14,346	20,515	0.0095
Total cost of production	1,106	1,873	0.0010
Net income	13,240	18,642	0.0120
Net income per AE	3,143	3,680	0.2610

Source: Own survey (August, 2008)

Table 25: Comparison of income of users of improved seeds and non-users

Income source	Non-adopters	Improved seeds adopters	Significance level
Field crops	11,750	18,356	0.0026
Fruits and vegetables	6,534	4,971	0.4638
Livestock	848	1,517	0.0600
Non-farm income	113	112	0.9772
Total household income	13,253	20,697	0.0023
Total cost of production	922	1,918	0.0000
Net income	12,331	18,779	0.0030
Net income per AE	2,400	3,954	0.0015

Source: Own survey (August, 2008)

In addition to the individual technologies, the income of users of improved seeds, chemical fertilizers and pesticides as a package and that of the non-users was compared (Table 26). The users of the three technologies could double the household income and the difference is statistically significant at 1% probability level. The users of the packages of agricultural inputs also have better livestock size and generate higher income.

Table 26: Comparison of income of adopters of a package of technologies and non-users

Income source	Non-adopters	Improved package	Significance
Field crops	12,246	22,595	0.0000
Fruits and vegetables	5,764	4,982	0.6642
Livestock	867	1,908	0.0000
Non-farm income	80	151	0.0681
Total household income	13,701	25,590	0.0000
Total production cost	1,087	2,414	0.0000
Net income	12,614	23,176	
Net income per AE	2,658	4,738	0.0000

Source: Own survey (August, 2008)

6.1.4 Household food security

Food security is conceived in terms of food availability that is related to own production, food access that can be realized through increased purchasing power and food utilization that can be realized through increased hygiene and sanitation, food processing, etc. Food security at household level is achieved when people have physical and economic access to sufficient food for an active and healthy life. In this study, both availability and accessibility were considered. The per capita income of the household was used as a benchmark for measuring the food security status of the household. A cut off point was established at Birr 1,200 per person as a minimum requirement for subsistence. It was assumed that about 200 kg of cereals provide the minimum calorie requirement per person per year (Emana, 2000) and that the most common staple food in the rural area is maize which could be purchased for about Birr 800 during the study period. In addition, an estimated Birr 400 per AE would be needed to provide minimum basic necessities under the rural setting of the study area.

The increase in yield of crops has a profound effect on the household food security. It improves food supply of households. About 6% of households who used irrigation have indicated that their food security increased by using irrigation technology. The increased income from the use of agricultural technologies creates the opportunity for accessing food. Households with traditional inputs are likely to be less food secured compared to households who use the agricultural technologies.

Table 27 shows a significantly large difference between the mean per capita income of food secure and food insecure households. Moreover, an analysis of the difference in per capita income of users and non users of different technology shows that the food insecure households earn a low mean income, and that this is the same for both users and non-users of technology except for the use of improved seeds. On the other hand, the difference between the per capita incomes of food secure households due to technology adoption is highly significant except in the case of irrigation and pesticides. Irrigation is capital intensive and the product prices of irrigated crops like vegetables is often low making the return to the farmers low.

Food security could be affected by different factors including ownership of livestock, farmland size and labour supply, employment opportunities, market access, level of technology application, level of education, weather conditions, crop pests, and rainfall. An econometric analysis using a logistic regression model shows a significant positive impact of fertilizer use (at 1% probability level), livestock ownership (1% level). Education of the household head positively and significantly affects food security (at 5% probability level). Being female headed and having larger family size has negative and significant impacts at 5% probability levels. The impacts of individual technologies such as irrigation, improved seeds and pesticides are not significant. The role of irrigation to reduce the impacts of moisture is apparent. Yet the small size of irrigation could not bring about a significant difference between the per capita income of food secure and food insecure households.

Table 27: Comparison of per capita income of food secure and insecure HH

Category	Food secure Households	Food insecure Households
All cases:		
No. of HH	236	69
Mean income per AE	4327**[a]	718
Improved seeds:		
Users of improved seeds	4781**	775*
Non-user of improved seeds	3,081	613
Irrigation:		
User of irrigation	3,789	774
Non-user of irrigation	4,479	701
Pesticides:		
Users of pesticides	4,356	732
Non-users of pesticides	4,253	670
Fertilizer:		
User of fertilizer	4725**	695
Non-user of fertilizer	2,490	736
Package of technologies		
Users of package (fertilizer, improved seeds and pesticides)	5120*	777
Non-user of package (fertilizer, improved seeds and pesticides)	3,586	707

Note: *, ** imply that the mean difference between the technology users is statistically significant at 5% and 1% level, respectively.

**a* implies the mean difference between food secure and food insecure is significant at 1% level.

Source: Own survey (August, 2008)

6.2 SOCIO-CULTURAL IMPACTS

6.2.1 Labour migration

Introduction of modern agricultural inputs created job opportunities particularly for the youth and the landless. There is a large flow of labour force from Amhara National Regional State, northern Oromia, and SNNPR to the study area. Smallholder farmers who adopted the agricultural technologies employ casual labourers for planting and harvesting of vegetables, weeding and harvesting of cereals. In order to timely accomplish farm operations, almost every farmer in the FAs visited at Boset employed labourers in some form. The wage rate ranges from Birr 10 to 40 per person per day depending on the type of the work and season.

The cut flower companies also provide about nine thousand jobs for the cut flower production (cultivation, weeding, spraying and cutting). The families of the labourers live on the remittances generated from these farms.

6.2.2 Impacts on gender relations and empowerment

Gender based labour division is a common phenomenon in rural areas of Ethiopia. Women participate both in household chores and farm activities. In the study area the majority of women participate in fetching water (48%). Though a small proportion, women also participate in farm activities such as weeding crops (6%). Although the use of fertilizer increases women's participation in production activities, the small proportion of women participation in weeding may be attributed to the introduction of herbicides in the area.

The introduction of these inputs has also enhanced women's access to information and communication. When farmers (usually women) go to the market or meet other people at a place where they collect fertilizer/improved seed, they get the opportunity to discuss many issues (such as health, farming practices, market jargons, etc.). The introduction of improved agricultural inputs has also increased the possibility for women to get employed in private farms. For instance, in the Sher Holland Flower Company located in Zeway, about 92 percent of the total workers are females who work with various activities; bending the flowers, collection of sucker, pins, cutting and packing, etc.

6.2.3 Impacts of agricultural technology use on local institutions

This study explored the impact of agricultural technologies on the local institutions. One of the key factors for the change of shape and strength of the traditional mutual self support institutions is change in technology. Since the agricultural technologies are different in nature we hypothesized their impacts would be also different. The majority (54%) of the respondents reported that using fertilizer has no impact on local institutions. When we disaggregate the result between the two districts, about 59% from Boset and 50% from ATJK reported using chemical fertilizer has no impact on the institutions (Table 28).

Table 28: Impacts of agricultural inputs on local institutions (% of respondents)

Impacts	**Fertilizer**	**Irrigation**
No impact	68.0	78.6
Working together	12.3	
Daily labourer	7.0	
Encourages experience sharing		16.2
It kills working time	1.2	
Discourages people to participate in traditional institution	3.3	1.7
Positive due to high income		2.6
Strengthen Idir and Mahiber	9.5	
Increase women participation		0.9

Source: Own survey (August, 2008)

More than 70% of the sample respondents feel that none of the local institutions have been abandoned due to fertilizer application and 85% think no institutional impacts due to pesticides use. But due to the introduction of irrigation, the functions of some social groups such as "*debo"* have changed. The voluntary labour mobilization for field work has decreased especially in vegetable farming due to increased wage work associated with technology introduction, and due to the interest by the farmers to pose strict quality control on work done. In the case of free labour contribution, the farmers cannot control the quality of work. Poor work quality such as inappropriate planting severely affects the yield of vegetables.

6.3 ENVIRONMENTAL AND HEALTH IMPACTS

6.3.1 Human health

The study identified 114 active ingredients of pesticides used in the floriculture farms. The pesticides were grouped into WHO Classifications of toxicity levels. The number of the different pesticides falling in different toxicity levels is given in Table 29 while the details are given in Annex 6. Twenty three of the 114 (20%) active ingredients of pesticides are extremely hazardous and about 25% are highly hazardous. In fact it is only 10% of the pesticides are unlikely to be hazardous. At the Zeway Rose farm, 97 employees are engaged in the pest control work in different capacities. Seventy three percent of the employees who are directly involved in spraying are illiterate. Although there is no baseline health information to measure the impact of pesticides on employees' health, the intensity of the pesticides application reveals a worrisome situation.

Table 29: Pesticide groups classified according to WHO Class and toxicity level.

WHO Class	Toxicity	Group of pesticides			Total
		Insecticide	Fungicide	Acaricde	
I	Extremely hazardous	9	9	5	23
II	Highly hazardous	18	5	5	28
III	Moderately hazardous	7	15	9	31
IV	Slightly hazardous	3	14	3	20
U	Unlikely to cause hazard	2	8	1	11
None Classified	Other	-	1	-	1
	Total	39	52	23	114

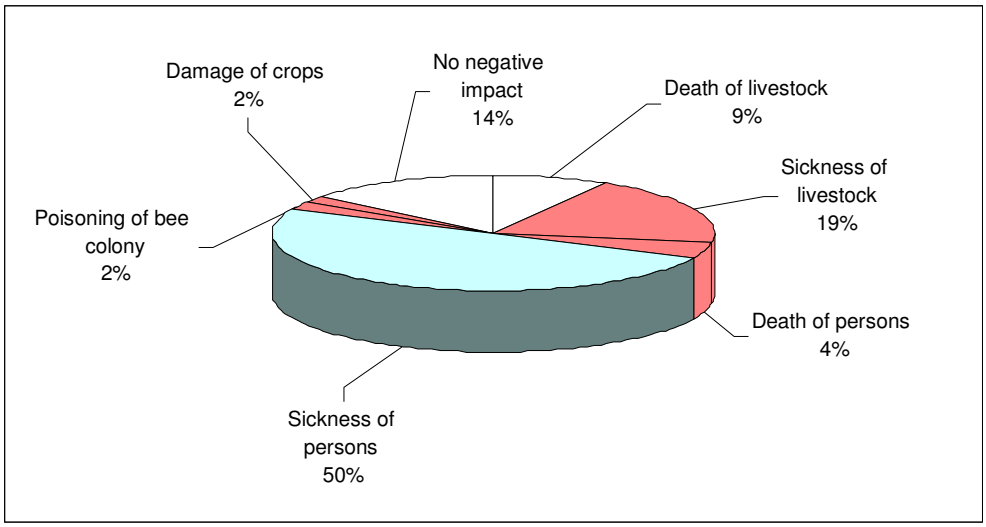
Sources: Derived from Zeway Rose Farm data

Discussions held with farmers around the flower companies highlights the fact that despite the economic benefits, the use of pesticides has affected the health situations of the employees involved. Farmers in the neighboring FAs reported the death of cattle eating the left over flower leaves. Many farmers consider the expansion of these companies as a threat towards their livelihood.

The focus group discussions made with smallholder farmers indicate that human poisonings and deaths occurred in 5 FAs visited. The reports cover farmers' experience of the incidence since they started using the chemicals. Poisoning is mainly related to mismanagement and suicidal incidences. Three poisonings and eight deaths occurred at Abine Germama, Bochessa, Gulba and Garbi FAs of ATJK districts, while 6 poisonings and three deaths were from Xiyo FA of Boset district. The pesticides involved were DDT, Phostoxin, 2,4-D and Malathion. Malathion is the most common chemical involved in the 20 cases of poisonings and death. With the exception of 2 cases all were suicidal.

The survey result also shows that the pesticide users encountered different negative impacts of pesticide since they started using it. Half of the respondents reported sickness of persons while 19% reported sickness of livestock. Death of people (4%) and livestock (9%) also occurred. (Figure 6).

Figure 6: Proportion of HH observing negative impacts of pesticide use (N=163)



Source: Own survey (August, 2008)

Poisoning symptoms such as mild, severe and extremely grave are used to assess the extent of sickness caused by pesticide poisoning. About 187 poisoning cases due to pesticides application have been reported. Eleven and 42 of the cases were extremely grave and severe, respectively. Most of the poisoning cases were mild and occurred occasionally (Table 30).

Table 30: Degree of poisoning cases and percentage of occurrences in each case

S/n	Degree of poisoning	Cases	Occurrence (%)			Total percentage
			occasional	often	always	
1	Mild	144	44	21	35	100
2	Severe	42	50	45	5	100
3	Extremely grave	11	82	18	-	100

Source: Own survey (August, 2008)

6.3.2 Livestock, wildlife, fish and bees

Misuse of pesticides is a major reason behind the death of livestock and wildlife. For instance, in an attempt to control ticks, fleas and mites, a farmer treated 43 heads of cattle with Malathion which resulted in death of 34 heads of cattle. The impact of pesticides on bee colonies is significant. The focus group discussions made at Garbi, Gulba and Bochessa FAs reveal that the community used to produce honey before the introduction of pesticides in the area. Nowadays beekeeping is becoming a rare activity. Abortion of pregnant cows and defective births are common in Garbi FA where the pesticides production plant is located. About 19% of the sample respondents also confirmed sickness of livestock while 9% experienced death of livestock after chemical poisoning. Among the wildlife, hyenas are deliberately poisoned with Malathion for attacking domestic animals and this has serious effect on the food chain.

Table 31: Case/incidents of human and livestock poisonings and deaths

No	Places/Peasant Association	District	Human beings		Livestock	
			Poisonings	Deaths	Poisonings	Deaths
1	Harufalolle	ATJK	-	-	1	2
2	Gulba	ATJK	1	-	20	6
3	Bochessa	ATJK	-	5	-	-
4	Abine Germamai	ATJK	-	3	1	-
5	Sher Ethiopia Hospital	ATJK	20 (treated)	-	-	-
6	Xiyyo	Boset	6	3	1	-
7	Sara Arada	Boset	-	-	-	1
8	Welencheti Health Center	Boset	18 (treated)	-	-	-
Total			45	11	23	9

Source: Own survey (August, 2008)

The extent to which the intensively used pesticides at the flower farms affected the wildlife and the environment was difficult to assess. Attempts were, however, made to assess the nature of pesticides used (Annex 6) and the type of organisms they affect. The number of pesticide ingredients that affect the flora and fauna is given in Table 32. The result shows that 71% of the pesticides are hazardous to fauna and flora while 29% are non-toxic. The pesticides application depends on the pest intensity.

Table 32: Environmentally hazardous pesticide groups to fauna and flora

Type of fauna and flora	Hazardous pesticide groups			
	Insecticide	Fungicide	Acaricide	Total
Fish	9	14	7	30
Fish + bird	11	18	7	36
Fish + bee	5	19	2	9
Fish + bird + bee	2	1	-	3
Phtttoxic	-	1	-	1
Aquatic	1	1	-	2
Non-toxic	14	12	7	33
Total	42	49	23	114
Percentage	37%	43%	20%	100%

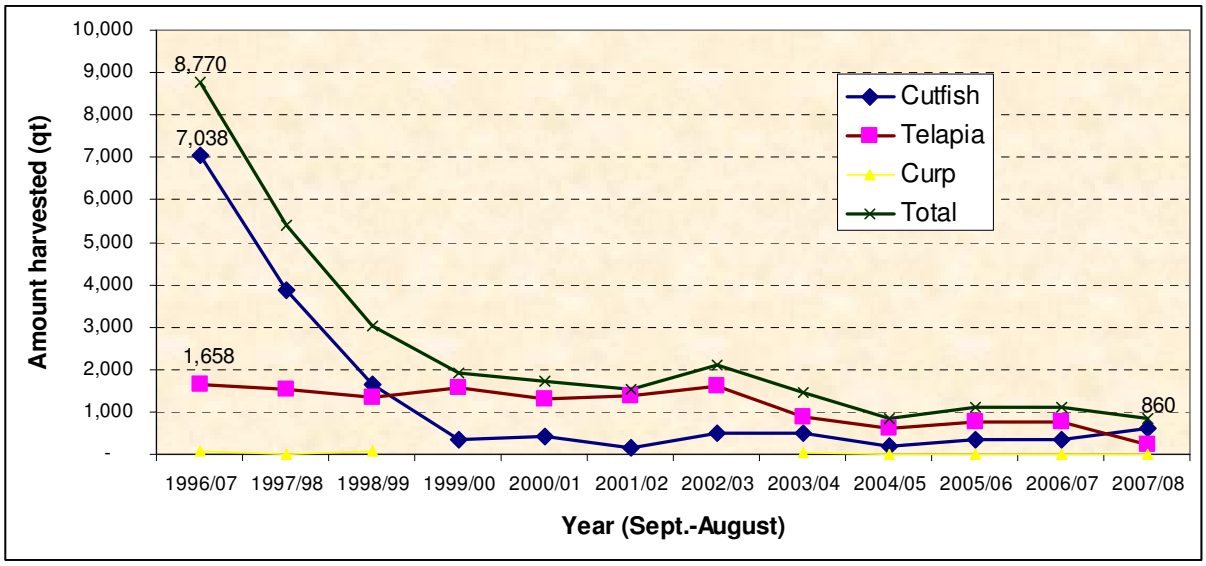
Source: Derived from Zeway Rose PLC data

In order to get evidence on the quality of water in the lake Ziway, water samples were taken from two sites of the lake and analyzed by Hawassa University. One sample was taken near the flower farm and another at certain distance from the farm. No significantly different water quality was found between the two sites. At both sites, the water is not potable and concentration of metallic elements is within the range of WHO's standard except for Fe^{+2}.

According to the data obtained from the Ethiopian Fish Production and Marketing Enterprise in Ziway, the fish yield of Lake Ziway is declining (Figure 7). The major cause could be the environmental degradation affecting the lake water volume and increased silt deposit and use of

inadequate mesh size by private fishermen. Although the impact of pesticides application on fish population has not been well established yet, the use of pesticides along the lakesides poses a high threat to the fish population.

Figure 7: Trend of fish harvest from Lake Ziway



Source: Based on data from the Ethiopian Fish Production and Marketing Enterprise, Ziway (August 2008)

6.3.3 Natural resources and biodiversity

Large quantities of pesticides, high yielding variety (HYV) seeds, and chemical fertilizers have interfered with biodiversity, soil life, and soil health causing salinity, water-logging and soil erosion leading to irreversible and irreparable consequences (Dudani et al, .1992). These consequences are expressed through the food chains, contamination of ground water, water courses, rivers and lakes. This has led to the extinction of useful plants, and animals, i.e., loss of biodiversity by disrupting ecological balances and change in the natural resource base (Krishnamurthy, 1984). It is believed that similar consequences could be expected from the current intensive misuse of these technologies in the study sites.

The results of the FGD revealed that farmers give due consideration to the yield gain from the introduced few selected varieties and little or no attention to conservation of indigenous species or the landrace. There was no systematic ways of conserving the landraces. Farmers also abandoned the traditional soil fertility management system due to reliance on fertilizers and pesticides which can significantly affect the biodiversity and the environment.

7. CRITICAL FACTORS AND PROSPECTS FOR INPUTS USE

7.1 CRITICAL FACTORS

Key economic factors that constrain agricultural production growth include: insufficient supporting infrastructure; skyrocketing prices of modern agricultural inputs such as fertilizer, shortage of improved seeds and agro-chemicals; lack of capital; limited credit facility; lack of non-farm income, poor soil conservation investments and poor market infrastructure; lack of appropriate agricultural and market policy; production and marketing risk. Generally, economic constraints relate to input supply and input and output prices. These factors are critical for the majority of sample respondents. As shown in Table 33, about 85%, 73% and 63% of the respondents indicated chemical fertilizer, improved seeds and rainfall as critical factors, respectively. It is also important to note that rainfall, chemical fertilizer and improved seeds are ranked from 1st to 3rd, respectively in terms of priority.

Table 33: Proportion of respondents ranking critical factors of crop production (%)

Critical factors of production	Rank of critical factors				
	1st	2nd	3rd	4th	% of total sample
Improved seeds	11.4	18.9	**34.4**	18.5	**73.1**
Manure	5.7	11.2	11.2	16.4	40.0
Chemical fertilizer	**24.9**	**33.2**	**24.1**	11.4	**84.9**
Pesticides	2.4	5.2	5.8	16.4	26.9
Farm size	9.4	13.6	9.5	13.2	41.6
Irrigation water	11.4	4.9	5.4	11.4	30.5
Rainfall	**33.3**	12.2	9.1	12.5	**62.6**
Oxen	1.0	0.3	0.4	0.4	2.0
Market problem	-	0.3	-	-	0.3
Total sample	297	286	241	281	305

Source: Own survey (August, 2008)

Other factors indicated include farm size, irrigation water, traction power, pesticides and marketing problems. The extent to which these critical factors are lacking at farm household level has been assessed. The results show that the critical factors of production such as fertilizer, improved seeds, oxen, etc. are not adequately available in the study districts (Table 34).

Previously these inputs were supplied to the farming community with subsidy and credit facilities. Since the 2008 production season, the government abandoned fertilizer credit and down payment on agricultural inputs credit. At the same time, the fertilizer price doubled. Though the price of food crops increased, the farmers lacked the preparedness to accept the change in fertilizer pricing and supply system. The current price escalation of these inputs forced farmers to look for alternative inputs such as compost, animal manure and locally produced seeds. The proportion of sample households who used fertilizer was 40% while 60% used compost/manure during the study year. Likewise, farmers continued to use local seeds and exchanged the generations of improved seeds produced for consumption. There were no alternatives to

pesticides with the price increase. Farmers have been applying pesticides below the recommended rate to cover a larger area with the pesticides they afforded to buy.

Table 34: Proportion of respondents by constraints of production

Constraints of production	% of sample	% with the problem ranked 1st	No. of case
Oxen shortage	**77**	56	235
Insects	40	55	122
Disease	20	34	62
Drought	**100**	56	305
Weed	57	43	173
Flood	22	55	66
Frost	17	36	53
Seed shortage	**87**	23	265
Shortage of fertilizer	**100**	31	305
Shortage of pesticides	22	6	66
Lack of market	4	33	12
Low output price	5	29	14

Source: Own survey (August, 2008)

7.2 PROSPECTS FOR INPUTS USE

Opportunities available for increasing agricultural production in the area include the awareness gained by the farmers about the use of improved agricultural technologies. It is indicated by the majority of the farmers that they will continue to use fertilizers and pesticides. The demand for improved seeds is very high and the supply is limited. This indicates that if inputs are provided timely, at reasonable prices, the opportunity to increase agricultural production increases. Another important opportunity is the growing demand for food and vegetable products. Theoretically, price serves as stimuli for boosting production. The increasing grain price is an opportunity for increasing grain production. The perception of people towards technology has great implication in technology use and dissemination. With regard to pesticides, overall about 29 % of the respondents have the opinion that pesticides use should be further promoted, about 28% continue to use pesticides and 23% suggested provision of pesticides with low cost. There is no respondent that wishes to abandon the use of pesticides (Table 35).

Table 35: Perception of people on future use of pesticide (% HH)

Opinion	ATJK	Boset	Total (N=305)
Pesticides should be further promoted	37.42	20.67	29.18
Provide it with low cost	33.55	12.00	22.95
Provide it through DA office	3.23	2.67	2.95
Increase the supply	9.03	11.33	10.16
I will continue to use pesticide because of pest problem	8.39	48.00	27.87
Use labour to protect pests	0.65	4.00	2.30
Give training on how to use it appropriately	3.23	4.67	3.83

Source: Own survey (August, 2008)

Moreover, the households will continue to use fertilizer though there is a concern that the high fertilizer price can have implication on the application rate. Many studies have indicated that smallholder farmers use a sub-optimal fertilizer rate per hectare due to high prices and the risk of crop failure. The largest proportion of the respondents indicated that the price of fertilizer is the major determinant of fertilizer application (Table 36). The results of the study suggest the need for lowering fertilizer prices to increase the use intensity.

Table 36: Perception of people on future use of fertilizer (% HH)

Opinion	**ATJK**	**Boset**	**Total**
Price of fertilizer should be lower to increase the application rate	54.84	27.33	41.31
It should be available on short terms of credit	22.58	6.67	14.95
Make it timely available	4.52	12.00	8.20
If capacity to purchase it increases	1.94	4.00	2.95
To reduce fertilizer and replace with manure	12.91	6.00	9.31
Use fertilizer with compost	-	8.67	4.26
Continue to use fertilizer in the future	-	36.67	18.03

Source: Own survey (August, 2008)

Institutional arrangements: Government institutions such as the departments of plant production and crop protection of MoARD and regional government structures, enterprises like the Agricultural Inputs Supply Enterprise, Ethiopian Seed Enterprise, Cooperatives and Unions, NGOs, private merchants, and farmers are involved in different aspects of inputs supply processes with the aim to increase agricultural production. The involvement of these institutions include regulations, law enforcements, distribution, purchases, sales and uses of these selected seeds, fertilizers and pesticides.

8. CONCLUSIONS AND POLICY IMPLICATIONS

8.1 CONCLUSIONS

The packages and strategies followed in the first Green Revolution have been attempted in Ethiopia during the last 4 decades. The attempts made lack consistency and stability in terms of strategies, packages and targeting. Approaches and strategies were designed and implemented based on the experiences observed in other countries. The input output markets were inefficient; input use intensity was low and adoption rate was low.

The qualitative and quantitative data collected form ATJK and Boset districts show that about 73% of the sample farmers used fertilizer during the last production year. During the same period, 71% and 68% of the sample farmers used improved seeds and pesticides, respectively. Most of the improved seeds are produced by the farmers themselves since there is a critical shortage of improved seeds. Farmers rely on local seed exchange although the vigour of improved seeds is drastically reduced when multiplied by the farmers (not planned for seed multiplication). Only 10% of the seed supply is made through the extension system. The use of agricultural inputs is now constrained by the escalating prices of fertilizers and improved seeds and a delay in the supply. The problem is compounded because of limited access to credit support.

The use of agricultural inputs resulted in positive as well as negative impacts. The positive impacts are mainly related to economic and social impacts while the negative impacts are related to environmental and health impacts. The following positive and negative impacts have been identified:

Positive impacts:

i. Increased agricultural productivity and production. As a result of increased production, the income of users of fertilizers, improved seeds, pesticides and irrigation increased. The impact of the increase in income on food security is generally positive and highly significant. Besides increased grain supply in the area, the introduction of improved inputs also enhanced the export of agricultural commodities such as haricot beans and cut flowers.
ii. Increased diversification of agricultural activities especially on irrigated farms due to introduction of improved seeds. This contributes to mitigating the risk of crop failure and increased production intensity.
iii. Increased market participation. Market participation takes two forms: increased use of marketed inputs and sales of a larger proportion of agricultural commodities. In both cases, improved agricultural technologies created good opportunities for cash crop production and marketing.
iv. Increased welfare, which can be expressed in terms of increased income, nutrition, health, access to education for children, better housing, etc.
v. Increased assets building. The use of these technologies in general helped the target households to purchase livestock, build new and better houses, improved housing conditions, procurement of motor pumps for irrigation, etc.
vi. Improved saving behaviour. Through its impact on income, the introduction of these technologies enhanced rural saving.

vii. Empowerment of women: women's participation in income generating activities was enhanced as a result of the increase of their participation in the marketing of agricultural products. Women actively participated in decisions involving income generation and its utilization.
viii. Smallholders and flower companies in the study area created job opportunities for the rural labour force. In effect, it is motivating rural labour migration.
ix. Information and knowledge exchange. Farmers' knowledge of production techniques has been improving over time. Acquisition of agricultural inputs from the cooperatives and the extension department creates opportunities to meet with people and discuss on development issues.
x. The introduction of improved seeds and agrochemicals in many of the localities changed the value and perception of people towards land and other resources. Farmers were increasingly involved in renting land for production and participated in the trading of pesticides with the objective of increasing income.

Negative impacts:

i. Environmental damages. The use of fertilizer affects soil structure, soil-life and organic content, changing the soil from biological to chemical farming, and leading towards land mining and degradation. Most of the farmers indicated that the land became unproductive after application of fertilizer for several years. In fact, with the adoption of chemical fertilizers, farmers became dependent on external inputs and abandoned the traditional soil fertility management system, which negatively affected the soil structure.
ii. The negative externalities associated with the use of pesticides are high. Poisoning of people and livestock, bee colonies and wildlife has been reported. In most cases, lack of knowledge of pesticides management resulted in death of people and livestock. Farmers are applying pesticides without personal protective equipment, and without accurate measurements causing danger for themselves, other people and the environment. Flower farms apply several types of pesticides of high and extremely high toxic nature. The application is intensive and a large number of illiterate sprayers are involved. It is also apparent that the impacts of pesticides range from immediate to long term. Thus, the negative impacts of pesticides use in the farm on the people and the surroundings can be far reaching.
iii. The knowledge, information, skill, experience and prior training to handle the toxic pesticides safely in the farming community and the floriculture industry do not commensurate with the current inflow of pesticides in terms of type and intensity of pesticides use.
iv. A negative social impact is related to the unbalanced wealth distribution within the communities. The youth and the landless lack the opportunity to benefit from the positive gains from improved agricultural technologies.
v. The functions of traditional institutions like labour support and exchange through *guza* or *debo* declined. The farmers became cautious of the work quality and the labourers started to gain from the emerging labour market.
vi. A large influx of labour force from different parts of Ethiopia work in the Rift Valley both on smallholder farms and flower companies. These workers involve in risky activities such as spraying pesticides jeopardizing their health.
vii. The diversity of landraces of crops declined.

8.2 POLICY IMPLICATIONS

The review of the experiences of the first Green Revolution in the world, past and current extension activities in Ethiopia and impacts of the use of improved agricultural inputs in the study area provide evidence for drawing lessons for future endeavours. Basically, all elements of the first Green Revolution have been attempted in Ethiopia at different intensity and scope. In the Rift Valley, intensive use of agro-chemicals is taking place in a context of weak and unharmonized regulations, standards and control frameworks. Both the smallholder farms and flower farms (visited) lack adequately trained personnel for appropriate pesticides management and appropriate organizational setup. The local communities and producers seem to remain largely unaware of the advantages of conserving and the sustainable management of landraces.

The following policy implications are suggested for consideration if the Green Revolution should be promoted in Africa in general and Ethiopia in particular.

i. The New African Green Revolution aims to feed Africans and alleviate the hunger and poverty of the great majority of the African people. The core inputs of the New African Green Revolution are high-yielding varieties, fertilizers and pesticides that contain toxic elements that undermine human health and a sustainable environment. In order to take care of the toxic elements of the program, a wider participation across disciplines and among all stakeholders is essential. Before adopting the concept of the new African Green Revolution it is crucial to build institutional and human capacity to ensure adequate management of agro-chemicals and use in a sustainable manner that reduces the short and long-term impacts on people, animals and the environment. Until these basic requirements are put in place, care must be given to counteract undue influences of fertilizer companies, multilateral agencies and agribusiness.
ii. It is also important to note that investment in water resources was a key to success of the Green Revolution in Asia. It is therefore impossible to expect maximum economic boost without investing in water resources to reduce the risk of rainfall shortage. Besides, Africa and Ethiopia have a diverse ecological setting and crop varieties. This require special care if the concept of the Green Revolution should be applied. We suggest a review of the existing bottlenecks of increased production and productivity and significant investment in the solution.
iii. Introduction of new agricultural technologies should not be evaluated only from the short term economic benefits. In this regard, it is recommended to integrate chemical soil fertility management with biological measures. The type and amount of fertilizer to be applied should be based on soil calibration results.
iv. Efforts to promote new varieties of crops should be accompanied with a program of conserving the landraces and maintenance of biodiversity. Improved seeds supply is not well institutionalized. Only a small number of farmers have access to improved seeds through the extension system. The role of the private sector in the seed supply system is minimal. It is essential to set up a well functioning supply system for improved seeds and establish a regulatory framework for seed quality.

v. Pesticides management is made without any scientific knowledge and standard rules and regulations. Three interventions are needed:
    (a) advocate on the damages caused by pesticides abuse and misuse;
    (b) build the technical capacity of pesticides users (commercial as well as smallholders) and development agents on pest and pesticides management;

(c) strengthen the agro-chemicals regulatory systems and enforce rules and regulations pertinent to pesticides import, registration, handling and utilization.

vi. A wide range of agrochemicals are applied by commercial farmers in the Rift Valley. The damage done so far has not been investigated in depth. The impacts of continued use of these chemicals needs to be monitored through periodic and in depth studies.

In general, the institutional capacity building on agricultural technology generation, dissemination and usage and technical support to the farmers (commercial as well as subsistence), establishing efficient input supply systems, regulatory frameworks, market linkages, accountability for environmental damages, and appropriate targeting of agro-ecology with distinct packages of agricultural technologies are necessary pre-requisites to think of a Green Revolution in Africa in general and in Ethiopia in particular.

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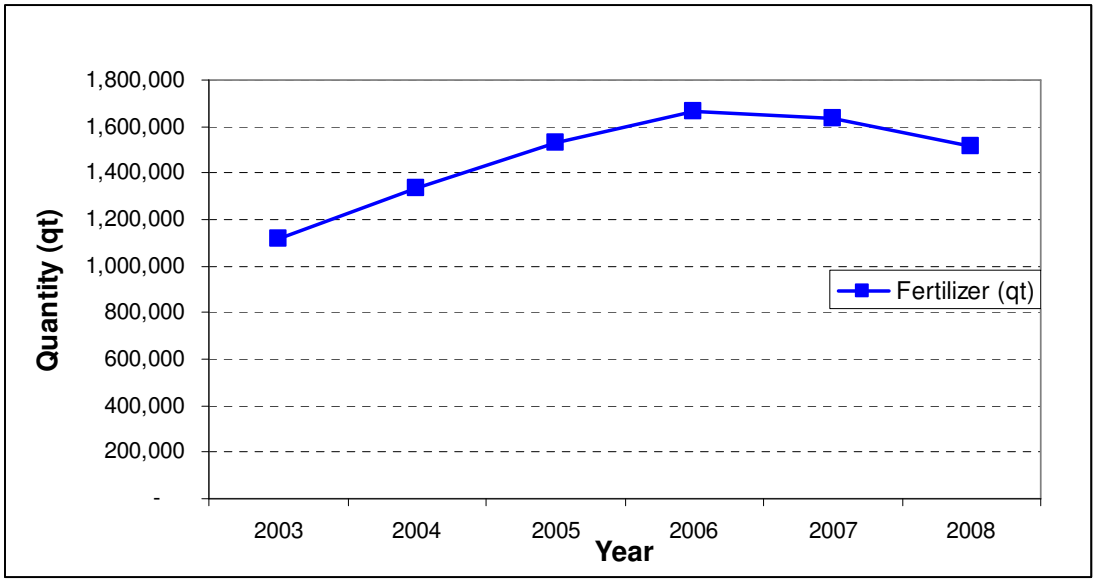
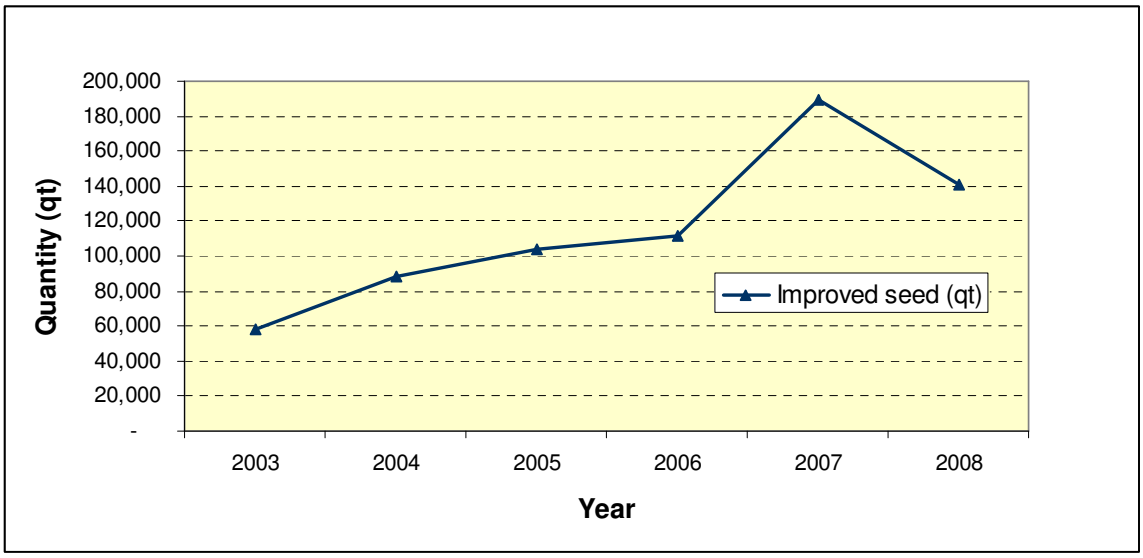
ANNEXES

Annex 1: Trend of fertilizer distributed by cooperatives in Oromia (qt)



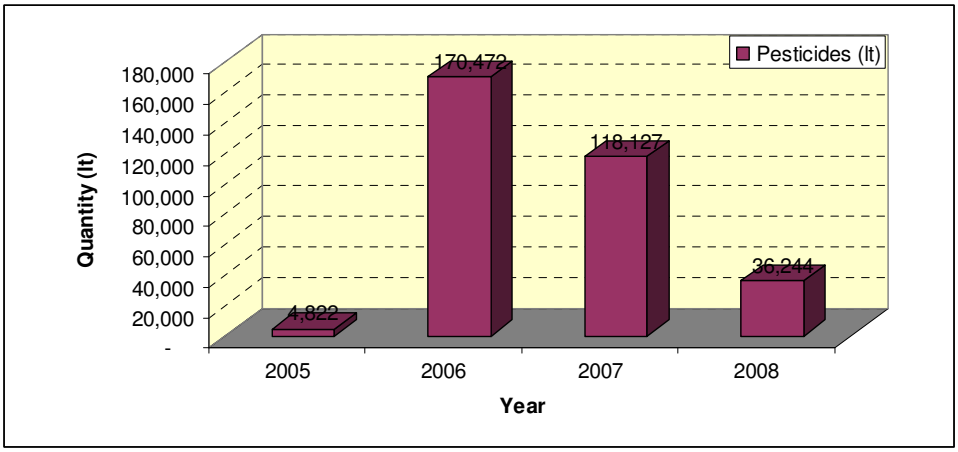
Source: BoARD (2008): Unpublished data

Annex 2: Trend of improved seeds distributed through the extension system in Oromia



Source: BoARD (2008): Unpublished data

Annex 3: Quantity of pesticides distributed to smallholder farmers in Oromia



Source: Oromia BoARD (2008)

Annex 4: Pest prevalent in the study areas and vicinities

Common name	Scientific name	Crops affected
1. Migratory Insect		
• Desert locust	Schistocerca gregaria	cereals and pastures
• African army worm	Spodoptera exempt	cereals, pastures
2. Non-migratory Insect		
• Stalk borer	Chilo pastellus	maize and sorghum
• African bollworm	Helico verpa armiger	vegetables, sorghum, cotton
• thirps	thrips tabaci	onion
• White fly	Bemissia tabaci	tomato, peppers, cotton
• Aphids	Various spp	cereal, vegetables and cereals
• Cutworm	Ayrotis segetum	cereals and vegetables
• Termites	Macrotermes spp	cereals and vegetables
• Sorghum chafer	Pachnoda interupta	sorghum, maize and other crops
• Shoot fly	Delia aram bourgi	tef and wheat and grass
3. Disease pathogens		
• Downy mildew	Peronospora destructor	onion
• Early blight	Alternaria solani	tomato
• Purple blotch	Alternaria porri	onion
• Powdery mildew	Leveillula taurica	Peppers & tomato
• Sartorial leaf spot	Spetoria lycopersic	tomato
• Late blight	Phytophothora infestants	tomato
4. Weeds		
• Kacler	Xanthium strumarium	cereals and vegetables
• Gallant solider	Galinsoga parviflora	cereals and vegetables
• Mexican thistle	Argemone mexicana	cereals and vegetables
• Pig weed	Amaranthus spp	cereals and vegetables
• Thorn apple	Datura stamonium	cereals and vegetables
• Congress weed	Parthenium hysterophous	Spreading along rood sides
5. Migratory bird:	Quelea quela	Sorghum, barley & tef

Source: Filed study, August, 2008

Annex 5: Common pesticides used by Smallholders

No	Common Name	Trade Name	Group	WHO class	Environment Impact
1	Mancozeb	Mancotan	Fungicide	IV	hazardous to fish
2	copper hydroxide	Kocide 101	Fungicide	I	-
3	Lambda-cyhalthrin	Karate	Insecticide	I	fish
4	Malathion	Malatoz	Insecticide	III	fish, bee
5	Profenofos	Selecron	Insecticide/ Acaricide	II	-
6	Carbosulfan	Marshal	Insecticide/ Nematicide	I	-
7	Triadimefon	Bay leton	Fungicide	-	-
8	Carbaryl	Sevin	Insecticide	I	fish, bird, bee
9	Aluminum phos phide	Phostoxin	I/ fungicide	I	Ventilation
10	endosulfan	Thionex	Insecticide/ Acaricide	I	fish, bird, bee
11	Diazinon	Diazol	Insecticide/ Nematicide	II-III	fish, bee
12	dimethoate	Agro son	Insecticide/ Acaricide	II	fish, bee
13	deltamethrin	Decis	Insecticide	II	fish, bee
14	fenitro thion	Sumithion	Insecticide	II-III	fish, bird
15	DDT	DDT	Insecticide	III	fish
16	cymoxanil	Cur zate	Fungicide	III	fish, bird
17	Fenthion	Queletox	Insecticide	II	-
18	Amitraz	Mitac	Insecticide/ Acaricide	II	fish, bird
19	Dicofol	mitigan	Acaricide	II-III	fish
20	deltamethrin	K-o Tab	Insecticide	II	-
21	Glyphosate	round up	Herbicide	II	-
22	2,4-D	720 g/l A.E	Herbicide	II	-
23	Metalaxyl	Ridomil	Fungicide	III	fish, bird,
24	chlorothaloni	Daconil	Fungicide	I	fish, bird,

Source: - Field study, August, 2008

Annex 6: List of Pesticides Used In Zeway Rose Farm

No	Common Name	Registered	Un-Registered	Product No	Pesticide Use			WHO Class	Environmental hazards
					F	I	A		
1.	abermectin	-	✓	3			A		Non toxic
2.	acephate	-	✓	4		I		**III**	Fish ,bird, bee
3.	acrinathrin	-	✓	4		I	A	**IV**	-
4.	albesilate	-	✓	1		I		**U**	-
5.	aldicarb	-	✓	1			A /I	**I**	Fish
6.	Alpha-cypermethrin	✓	-	3		I		**II**	Fish
7.	amitraz	✓	-	3		I	A	**II**	Fish, bird
8.	azidaractin	-	✓	4		I		**II**	Fish, bird
9.	azocyclotin	-	✓	1			A	**II**	Fish, bird
10.	azoxystrobin	-	✓	6	F			**U**	Bee nontoxic
11.	bacillus thuringiensis	-	✓	1		I		**III**	nontoxic
12.	bupirimate	-	✓	1	F			**III**	Fish
13.	benalxyl+mancozeb	-	✓	1	F			**III**	Fish ,bird
14.	benomyl	✓	-	6	F			**IV**	Fish, bird
15.	beta cyfluthrin	-	✓	1		I		**II**	Fish
16.	beta cypermethrin	✓		3		I		**II**	Fish
17.	bifenazate	-	✓	1			A		-
18.	bifenthrin	✓	-	6			A	**II**	Fish , bee
19.	bitertanol	-	✓	3	F			**III**	Fish , bee
20.	bromopropylate	✓	-	1			A	**IV**	Fish
21.	buprofenzin	-	✓	1		I		**III**	Fish
22.	captan	-	✓	2	F			**I**	Fish
23.	carbendazin	-	✓	6	F			**IV**	Fish
24.	carbosulfan	✓	-	1			A/I	**I:III**	Fish
25.	chlorfenapyr	-	✓	2			A	**II:III**	Fish
26.	chloropyriphos	✓	-	4		I		**II**	Fish, bird
27.	chlorothalonil	✓	-	6	F			**U**	phyotoxic
28.	clofentezine	-	✓	1			A	**III**	Fish bees
29.	copper hydroxide	-	✓	1	F			**I**	Fish
30.	cymoxanil+propineb	-	✓	1	F			**III**	Fish, bird
31.	cypermethrin+profenofos	-	✓	3		I		**II**	Fish, bird
32.	cyproconazole	-	✓	1	F			**III**	Fish, bird
33.	cyprodinil+fludioxonil	-	✓	1	F			**III**	Fish
34.	dazomet	-	✓	1	F			**III**	Fish
35.	deltamethtrin	✓	-	6		I		**II**	Fish, bird
36.	diaenthiuron	-	✓	4			A		Fish, bird

Annex 6: Continued

37.	diazinon	✓	-	5		I		**III:II**	Fish ,bee
38.	dichlorvos	✓	-	5		I		**I:III**	Fish ,bee
39.	dicofol	✓	-	1			A	**II:III**	Fish
40.	difenoconazole	-	✓	3	F			**III**	Fish , bird ,bee
41.	diflubenzuron	-	✓	2		I		**III**	Fish , bird
42.	dimethoate	✓		3		I		**II**	Fish ,bee
43.	dimethomorph=mancozel	-	✓	1	F			**U**	Fish
44.	dithionon	-	✓	1	F			**III**	-
45.	dodemorph acetate	-	✓	1	F			**I:II**	Fish , bird
46.	endosulfan	✓	-	4		I		**I**	Fish , bird ,bee
47.	famoxate=cymoxanil	-	✓	1	F			**III**	Fish , bird
48.	fenamiphos	-	✓	1				**I**	Fish , bird
49.	fenarimol	-	✓	1	F			**II:III**	Fish
50.	fenaxaquin	-	✓	1			A		Fish
51.	fenbutatin-oxide	-	✓	1			A	**I:III**	Fish , bird
52.	fenhexamid	-	✓	1	F			**U**	Fish , bird
53.	fenpyroximate	-	✓	1			A	**III**	Fish , bird
54.	fipronil	✓	-	1		I		**II**	Fish , bird
55.	flufenoxuron	-	✓	2		I	A	**III**	Toxic to acquits
56.	fluzilazol	-	✓	3	F				Toxic to acquits
57.	folpet	-	✓	2	F			**IV**	Fish , bird
58.	fosetyl al	-	✓	1	F			**III**	Fish , bird
59.	hexaconazole	-	✓	1	F			**IV**	Fish , bird
60.	hexythiazox		✓	1			A	**IV**	Fish , bird
61.	imidacloprid	✓	-	3		I		**II**	Fish , bird
62.	indoxicarb	-	✓	1		I			-
63.	iprodione	✓	-	7	F			**IV**	Fish
64.	kresoxim-methyl	-	✓	4	F			**I**	Fish
65.	lambda-cypermethrin	-	✓	4		I			-
66.	lambdA cyhalothrin	-	✓	1		I		**II**	-
67.	lufenuron	-	✓	2		I		**NONE**	-
68.	malathion	✓	-	1		I		**III**	Fish , bee
69.	mancozeb	✓	-	5	F			**IV**	Fish , bird
70.	metalaxyl=mancozeb	✓	-	1	F			**III**	-
71.	metham sodium	-	✓	2	F			**I**	Fish
72.	methiocarb	-	✓	3		I	A	**I**	Fish
73.	methomyl	-	✓	5		I		**I**	Fish , bee
74.	methoxyfenozide	-	✓	3		I			-
75.	methyl bromide	-	✓	1	F			**I**	Fish , bee
76.	metiram complex	-	✓	3	F			**IV**	-

Annex 6: Continued

77.	myclobutanil	-	✓	1	F			**I:II:III**	Fish , bee
78.	novaluron	-	✓	3		I			-
79.	omethoate	-	✓	2		I	A	**I**	-
80.	oxamyl	-	✓	1	F			**I**	Fish
81.	oxycarboxin	-	✓	1	F			**III**	Fish
82.	pirimcarb	-	✓	1		I		**II**	Fish
83.	pirimiphos methyl	-	✓	3		I		**II**	Fish , bird
84.	poloyoxin al	-	✓	1	F			**IV**	Fish , bird
85.	polyoxin b	-	✓	1	F			**IV**	Fish , bird
86.	primiphos methyl	✓		1		I		**II**	Fish , bird
87.	propamocarb		-	1	F			**IV**	Fish
88.	proparite		-	1			A		-
89.	propiconazole	✓		3	F			**II**	Fish , bird
90.	propineb	-	✓	3	F			**IV**	Fish , bird
91.	pyrimethanil	-	✓	1	F			**U**	-
92.	quintozene+etridiazale	-	✓	3	F			**U**	-
93.	sodium fluorosilicate	-	✓	2		I			-
94.	spinosid	-	✓	3		I		**U**	-
95.	spirxamine	-	✓	2	F			**II**	-
96.	sulphur	-	✓	2	F			**U**	-
97.	tau fluvalenate	-	✓	4		I	A	**U**	-
98.	tebuconazole	-	✓	1	F			**IV**	-
99.	tebufenpyrad	-	✓	1			A	**III**	-
100.	teflubenzuron	-	✓	1		I		**IV**	-
101.	tetraconazole	-	✓	1	F			**IV**	-
102.	tetradifon	-	✓	1			A	**III**	Fish
103.	thiabendazole	-	✓	4	F			**III**	Fish
104.	thiacloprid	✓	-	1		I		**II**	Fish
105.	thiocyclam oxalate	-	✓	3		I		**II**	Fish
106.	thiomethoxam	✓		2		I			-
107.	thiophanate-methyl	-	✓	7	F			**IV**	Fish, bird
108.	thyrocloprid	-	✓	2		I		**IV**	-
109.	tolclofos-methyl	-	✓	3	F			**U**	Fish, bird
110.	tolyfluanidu	-	✓	1	F			**IV**	Fish, bird
111.	triadimenol+folpet	-	✓	3	F			**Signal**	-
112.	trichlorfon	✓	-	1		I		**II**	Fish, bird
113.	trifloxystrobin	-	✓	4	F				-
114.	triforine	-	✓	3	F			**I**	-
TOTAL		26	88	264	52	39	23		

Source: Derived from Zeway Rose PLC, 2008
Keys: I –Insecticide,F – Fungicide, A- Acaricide

Annex 7: List of pesticides used by Zeway Rose Farm 2008, comparison with EU directives 91/414 Ψ

No.	Common name	EU directive 91/414/EEC declaration, approved for use in List of annex 1.	EU directive 91/414/EEC declaration not approved for use in List of annex 1.	environmental and health hazard by EU standard
1.	abermectin		X	?
2.	acephate		X	Ground water contaminant
3.	acrinathrin		X	High bioaccumulation potential
4.	albesilate		X	?
5.	aldicarb		X	PAN dirty dozen, ground water contaminant
6.	Alpha-cypermethrin	√		?
7.	amitraz		X	Bioaccumulation factor ,Threshold for concern
8.	azidaractin		X	?
9.	azocyclotin		X	Dangerous for environment, Very toxic, High bioaccumulation factor
10.	azoxystrobin	√		Respiration inhibitor(QoL fungicide)
11.	bacillus thuringiensis	√		No major harm to the environment(biopesticide)
12.	bupirimate		X	Persistent soil degradation, Bio accumulation threshold for concern
13.	benalxyl+mancozeb	√		
14.	benomyl		X	Dangerous for the environment
15.	beta cyfluthrin	√		
16.	beta cypermethrin		X	High risk for fish, aquatic vertebrates and honey bees, very toxic ,dangerous for the environment
17.	bifenazate	√		Neuronal inhibitor, non-systemic having contact and residual action
18.	bifenthrin		X (pending)	Persistent ,non degradable in soil, bioaccumulation threshold for concern, high risk for birds, fish ,earthworms, harmful for arthropods, invertebrates and honey bees
19.	bitertanol		X	?
20.	bromopropylate		X	?
21.	buprofenzin		X	Bio-concentration factor, Threshold for concern, moderate risk for birds, fish and aquatic in vertebrates
22.	captan	√		

Annex7: Continued

No.	Common name	EU directive 91/414/EEC declaration, approved for use in List of annex 1.	EU directive 91/414/EEC declaration not approved for use in List of annex 1.	environmental and health hazard by EU standard
23.	carbendazin	√		
24.	carbosulfan		X	Bio-concentration factor Threshold for concern, Bioaccumulation potential for mammals, birds, fish and aquatic invertebrates is high.
25.	chlorfenapyr		X	Bioaccumulation potential for mammals, birds, fish, honey bees and aquatic invertebrates is high
26.	chloropyriphos	√		
27.	chlorothalonil	√		
28.	clofentezine	√		
29.	copper hydroxide		X	?
30.	cymoxanil+propineb	√		
31.	cypermethrin+profenofos	√		
32.	cyproconazole		X	Persistent in soil degradation, bioaccumulation potential is moderate in mammals, birds, fish and aquatic invertebrates
33.	cyprodinil+ fludioxonil	√		
34.	dazomet		X	bioaccumulation potential is moderate in mammals, birds, fish and aquatic invertebrates
35.	deltamethtrin	√		
36.	diaenthiuron		X	?
37.	diazinon		X	Acetylcholinesterase (AChE) inhibitor. Bio-concentration factor Threshold for concern, Bioaccumulation potential moderate for mammals, algae and fish, high for birds, honey bees, aquatic invertebrates, crustaceans and sediment dwelling organisms.
38.	dichlorvos		X	?
39.	dicofop		X	Bioaccumulation potential moderate for mammals, algae and fish
40.	difenoconazole	√		
41.	diflubenzuron	√		
42.	dimethoate	√		

Annex7: Continued

No.	Common name	EU directive 91/414/EEC declaration, approved for use in List of annex 1.	EU directive 91/414/EEC declaration not approved for use in List of annex 1.	environmental and health hazard by EU standard
43.	dimethomorph=manc ozel	√		
44.	dithionon		X	?
45.	dodemorph acetate	√		
46.	endosulfan		X	Mutagenic potential, High Bioaccumulation potential, mammalian and fish toxicity high; bird toxicity moderate;
47.	famoxate=cymoxanil		X	Bioaccumulation potential high; neurotoxicant; eye and skin irritant; highly toxic to fish and aquatic invertebrates; highy toxic to soil arthropods
48.	fenamiphos	√		
49.	fenarimol		X	Moderate bioaccumulation potential; endocrine disruptor;
50.	fenazaquin		X	Respiratory tract irritant, eye and skin irritant; moderate bioaccumulation poteantial;
51.	fenbutatin-oxide		X	Moderate bioaccumulation potential; reproductive and development effects; eye and skin irritant;
52.	fenhexamid	√		
53.	fenpyroximate	√		
54.	fipronil	√		
55.	flufenoxuron		X	Respiratory tract irritant; skin and eye irritant
56.	fluzilazol	√		
57.	folpet	√		
58.	fosetyl al	√		
59.	hexaconazole		X	Moderate bioaccumulation potential; eye and skin irritant;
60.	hexythiazox		X	Respiratory, skin and eye irritant;
61.	imidacloprid	√		
62.	indoxicarb	√		
63.	iprodione	√		
64.	kresoxim-methyl	√		
65.	lambda-cypermethrin		X	?
66.	lambdA cyhalothrin	√		

Annex 7: Continued

No.	Common name	EU directive 91/414/EEC declaration, approved for use in List of annex 1.	EU directive 91/414/EEC declaration not approved for use in List of annex 1.	environmental and health hazard by EU standard
67.	lufenuron		X	High bioaccumulation potential; Respiratory, skin and eye irritant;
68.	malathion		X	Cholinesterase inhibitor; neurotoxicant;
69.	mancozeb	√		
70.	metalaxyl=mancozeb	√		
71.	metham sodium		X	Reproductive/developmental effects
72.	methiocarb	√		
73.	methomyl		X	Acety cholinesterase inhibitor; respiratory tract and eye irritant;
74.	methoxyfenozide	√		
75.	methyl bromide		X	?
76.	metiram complex	√		
77.	myclobutanil		X	Skin and eye irritant;
78.	novaluron		X	High bio-accumulation potential
79.	omethoate		X	Acetyl cholinesterase inhibitor, neurotoxicant; skin irritant;
80.	oxamyl	√		
81.	oxycarboxin		X	Skin and eye irritant;
82.	pirimcarb	√		
83.	pirimiphos methyl		X	Moderate bioaccumulation potential; respiratory and skin irritant; acetylcholinesterase inhibitor;
84.	poloyoxin al		X	?
85.	polyoxin b		X	?
86.	primiphos methyl	√		
87.	propamocarb	√		
88.	propargite		X	High bioaccumulation potential; eye and skin irritant;
89.	propiconazole	√		
90.	propineb	√		
91.	pyrimethanil	√		
92.	quintozene+etridiazal e		X	Bio-accumulation potential; skin irritant;
93.	sodium fluorosilicate		X	?

Annex 7: Continued

No.	Common name	EU directive 91/414/EEC declaration, approved for use in List of annex 1.	EU directive 91/414/EEC declaration not approved for use in List of annex 1.	environmental and health hazard by EU standard
94.	spinosid	√		
95.	spirxamine	√		
96.	sulphur		X	Respiratory, skin and eye irritant;
97.	tau fluvalenate		X	Endocrine disruptor
98.	tebuconazole	√		
99.	tebufenpyrad	√		
100.	teflubenzuron		X	Moderate bioaccumulation potential; respiratory tract irritant;
101.	tetraconazole		X	Reproductive/developmental effects?
102.	tetradifon		X	Moderate bioaccumulation potential;
103.	thiabendazole	√		
104.	thiacloprid	√		
105.	thiocyclam oxalate		X	Skin and eye irritant;
106.	thiamothoxam		X	Carcinogen?, respiratory tract irritant?
107.	thiophanate-methyl	√		
108.	thyrocloprid		X	?
109.	tolclofos-methyl	√		
110.	tolyfluanidu	√		
111.	triadimenol+folpet	√		
112.	trichlorfon		X	Acetycholinesterase inhibitor, neurotoxicant;
113.	trifloxystrobin	√		
114.	triforine		X	Reproductive/developmental effects; respiratory and skin irritant;
Total number of products		55	59	

Source: University of Hertfordshire (http://www.eu-footprint.org/), compiled by Abiye Alemu, DCG-Ethiopia Coordinator

Ψ: √ = EU directive 91/414/EEU declaration, approved for use in List of annex 1

X = EU directive 91/414/EEU declaration not approved for use in List of annex 1.

? = Environmental and health hazard by EU standard not known or indicated

Annex 8: List of Pesticide used by Zeway Rose farm (2008) , that are unauthorized for use as per EU directives 91/414

NO.	Common name	Pesticide type	Chemical group	Mode of action	WHO classification	US EPA classification	EU risk classification	EU safety classification[1]	Exposure route		Health Issues							
									Public	occupational	Carcinogen	Endocrine disruptor	Reproductive/ development effect	Acetyl cholinesterase inhibitor	Neurotoxicity	Skin irritation	eye irritation	respiratory track irritant
1	abermectin																	
2	acephate	I	Organo phosphate	Broad spectrum	III	III	XN-Harmful if swallowed	S2,S36	Dermal high risk	Inhalation	X	√	X	√	√	?	X	
3	acrinathrin	I & A	Pyrethroid	Contact, stomach action	U	IV	-	-	-	-	X	X	X	X	X	X	X	X
4	albesilate																	
5	aldicarb	I,A, N	Carbamite	Systemic	Ia	I	Very toxic	S1/2	Food residue	-	?	√	?	X	?	X	X	X
6	amitraz	I,A	Amidine	Non systemic	III	III	Xn Harmful	S2,S22	-	Inhalation, dermal	X	X	?	-	√	-	-	-
7	azidaractin	I	Bio pesticide	Disrupter	NL	IV	-	-		Inhalation, dermal	-	X	X	X	-	X	√	X
8	azocyclotin	A	Organotin	Contact	II	I	Very toxic	S1/2		Inhalatio	-	-	-	X	-	√	√	√
9	azoxystrobin	F	Stroblurin	Systemic	U	-	Toxic	S1/2	-	-	X	-	?	X	X	-	-	-
10	bupirimate	F	Pyrimidinol	Systemic	U	III	Xi	S36,S37	-	-	X	X	?	X	X	√	√	-
11	benomyl	F,M	Benzimidazole	Systemic	U	IV	Mutagenic category 2	S43,S53	-	Inhalation, dermal	?	?	√	X	-	?	X	√
12	beta cypermethrin	I	Pyrethroid	Non systemic	II	-	Very toxic	-	-	-	?	?	-	X	X	X	X	X
13	bifenthrin	I,A	Pyrethroid	Contact	II	II	Toxic	-	-	-	?	√	?	X	?	X	X	-
14	bitertanol	F	Triazone	Systemic	U	III	Reproductive risk cata.2	-	-	-	X	-	√	X	X	√	√	-
15	bromopropylate	A	Benzalite	Non systemic	U,II I	IV	-	-	-	-	-	-	-	X	-	-	-	-
16	buprofenzin	I,A	Unclassified	Contact	U	III	N-Dangerous	-	-	-	?	X	?	X	X	X	X	x
17	carbosulfan	I,N	Carbamate	Systemic	II	-	Very toxic	S1/2	-	-	X	X	?	√	X	√	X	X
18	chlorfenapyr	I,A	Arylpyrrole	Systemic, stomach, contact	II	III	Toxic	S1/2	-	Dermal	?	-	X	X	X	X	?	X
19	copper hydroxide	F	Inorganic compound	Protective	NL	-	-	-	-	-	X	X	?	X	X	√	√	√
20	cyproconazole	F	Triazole	Systemic	III	III	Reproductive risk Cat.3	S2	Spray drift	-	?	-	?	X	X	-	-	√
21	dazomet	I,F, H,F	Carbamate	Releasing	III	III	Xn –harmful	S2	-	-	X	-	?	X	X	?	√	?
22	diaenthiuron	I,A, M	Thiourea	Contact, Stomach	U,II I	-	Toxic	-	-	-	X	-	-	X	-	X	X	-
23	diazinon	I,A, R	Organophosphate	Non systemic	II	II	Xn, harmful	S2,S24/ 25	Inhalation	Dermal, inhalation	X	?	?	√	√	√	√	√
24	dichlorvos	I,A, M	Organophosphate	Contact, stomach	Ib	I	Very toxic	S1/2	-	Re-entry	?	?	-	√	√	√	√	?

NO.	Common name	Pesticide type	Chemical group	Mode of action	WHO classification	US EPA classification	EU risk classification	EU safety classification[1]	Exposure route		Health Issues							
									Public	occupational	Carcinogen	Endocrine disruptor	Reproductive/ development effect	Acetyl cholinesterase inhibitor	Neurotoxicity	Skin irritation	eye irritation	respiratory track irritant
25	dicofol	A	Organophosphate	Non systemic	III	II	Xn harmful	S2	-	-	?	?	-	X	√	√	√	√
26	dithionon	F	Quinone	Protective, curative	II	III	Xn harmful	S2	-	-	X	-	-	X	X	√	√	-
27	endosulfan	I,A	Organochlorine	Non systemic	II	I	Very toxic	S1/2	-	-	?	?	-	X	√	-	-	-
28	famoxate= cymoxanil	F	Oxazole	Protectant	U	III	Xn harmful	S2	-	-	X	-	?	X	√	√	√	-
29	fenarimol	F	Pyrimidine	systemic														
30	fenazaquin	A	Unclassified	Contact	II	-	Toxic	S1/2	-	-	X	-	X	X	X	√	√	√
31	fenbutatin-oxide																	
32	flufenoxuron	I,A	Benzoylurea	Contact, stomach	U	III	-	-	-	-	-	-	-	X	-	√	√	√
33	hexaconazole	F	Triazole	Systemic	U	IV	Xn harm	S2	-	-	?	-	-	X	X	√	√	_
34	hexythiazox	A	Carboxamide	Non systemic	U	IV	N-dangerous	S60	-	Inhalation, dermal	?	-	-	X	X	√	√	√
35	lambda-cypermethrin																	
36	lufenuron	I,A	Benzoylurea	Systemic	III	-	Xi	S2	-	-	X	-	X	X	X	√	√	√
37	malathion	I,A	Organophosphate	Non Systemic, contact	III	III	Xn-harmful	S2	Re entry	-	?	?	?	√	√	X	X	?
38	Metham Sodium	H,F, N,I	Carbamate	Soil fumigant	II	-	Xn-harmful	S1/2	-	-	?	?	√	X	X	√	X	-
39	methomyl	I,A, M	Carbamate	Systemic, contact	Ib	I,II,III	Very toxic	S1/2	-	Dermal	X	?	-	√	?	X	√	√
40	methyl bromide																	
41	myclobutanil	F	Trizole	Systemic	III	-	Reprodutive risk cat.3	S2	-	-	X	-	?	X	X	√	√	X
42	novaluron	I	Benzoylure	Contact	NL	-	N-dange	S61	-	-	X	-	X	X	X	?	X	?
43	omethoate	I,A, M	Organophosphate	Systemic, contact	Ib	I	Toxic	S1/2	-	Inhalation,dermal	X	-	X	√	√	√	X	-
44	oxycarboxin	F,M	Oxathiin	Systemic	U	IV	Xn –harmful	S2,S61	-	-	X	-	X	X	X	√	√	-
45	poloyoxin al	F	Biopesticide	Systemic	NL	III	-	-	-	-	-	X	X	X	-	?	-	?
46	polyoxin b	F	Biopesticide	Systemic	NL	III	-	-	-	-	-	X	X	X	-	?	-	?
47	primiphos methyl	I, A	Organophosphate	Contact	III	III	Xn-harmful	S2,S60	-	-	X	-	-	√	-	√	?	√
48	proparite	A	Sulphite ester	Non systemic	III	III	Carcinogen Cat.3	S1/2, S26	-	-	?	-	?	-	-	√	√	-
49	quintozene+etridiazale	F	Chlorophenyl	Contact	U	III	Xi irritant	S2	-	-	X	?	?	X	X	√	X	X
50	sodium fluorosilicate																	
51	sulphur	F,A	Inorganic	Contact, vapour	U	IV	-	-	-	-	X	-	X	X	X	√	√	√

NO.	Common name	Pesticide type	Chemical group	Mode of action	WHO classification	US EPA classification	EU risk classification	EU safety classification[1]	Exposure route		Health Issues							
									Public	occupational	Carcinogen	Endocrine disruptor	Reproductive/ development effect	Acetyl cholinesterase inhibitor	Neurotoxicity	Skin irritation	eye irritation	respiratory track irritant
52	tau fluvalenate	I,A	Synthetic	Contact	U	II	Xn	S2,S24	-	-	-	√	?	X	-	X	X	-
53	teflubenzuron	I	Benzoylurea	System	U	IV	Carcinogen cat.3	-	-	-	?	-	X	X	-	?	?	√
54	tetraconazole	F	Triazole	Systemic	II	-	Xn –Harmful	S2,S36	-	-	X	-	?	X	X	X	X	x
55	tetradifon	A	Bridge diphenyl	Non systemic	U	III	-	-	-	Inhalation	X	X	-	X	X	?	?	X
56	thiocyclam oxalate	I	Nereistuxin	Contact	II	-	Xn	S2	-	-	-	-	-	-	-	√	√	-
57	thiomethoxam	I,A	Organophosphate	Systemic	Ib	II	Toxic	S1/2	-	-	X	-	-	√	√	√	-	-
58	thyrocloprid																	
59	trichlorfon	I	Organophosphate	Non systemic	II	II	Xn	S2,S24	Spray drift	-	?	?	?	√	√	-	?	?
60	triforine	F	Piperazine	Systemic	U	IV	-	-	-	-	?	-	√	X	-	√	?	√

[1]: the keys for EU safety classification phrases are indicated under Annex 9.

√ = yes, known to cause a problem; X = no, known not to cause problem; ? = possibly, status not identified; - = no data; N = dangerous for the environment

NB: no description is given in the EU, WHO and USEPA for pesticides 1, 4, 31, 35, 40, 50, and 58 listed in the table.

Source: University of Hertfordshire (http://www.eu-footprint.org/ ***Compiled by Abiye Alemu Ayele***

Annex 9: EU Safety Phrases

Safety-phrases (also known as S-phrases) are defined in Annex II of EU Directive 67/548/EEC as amended by EU Directive 2001/59/EC which is concerned with identifying special risks attributed to dangerous substances and preparations. Whilst these phrases were developed for Europe they are used and recognized in many countries throughout the world.

Single Codes

S1 Keep locked up.
S2 Keep out of the reach of children.
S3 Keep in a cool place.
S4 Keep away from living quarters.
S5 Keep contents under ... (appropriate liquid to be specified by the manufacturer).
S6 Keep under ... (inert gas to be specified by the manufacturer).
S7 Keep container tightly closed.
S8 Keep container dry.
S9 Keep container in a well-ventilated place.
S10 Deleted.
S11 Deleted.
S12 Do not keep container sealed.
S13 Keep away from food, drink and animal feeding stuffs.
S14 Keep away from ... (incompatible materials to be indicated by the manufacturer).
S15 Keep away from heat.
S16 Keep away from sources of ignition – No smoking.
S17 Keep away from combustible material.
S18 Handle and open container with care.
S19 Deleted.
S20 When using do not eat or drink.
S21 When using do not smoke.
S22 Do not breathe dust.
S23 Do not breathe gas/fumes/vapor/spray (appropriate wording to be specified by the manufacturer).
S24 Avoid contact with skin.
S25 Avoid contact with eyes.
S26 In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S27 Take off immediately all contaminated clothing.
S28 After contact with skin, wash immediately with plenty of ... (to be specified by the manufacturer).
S29 Do not empty into drains.
S30 Never add water to this product.
S31 Deleted.
S32 Deleted.
S33 Take precautionary measures against static discharges.
S34 Avoid shock and friction. (No longer used).
S35 This material and its container must be disposed of in a safe way.
S36 Wear suitable protective clothing.
S37 Wear suitable gloves.
S38 In case of insufficient ventilation, wear suitable respiratory equipment.
S39 Wear eye/face protection.
S40 To clean the floor and all objects contaminated by this material, use ... (to be specified by the manufacturer).
S41 In case of fire and/or explosion, do not breathe fumes.
S42 During fumigation/spraying, wear suitable respiratory equipment (appropriate wording to be specified by the manufacturer).

S43 In case of fire, use ... (indicate in the space the precise type of fire-fighting equipment. If water increases the risk, add - Never use water).
S44 If you feel unwell, seek medical advice (No longer used).
S45 In case of accident or if you feel unwell, seek medical advice immediately.
S46 If swallowed, seek medical advice immediately and show this container or label.
S47 Keep at temperature not exceeding ...°C (to be specified by the manufacturer).
S48 Keep wetted with ... (appropriate material to be specified by the manufacturer).
S49 Keep only in the original container.
S50 Do not mix with ... (to be specified by the manufacturer).
S51 Use only in well-ventilated areas.
S52 Not recommended for interior use on large surface areas.
S53 Avoid exposure - obtain special instructions before use.
S54 Obtain the consent of pollution control authorities before discharging to wastewater treatment plants. (No longer used).
S55 Treat using the best available techniques before discharge into drains or the aquatic environment. (No longer used).
S56 Dispose of this material and its container at hazardous or special waste collection point.
S57 Use appropriate container to avoid environmental contamination.
S58 To be disposed of as hazardous waste. (No longer used).
S59 Refer to manufacturer/supplier for information on recovery/recycling
S60 This material and its container must be disposed of as hazardous waste.
S61 Avoid release to the environment. Refer to special instructions/Safety data sheets
S62 If swallowed do not induce vomiting: seek medical advice immediately and show this container or label.

Multiple Codes

S1/2 Keep locked up and out of the reach of children.
S3/7 Keep container tightly closed in a cool place.
S3/7/9 Keep container tightly closed in a cool, well-ventilated place.
S3/9/14 Keep in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer).
S3/9/14/49 Keep only in the original container in a cool, well-ventilated place away from ... (incompatible materials to be indicated by the manufacturer).
S3/9/49 Keep only in the original container in a cool, well-ventilated place.
S3/14 Keep in a cool place away from ... (incompatible materials to be indicated by the manufacturer).
S7/8 Keep container tightly closed and dry.
S7/9 Keep container tightly closed and in a well-ventilated place.
S7/47 Keep container tightly closed and at temperature not exceeding ... °C (to be specified by the manufacturer).
S20/21 When using do not eat, drink or smoke.
S24/25 Avoid contact with skin and eyes.
S27/28 After contact with skin, take off immediately all contaminated clothing, and wash immediately with plenty of ... (to be specified by the manufacturer).
S29/35 Do not empty into drains; dispose of this material and its container in a safe way.
S29/56 Do not empty into drains, dispose of this material and its container at hazardous or special waste collection point.
S36/37 Wear suitable protective clothing and gloves.
S36/37/39 Wear suitable protective clothing, gloves and eye/face protection.
S36/39 Wear suitable protective clothing and eye/face protection.
S37/39 Wear suitable gloves and eye/face protection.
S47/49 Keep only in the original container at temperature not exceeding ... °C (to be specified by the manufacturer).

Source:University of Hertfordshire (http://www.eu-footprint.org/

Annex 10: Key informants contacted at different institutions

No	Name	Institution	Position	Telephone	District
1	Hussien Kabaro Wariyo	Agri. and Rural Development Office (ARDO)	Dupty Head		ATJK
2	Hussen Boqa	ARDO: Agr. Input Dept.	Team Leader		ATJK
3	Negash Heda	ARDO: Hurufa Lole	Supervisor	0911094563	ATJK
4	Juhar Gole	ARDO: Golba	Supervisor	0913243102	ATJK
5	Ayanu Tuffa	ARDO: Garbi	DA	0464414062 (Res)	ATJK
6	Aman Dhabu	ARDO: Hurufa Lole	DA	0913377158	ATJK
7	Ahmed Ali	ARDO: Edo Gojola	DA		ATJK
8	Feyessa Assefa	ARDO	Head	0911019730	ATJK
9	Abrham Walleye	ARDO, Irrigation	Expert	0911305642	ATJK
10	Bogale Bekele	ARDO , extension	Expert	0911537908	ATJK
11	Mengistu Ayele	ARDO: protection expert	Expert	0913148738	ATJK
12	Fayissa Urgessa	ARDO: Xiyyo	DA	0912147938	Boset
13	Bishash Meles	PA Manager: Xiyyo		0913304735	Boset
14	Almaz	ARDO: Xiyyo	DA		Boset
15	Marga Bune	ARDO: Digalo wanga	Supervisor	0912237968	Boset
16	Banki Gemeda	ARDO: Digalo wango	DA	0912237610	Boset
17	Yeshiareg Nigussie	Digalo Wanga: PA manager		0913329752	Boset
18	Mustefa Beshir	ARDO: Sara and Qacacule	Supervisor	0912192472	Boset
19	Temam Kamal	Sara Arada	DA	0911978354	Boset
20	Godana Eda'o	Sara Arada	DA	0911746762	Boset
21	Dadhi Shibiru	Sara Arada	DA	0912224927	Boset
22	Taye Kebede	ARDO	Supervisor	0911707626	Bosset
23	Tefera Folle	ARDO	Input Expert	0913451816	Bosset
24	Beka Beree	ARDO	Agronomist	0221130067	Bosset
25	Esatu Elelo	World Vision	Manger	0911453487	Bosset
26	Amede Mokonen	ARDO, Protection	Expert	0911831780	Bosset
27	Roba Bedasso	WHC (Welencheti)	Head	0913141644	Bosset
28	Tsega Abraha	Qacacule	DA		Ziway
29	Teshome Buqa	Plant Health Clinic	Head		ATJK
30	Taye Asfaw	Plant Health Clinic	Pathologist	0912155011	ATJK
31	Zebdios Salato	Plant Health Clinic	Herbiologist	0911922499	ATJK

Annex 10: Continued

No	Name	Institution	Position	Telephone	District
32	Bezuayehu Tessema	Plant Health Clinic	Technical manager	046412303	ATJK
33	Hiry Gebru	Plant Health Clinic	Protection & Technical Dept. Head	046412303	ATJK
34	Semenach Altaye	Plant Health Clinic	Safety Officer	046412303	ATJK
35	Bereket Haile	Plant Health Clinic	Admin head	046412303	ATJK
36	Mekonnen Kibre	ARDO: Extensions-Rainfed	SMS	0911048469	Ziway
37	Lemma Marikos	ARDO: Extensions-Irrigation	SMS	0916820735	Ziway
38	Imana Guddissa	ARDO	A/ Head	0911380947	Ziway
39	Tefera Fole	ARDO: Agr. inputs Dept.	Team Leadr	0913451861	Ziway
40	Gerrit Barnhoorn	SHER Flowers B.V.	Managing Director	0916580039	Ziway
41	Cheru Dana	SHER Flowers PLC	Human Resources Director	0916839461	Ziway
42	Cor van Urk	Ziway Roses PLC	Farm Manager	0916580044	Ziway
43	Bekele Belda	SHER Flowers , Ziway	Public Relations Officer	0911958621	Ziway
44	Yohannis Tadesse	Ziway Roses PLC, Ziway	Pesticides control officer	0912221492	Ziway
45	Teshome Bereda	SHER Ethiopia Hospital	Human Resource Management Officer	0911420238	ATJK
46	Dr. Minilik Derid	SHER Flowers , Hospital	Physician	0911406104	Ziway
47	Berhanu Gelatu	Rift Valley NGO	Manager	0464412325	ATJK
48	Dr. Bogale Tolossa	Oromia Agr. And Rural Development Bureau	Deputy Head	0911550285	Addis Ababa
49	Dr. Abera Debelo	SG2000, Addis Ababa	Director	0911247539	Addis Ababa
50	Belayneh Assegid	Agri. Inputs Supply Enterprise	Manager	0911651568	Addis Ababa
51	Demere Demissie	Lume Adama Farmers Cooperative Union	G/Manager	0221161582	Modjo
52	Diriba Mekonnen	Lume Adama Farmers Cooperative Union	Program Officer	0911831780	Modjo
53	Dr. Tafesse Gebru	Ethiopian Seed Enterprise	G/Manager	0116625298	Addis Ababa
54	Enasa Ahmed	EHPEA	Information Officer	011685178	Addis Ababa

Compiled by Abiye Alemu Ayele, DCG E National Coordinator

Annex 11: Participants of FGD at community level

No.	Name	Sex	Age	Education	PA
District: **Adami Tullu Jido Kombolcha**					
1	Guna Tuffa	Female	27	No formal education	Hurufa Lole
2	Katabo Miesso	Male	38	3rd grade	Hurufa Lole
3	Shola Amda	Male	40	No formal education	Hurufa Lole
4	Biyya Badhane	Male	30	3rd grade	Hurufa Lole
5	Milkesso Daliyo	Male	30	No formal education	Hurufa Lole
6	Korme Rakabi	Male	40	6th grade	Hurufa Lole
7	Mohammed Hassen	Male	66	No formal education	Hurufa Lole
8	Jatani Shege	Female	60	No formal education	Hurufa Lole
9	Hawi Sado	Female	30	No formal education	Hurufa Lole
10	Qabato Bune	Male	31	6th grade	Hurufa Lole
11	Idessa Bariso	Male	40	6th grade	Hurufa Lole
12	Kadir Una	Male	28	2nd grade	Hurufa Lole
13	Kadir Bukure	Male	28	10th grade	Hurufa Lole
14	Badhaso Badhane	Male	28	6th grade	Hurufa Lole
15	Gachaw Idessa	Male	30	7th grade	Hurufa Lole
16	Dimite Bune	Male	55	4th grade	Hurufa Lole
17	Hasena Imam	Male	27	2nd grade	Hurufa Lole
18	Umer Mohammed	Male	20	7th grade	Hurufa Lole
19	Faxuma Melkato	Female	40	No formal education	Hurufa Lole
20	Aysha Lamesso	Female	30	No formal education	Hurufa Lole
21	Galgalo Gelcha	Male	30	6th grade	Garbi
22	Jalato Qawati	Male	50	No formal education	Garbi
23	Hussen Guye	Male	40	5th grade	Garbi
24	Mekada S/Hussen	Female	25	4th grade	Garbi
25	Amina Hamda	Female	30	No formal education	Garbi
26	Ameno Kodoxesa	Male	50	1st grade	Garbi
27	Gemeda Guyye	Male	18	9th grade	Garbi
28	Dedu Waya	Male	38	10th grade	Garbi
29	Awal Warisso	Male	22	5th grade	Garbi
30	Qabato Kedir	Male	38	3rd grade	Garbi
31	Wariyo Daqabo	Male	68	7th grade	Garbi
32	Amin Dalo	Male	27	4th grade	Garbi
33	Shuferi Deqabo	Male	26	10th grade+1	Garbi
34	Dhimma Bino	Male	28	7th grade	Garbi
35	Guta Banti	Male	23	7th grade	Garbi
36	Feyiso Woyiso	Male	25	9th grade	Garbi
37	Edato Jino	Female	45	No formal education	Garbi
38	Warite Badhasso	Female	40	No formal education	Garbi
39	Marta Qufe	Female	25	2nd grade	Garbi
40	Tirunesh Bushura	Female	45	5th grade	Garbi
41	Fayiso Nagaho	Male	52	2nd grade	Garbi
42	Qawuto Jiba	Male	60	No formal education	Garbi

Annex 11: Continued

No.	**Name**	**Sex**	**Age**	**Education**	**PA**
43	Wayya Guyye	Male	50	No formal education	Garbi
44	Bacaa Birmajii	Male	45	No formal education	Garbi
45	Hussien Kadiro	Male	27	5th grade	Garbi
46	Dalu Roba	Male	80	No formal education	Garbi
47	Tibo Daqaboo	Male	73	No formal education	Garbi
48	Abu Tesso	Male		10th grade	Golba
49	Jemal Qamite	Male		4th grade	Golba
50	Shano Birqi	Male		6th grade	Golba
51	Hambi Milkisso	Male		7th grade	Golba
52	Obse Galgalo	Female		3rd grade	Golba
53	Seifu Dadafo	Male		5th	Golba
54	Buluda Lali	Male	53	No formal education	Golba
55	Waaqo Hobsa	Male	45	2nd grade	Golba
56	Abe Qaweti	Male	45	No formal education	Golba
57	Tibesso Bekuye	Male	52	6th grade	Golba
58	Amina Hircaa	Female	60	No formal education	Golba
59	Obse Galgaloo	Female	35	3rd grade	Golba
60	Tusu Waariyo	Male	58	6th grade	Golba
District: **Boset**					
No.	Name	Sex	Age	Education	PA
1	Berisso Dori	Male	34	4th grade	Xiyyo
2	Degasa Gada	Male	40	No formal education	Xiyyo
3	Shumi Boset	Male	52	No formal education	Xiyyo
4	Gada Qanani	Male	56	No formal education	Xiyyo
5	Seifu Ya'i	Male	34	No formal education	Xiyyo
6	Haye Badhaso	Male	64	No formal education	Xiyyo
7	Dechassa gada	Male	47	5th grade	Xiyyo
8	Gudata Robale	Male	43	No formal education	Xiyyo
9	Caali Boset	Male	46	No formal education	Xiyyo
10	Dadhi Dori	Male	45	No formal education	Xiyyo
11	Kebede Lemma	Male	37	No formal education	Xiyyo
12	Reta Jima	Male	32	4th grade	Xiyyo
13	Bekele Biftu	Male	39	3rd grade	Xiyyo
14	Dechassa Hundessa	Male	43	3rd grade	Xiyyo
15	Negash Telila	Male	28	2nd grade	Xiyyo
16	Dhibe Bedhassa	Male	61	No formal education	Xiyyo
17	Abebe W/Giorgis	Male	62	No formal education	Xiyyo
18	Dechassa Hawas	Male	46	No formal education	Xiyyo
19	Gemada Tesema	Male	50	5th grade	Xiyyo
20	Ishetu Bedhaso	Male	40	6th grade	Xiyyo
21	Dechassa Dhugo	Male	46	No formal education	Xiyyo
22	Shumbi Badhadha	Female	50	No formal education	Xiyyo
23	Girma Mekuria	Male	36	10th grade	Xiyyo
24	Asaminew Merida	Male	66	4th grade	Digalo Wanga

Annex 11: Continued

No.	Name	Sex	Age	Education	PA
25	Tayech Shimelis	Female	57	No formal education	Digalo Wanga
26	Qalamuwa Reta	Female	61	No formal education	Digalo Wanga
27	Yimenyushal Yisimu	Female	38	6th grade	Digalo Wanga
28	Mazengia Agonafir	Male	35	No formal education	Digalo Wanga
29	Endalish Gebeyehu	Female	32	6th grade	Digalo Wanga
30	Minda Eshete	Male	55	No formal education	Digalo Wanga
31	Etagenyew Assefa	Female	32	No formal education	Digalo Wanga
32	Yeshumanesh Zegene	Female	60	No formal education	Digalo Wanga
33	Beharwork W/Yohanis	Female	50	No formal education	Digalo Wanga
34	Abebech Getaneh	Female		No formal education	Digalo Wanga
35	Alem Kebebe	Female	49	No formal education	Digalo Wanga
36	Yemane Mekasha	Male	70	No formal education	Digalo Wanga
37	Bekele Tufa	Male	76	No formal education	Sara Arada
38	Faye Bekele	Female	45	No formal education	Sara Arada
39	Qanani Boru	Female	42	No formal education	Sara Arada
40	Kamal Yami	Male	45	No formal education	Sara Arada
41	Lemma Oda	Male	70	No formal education	Sara Arada
42	Roba Imamu	Male	28	No formal education	Sara Arada
43	Tullu Wirji	Male	40	No formal education	Sara Arada
44	Bekele Yami	Male	33	3rd grade	Sara Arada
45	Shiferaw Bekele	Male	38	No formal education	Sara Arada
46	Tullu Gada	Male	39	No formal education	Sara Arada
47	Bene Yami	Male	40	10th grade	Sara Arada
48	Melka Ida'o	Male	28	No formal education	Sara Arada
49	Jemal Jambo	Male	24	No formal education	Sara Arada
50	Haji Ullaa	Male	30	No formal education	Sara Arada
51	Reta Dulla	Male	67	No formal education	Sara Arada

Drylands Coordination Group
TØRRLANDS-KOORDINERINGSGRUPPEN
GROUPE DE COORDINATION DES ZONES ARIDES

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