2: Plant Production and Health Sub theme

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Research on Plant Production and Health has been conducted for several decades and encouraging results have been obtained both at regional and national scales. However, the crop production and productivity is constrained with many problems in Eastern Ethiopia. The climate change, erratic rainfall, recurrent drought and moisture stress in Eastern Ethiopia need to be addressed through technologies generated by researches. Researches may not address all the problems of crop production and productivity of the region in a short period of time and therefore problems that need urgent solution have been identified in each research area. Efforts have been made by research teams to address the identified problems with research projects; and high priority research projects are selected. These projects mainly focused on development of technologies for drought tolerant and moisture stress, farmers' participatory selection of technologies, development of technologies for multi-constraints and multi-cycle production, crop protection, germplasm enhancement and maintenance, quality seed multiplication, characterization and evaluation of fruit crops, neglected crops, plant species, indigenous trees and shrubs, as well as medicinal and aromatic plants. Thematic research approach has been attempted to apply in the process of identifying high priority research projects. The importance of professionals' participation from wide range of fields of specializations and the establishment of multidisciplinary teams in each research project should be considered for the success of the projects. The projects should have statement of the problems, objectives, research components/activities and expected outputs. However, for the purpose of the research call only the research projects titles and research components/activities to be executed to achieve the objectives and outputs of the projects are presented under each research area.

2.1. Field Crops Research Area

a. **Participatory Evaluation of Cultivars, Production Packages, and Integrated Pest Management of Sorghum in Eastern Ethiopia**

Sorghum is the major crop produced in Eastern Ethiopia. However, the production and productivity of the crop is very low due to frequent drought, moisture stress and short growing season brought about by the global climate change. Disease and pest problems associated with the crop also need to be addressed. Promotion of production packages compatible with the production system are also among the major production constraints. Therefore, participatory evaluation of cultivars, production packages, and integrated pest management of sorghum are the research priorities in Eastern Ethiopia. The research components are:

- Participatory Evaluation and Identification of Moisture Stress Tolerant and Short Duration Sorghum Varieties for Eastern Ethiopia;
- Participatory Evaluation and Identification of Agronomic Packages Suitable to Sorghum Production System in Eastern Ethiopia;
- Development, Participatory Evaluation and Selection of Integrated Pest Management for Sorghum in Eastern Ethiopia.

b. Generation and Promotion of Maize Technologies in Eastern Ethiopia

In Eastern Ethiopia, the major problems in maize production and productivity are drought, moisture stress, disease and insect pest. The adaptability of maize varieties with enhanced nutritional qualities (Protein quality, Pro Vitamin A and improved feed traits) in Eastern Ethiopia has not been tested at large and farmers have not participated in selection of maize technologies. The following research components are identified as high priority to address the problems within a short period of time. Components under this research area are:

- Participatory Evaluation and Promotion of Improved Maize Varieties at Different Agro-ecologies of eastern Ethiopia;
- Assessment of Ecological Distribution of Parasitic- and Non-parasitic Weeds, Maize Stalk Borer, Diseases and Pest, and Development of Integrated Weed, Disease and Pest Management in eastern Ethiopia, and
- Improved Agronomic Management Options for Maize Production in Eastern Ethiopia.

c. Development of Technologies for Small Cereals that fit to eastern Ethiopia

The production of wheat, tef and barley is low and they have low contribution to the agriculture sector in Eastern Ethiopia. However, farmers' interest to produce these crops is increasing. This crop production in Eastern Ethiopia is mainly constrained by unavailability of crop varieties adaptable to the region, disease and pest, and abiotic stresses. The following research components are believed to address the major problems. The research components under this are:

- Identification of Disease Resistant, High Yielding and Wide Adaptable Wheat, Tef and Barley Varieties in Eastern Ethiopia;
- Development of Integrated Weed, Disease and Pest Management for Wheat, Tef and Barley in Eastern Ethiopia;
- Development of Improved Agronomic Practices for Wheat, Tef and Barley and Farmers' Participatory Evaluation of Technologies in Eastern Ethiopia.

d. Integration of Technologies to Alleviate Multiple Constraints of Lowland Pulse Crops Production in Eastern Ethiopia

In Eastern Ethiopia, the production of lowland pulses has multiple advantages including the compatibility of crops to the existing intercropping crop production, enhancement of soil fertility, withstanding drought and moisture stress, providing protein rich food to the community and cash income as an export commodity. However, the production of these crops is constrained by multiple problems, and production agroecology shift is observed due to climate change that is not addressed by the University and National Project researches. The severity and frequency of drought also cannot be tackled with the existing lowland pulses species. The tackling of these problems requires identification of varieties to mid and high land altitudes, introducing drought tolerant species, alleviating disease and pest management problems, and demonstration of lowland pulses products. Components are:

- Adaptation and Farmers' Participatory Selection of Common Bean Varieties in Mid and Highlands of Eastern Ethiopia;
- Demonstration and Farmers' Participatory Selection of Drought Tolerant Mung Bean Varieties and Cowpea Genotypes for Food Security and Income Generation in Eastern Ethiopia;
- Characterization and Product Development of Common Bean, Cowpea and Mung Bean in Eastern Ethiopia;
- Testing of the Compatibility of Mung bean Varieties in Existing Intercropping Crop Production System in Eastern Ethiopia;
- Integrated Management of Diseases, Insect Pests and Weeds of Common Bean, Cowpea and Mung Bean in Eastern Ethiopia.

e. Generation of Highland Pulses Technology Packages in Eastern Ethiopia: Emphasis to Participatory Evaluation, Improved Management Practices and Promotion of Products

Haramaya University has been developing technologies for highland and lowland pulses. Most of the technology development focused on varieties releases. However, the varieties were not properly demonstrated to farmers and farmers have not participated in the selection of technologies. In addition, variety development for some crops such as chick pea for Eastern Ethiopia is not well developed or/and released varieties are not tested for adaptability. Disease and pest problems also become the major production constraint in these crops not only in Eastern Ethiopia but also throughout the country. Therefore, tackling of production problems in highland and lowland pulses in Eastern Ethiopia is not only ensuring nutrition and food security problems but also income generation for farmers from international market. The short term research activities suggested in to alleviate the problems indicated above include:

- Participatory Evaluation and Selection of Improved Varieties and Agronomic Practices of Faba bean in Eastern Ethiopia;
- Participatory Evaluation and Selection of Improved Varieties and Agronomic Practices of Chick pea in Eastern Ethiopia;

- Survey, Identification and Integrated Management of Diseases, Insect Pests and Weeds of Faba bean and Chick pea in Eastern Ethiopia;
- Product Development, Characterization and Promotion of Faba bean and Chick pea Varieties for Improved Nutrition and Health in Eastern Ethiopia.

f. Enhancing Groundnut Productivity and Production in Eastern Ethiopia

Eastern Ethiopia is among the major groundnut producing regions in the country. The crop has a potential to alleviate food and nutrition security problems. It is also a high potential crop as export commodity that will be a good opportunity to generate additional income to poor farmers in moisture stress areas of lowland Ethiopia. However, the production and productivity of the crop is constrained as a result of either unavailability of technologies to farmers. In addition, Aflatoxin contamination limited export to international market. These problems have not been well addressed by the National Research Project in Eastern Ethiopia. Therefore, Haramaya University needs to take the responsibility in alleviating the problems. Though the alleviation of the problems requires a long term research, the research team has identified the short term research activities in this project. The research components are:

- Integrated Management of Aflatoxin Contamination in Groundnut;
- Scaling Up of Groundnut Sheller in Eastern Hararghe;
- Scaling-up of Improved Groundnut Varieties through Community based Small-Scale Seed Production Scheme in East Hararghe ;
- Training on Groundnut Product Development for Enterprises and Smallholder Farmers

2.2. Horticultural Crops Research Area

a. Assessment, Development and Promotion of Technologies for Underutilized Crops: Emphasis to Okra and Amaranthus

Ethiopia is claimed to be the origin of Okra. The highly mutinous Amaranthus is grown as weed in the country. The production of Okra is only in pocket area of the country but grown as a wild plant at large in the country. Okra and Amaranthus can be potential to food and nutrition security in the country; the crops withstand moisture stress and potential export crop (particularly Okra). However, technologies have not been developed for these crops in the country and are not included in the National Research System. But Haramaya University has started to address the problem since the beginning of this decade. However, the successes of the past efforts of the University depend on the continuation of the started research activities which are listed below. The focus areas are:

- Assessment of the Genetic Diversity and Potential Utilization of Amaranthus Germplasm in Ethiopia;
- Characterization and Evaluation of Ethiopian and Exotic Okra Genotypes for Tender Fruit and Seed Yield and Quality;
- Demonstration and Farmers' Participatory Selection of Exotic Amaranthus Varieties in Eastern Ethiopia;
- Development and Demonstration of Okra and Amaranthus Products, and Characterization of Nutritional Contents.

b. **Development of Potato Technologies for Sub-optimal Irrigation and Multiple Cycle Production in Eastern Ethiopia**

Potato is the second most important food and export crop in Eastern Ethiopia next to Khat. The farmers are producing potato with two and three production cycles in a year using local cultivars with short dormancy period under sub-optimal irrigation. The local cultivars are disease susceptible and cannot be used for main cropping season. However, the improved potato varieties have long dormancy period that cannot be used for successive production under irrigation. In addition, the reduction in sugar content of local cultivars is very high and the flourishing of chips and french-fries products in the region has high potential to create health problems (cancer) along with the use of the wrong kind of vegetable oils and frying methods. Neither the University nor the National Research System had addressed these issues to alleviate the potato production system in Eastern Ethiopia. But the interlinked production problems are not to be tolerated any more due to public health problems, the production of the crop below its potential in the region, the ever increment of production area

and the demand of the farmers for technologies that fit the production system. Therefore, the following research activities have been identified as urgent to alleviate the potato production problems in Eastern Ethiopia. The research components are:

- Identification of Dormancy-Breaking Methods in Improved Potato Varieties;
- Assessment of Small Scale Chips and French fries Processing Methods;
- Assessment of Potato Production Constraints Under Sub-optimal Irrigation Water;
- Development of Integrated Technologies fit to Potato Production System in the Changing Climate in Eastern Ethiopia.

c. Development of Methods for Quality Carrot Seed Production

The production of carrot seed in tropics is difficult and commercial seed production is practically impossible. Due to this, the country is producing carrot from imported seeds. Haramaya University has released the first carrot variety in the country, *Haramaya I,* in 2014 after decades of efforts. This variety has not vernalization requirement and seed can be produced using root to seed and seed to seed methods. However, the production of high quality commercial carrot seed production to substitute the imported seeds need development in seed production methods, but it is not determined yet. Therefore, this project has been identified as important to substitute the imported seed and to save the foreign currency of the country. To achieve the goal of this project the following activities are proposed. The research components are:

- Determination of Optimum Plant Density, and Fertilizer Rates to Produce Quality and High Seed Yield of Haramaya I Carrot Variety;
- Determination of Branch Pruning, Umbels and Plant Density to Produce Quality and High Seed Yield of Haramaya I Carrot Variety;
- Establishment of Seed Processing and Seed Quality Test Procedure, Packaging and Storage for Quality Seed of Haramaya I Carrot Variety;
- Determination of the Economic Benefit of Improved Seed Production of Haramaya I Carrot Variety and the Profitability of the Commercial Seed Production.

d. **Collection, Characterization and Evaluation of Fruit Crops in Eastern Ethiopia**

In the current agriculture, Eastern Ethiopia has not contributed much to the production of fruit crops. The tragedy is that the declining fruit production status of the region is due to production constraints not addressed by research. The University needs to address the critical fruit production problems before fruit production become nonexistent in the region. Though it is known that fruit research requires decades and huge amount of investment, research activities are identified as stepping stones as follows. The research components are:

- Establishment of Orchard for Research, Demonstration and Training;
- Assessment of Fruit Crops Production Constraints in Eastern Ethiopia;
- Collection, Characterization and Evaluation of Fruit Crops Importance to the Region ;
- Collection, Characterization, Evaluation and Conservation of Fruit Crops Varieties in Eastern Ethiopia.

2.3. Crop Protection Research Area

a. Integrated Management of Parasitic Weeds of Major Crops in Eastern Ethiopia

The parasitic weeds are the major crop production constraints in Eastern Ethiopia. It is not possible to control efficiently the known parasitic weeds (Striga spp) in sorghum and maize, and *Orobanche spps* in pulse crops in the past. Moreover, the parasitic weeds (*Orobanche spps*) are emerging as major constraints of potato and tomato production in Eastern Ethiopia. Therefore, the following research activities are proposed to tackle the problems of parasitic weeds in Eastern Ethiopia. The research components are:

- Survey, Identification and Characterization of Parasitic Weeds (*Orobanche spps*) of Potato and Tomato in Eastern Ethiopia;
- Survey, Identification, Characterization and Development and Promotion of Integrated Management of Striga in Sorghum and Maize in Eastern Ethiopia;
- Developing Integrated Management of Parasitic Weeds for Tomato and Potato in Eastern Ethiopia.

b. Improving the Productivity and Health of Honeybees and Silkworms in Eastern Ethiopia

The major focuses under this research area are:

- Improving the productivity and health of honeybees in Eastern Ethiopia;
- Improving the productivity and health of silkworms in Eastern Ethiopia.

2.4. Medicinal and Aromatic Plants, Indigenous Trees and Shrubs Research Area

a. Status, Utilization and Future Prospects of Medicinal and Aromatic Plants, Indigenous Trees and Shrubs in Eastern Ethiopia

In Eastern Ethiopia, unorganized fragmented research activities have been conducted on medicinal and aromatic plants, indigenous trees and shrubs. However, the University has established a research area for these plant species to conduct researches in an organized manner and multidisciplinary approach. The following research activities are proposed as a direction for future organized researches in these crops. The major focuses under this research area are:

- Status and Utilization of Medicinal and Aromatic Plants in Eastern Ethiopia;
- Status and Future Prospects of Indigenous Trees and Shrubs in Eastern Ethiopia.

2.5. Germplasm Maintenance and Enhancement Research Area

a. Germplasm Maintenance and Enhancement of Crops and Seed Multiplication of Crop Varieties

Haramaya University has been contributing a lot to the country in developing crops varieties since its establishment as Agriculture College. The germplasm collected by the University has been the basis for the establishment of national gene bank and thousands of collections were conserved as world wealth at different gene banks. However, the University has failed to maintain its own varieties, collections and introduced crops genotypes. The seed production of crop varieties in the University is not under strict supervision of breeders. Therefore, the following activities are proposed to be implemented every year. Some of the activities related to this research area are:

- Maintenance of Enhancement of Potato and Sweet potato Collections and Seed Tubers and Cutting Multiplication of Commercial Varieties;
- Maintenance of Inbred Lines and Old Maize Varieties, and Seed Multiplication of Commercial Varieties;
- Maintenance of Cereal Crops Germplasm and Seed Multiplication of Commercial Varieties**;**
- Maintenance of Common Pulse Crops Collections and Seed Multiplication of Commercial Varieties;
- Maintenance of Collections and Seed Multiplication of Commercial Varieties of Oil Crops.

b. Collection, Characterization of Plant Species and Establishment of Botanical Garden

Haramaya University is a pioneer agricultural institute in the country. It has been contributing a lot in crop diversity study and germplasm enhancement. However, the University is lacking systemic research on the change of plant species in the changing climate due to the absence of collection of plant species botanical garden in the University. In the world, the contribution of Universities in generating information about plant species change in the changing climate has not been demanded more than now. Therefore, as one of the oldest universities in the country, it is an urgent task for the institution to start the collection of plant species and the establishment of botanical garden for scientific research and education. Some of the major activities under this research area are:

- Site Selection, Preparation and Establishment of Botanical Garden;
- Collection, Characterization and Identification of Plant Species.