Theme I-2016/17 Call- Productivity and Environmental Sustainability for Food Security and Poverty Alleviation

1. Animal Production and Health

a. Camel Productivity Improvement

Camel production is known in Eastern Ethiopia, but productivity is very low. There is poor milk handling practice and high post harvest loss, and genetic and management problems hamper camel productivity. Trypanosomosis and other diseases are common causes of morbidity and mortality, and there is an indiscriminate use of anti-trypanocidal drugs. External parasites are prevalent and there is little or no information on vector borne diseases. Research focus areas are:

- Improving feed and water resource; adopting and up-scaling of feeds and feed treatment technologies; post-harvest handling, quality and shelf life of camel milk and milk products;
- Studies on quantitative and qualitative genetic parameters on camel selection and evaluation of economic traits.
- Epidemiological study and integrated prevention methods of Surra, external parasite, and camel calf morbidity and mortality.

b. Chicken Productivity Improvement

Smallholder chicken is an integral component of the livelihoods of nearly all poor rural households. However, germplasm resources are generally under-exploited and under-leveraged due to management problems, lack of effective capacity for testing, multiplication, and delivery to farmers, followed by continuous genetic improvement. Poultry diseases such as Newcastle disease, infectious bursal disease and infectious coryza are also the most important hindrances to village and improved poultry industry. Research focus areas are:

- Feeding different herbs and non-conventional feeds to improve productivity of dual purpose chicken; selection of potential chicken ecotype and on station genetic performance and feed conversion evaluation under optimum management;
- Adoption demonstration and development of synthetic tropical dual-purpose chicken breeds;
- Epidemiological study, preparation and determination of vaccination regime, and use of local and imported vaccines for ND, IBD and IFC, and design control methods for commercial and small scale poultry production.

c. Dairy Productivity Improvement in Eastern Ethiopia

The capacity of local dairy cattle is very low in milk production. There are high milk loss, poor milk handling and limited selection and genetic improvement programs for high milk production within indigenous cattle, and also the efficiency of reproductive technologies like AI and synchronization is poor. The technological intervention to improve the local available low quality feeds is poor; there is also shortage of feed. Poor performance of calf and heifers and higher mortality of calves limits future dairy replacement and expansion. Mastitis and other diseases that cause reduced milk production are common in the area, and there are no clear control and prevention methods for clinical and subclinical mastitis in dairy farms. The problem of drug resistance among mastitis causing organisms is increasing. The incidence and causes of reproductive disorders are also unidentified. The priority focus areas are:

- Effect of improved forage and feed treatment on milk production and milk quality; Milk handling and reducing post-harvest loss; The role of gender in urban dairy production;
- Genetic improvement of local dairy cattle through selection and breeding; Assessment of calf and replacement of heifer husbandry practice; Evaluation of estrous synchronization protocol and effectiveness of artificial insemination; Investigation of the major causes of reproductive disorders; Design and implementation of appropriate mitigation strategies;

- Epidemiological study, control and prevention methods of mastitis; Calf morbidity and mortality and appropriate control and prevention methods; Drug sensitivity test and selection of effective groups of drugs in Eastern Ethiopia.

d. Goat Productivity Improvement

There is limited selection and genetic improvement and lower productivity of local goats. Poor husbandry and high mortality rate of kids; technologies to improve feeds and feeding methods seem to be major problems. Presence of serious infectious diseases (CCPP, PPR etc) are hampering export of small ruminants and meat from these species to prime meat markets with better economic return. Kid morbidity and mortality are widespread affecting growth and replacements.
Reproductive disorders resulting in abortion are common in local goats. And also, parasitic diseases are among the most important causes of productivity loss in adult goats. The following are the focus areas:

- Development of different feed treatment technologies on performance of goat, and alternative starter feed formulation and housing management to reduce kid mortality;
- Improvement of goat breeds through selection and cross breeding;
- Investigation of internal parasites dynamics for strategic interventions; Epidemiological investigation on causes and risk factors of young stock morbidity and mortality; Impact of PPR and CCPP; and reproductive disorders affecting goats in Eastern Ethiopia.

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.

3. Environment, Natural Resource and Climate Change Research Sub-thematic Area

3.1 Water Resource Potential of eastern Ethiopia

The water supplies of urban and rural populations in Eastern Ethiopia region heavily depend on groundwater resource (bore holes, dugs wells and springs). Future water supply expansion projects of these in other parts of the country are also targeted on groundwater resources. However, including the surface water resource, the potential of groundwater resource is not well estimated and modeled. They have been overexploited for different purposes without having knowledge on the occurrence, distribution, flows and quality of the groundwater systems. Therefore, detail hydrologic and hydro-geologic investigations are needed in the region and the nation as a whole, for sustainable use of the water resources. In addition, rain fed agriculture is predominant land use type in the drier farming regions (arid and semi-arid environments) of Ethiopia, which implies the need for alternative water resource development. Some of the research components are:

- Ground and surface water resources potential estimation and modeling;
- Alternative water sources development;
- Water Harvesting Systems/Technology Development;
- Waste water treatment;
- Sediment and pollutant load estimation;
- Land suitability assessment for irrigation purposes;
- GIS and remote sensing for assessment of water resources;
- Socio-economic issues in water resource development, use and management.

3.2 Water Scarcity, Overexploitation and Misuse of Water Resources

Water is the finite resource that enables life and is critical for future economic growth. However, businesses in water-scarce areas are already at risk. Land users, including investors are increasingly taking water supply into consideration in their decision-making processes. If water resources are not smartly managed, they will increasingly threaten investment and also the fundamental needs of populations. Similarly, the future of water resources in our nation is being threatened by the misuses

and mismanagements. Taking action to implement the available solutions and models will ensure the viability and sustainable development of our society. Therefore, it is essential that the public, industries and policymakers understand, prioritize and act timely. A clean water supply is the single most important determinant of public health. Water and sanitation are fundamental to human development and well-being. Research components include:

- Sustainability of the water resources;
- Analysis and quantification of water for different uses;
- Coverage of safe water provision and utilization;
- Identification of water efficient engineering and management approaches;
- Monitoring and evaluation of water resource development techniques;
- Basin wide water resources allocation;
- Evaluating community based water use byelaws and regulations.

3.3 Soil Resource Assessment

There is limited information on soil resources in Eastern Ethiopia. Classification, characterization and mapping of soils of an area is, therefore, a significant contribution for sustainable management of the natural resource.

The major research components include:

- Characterization and classification of soils in the mandate areas;
- Characterization, classification and mapping of the soils of Eastern Ethiopia.

3.4 Soil Erosion and Vegetation Degradation

Erosion and related problems are common limitation of agricultural productivity in Eastern Ethiopia. They are some of the most widespread threats to soil quality. It is therefore, the task of researchers to study the hazard, distribution, extent and effect of soil degradation in the area. Forest resource is also degraded due to various reasons such as road development, building constructions and agricultural expansion and overgrazing. There is high population increment and energy demand. Therefore, new technologies are required to minimize the effect. Priority research areas include:

- Fundamental research on environmental causes of soil erosion;
- Assessing and delineating areas of risk for soil erosion, taking into account climate variability and climate change, using GIS and other technologies;
- Assessment of the extent and type of soil erosion in the mandate areas;
- Identification of local soil and water conservation approaches and their effectiveness;
- Assessment of the status of forest resource and other vegetation in the mandate area
- Assessment of the status of vegetation degradation and rate of rehabilitation;
- Investigating the values of forest goods and services and their contribution to poverty alleviation and the environment;
- Vegetation watershed management and rehabilitation strategies;
- Human population trends and reliance on vegetation resources;
- Monitoring vegetation utilization in East Hararghe.

3.5 Water Pollution

Surface and ground water are threatened worldwide by pollution. Increased human activities are threatening the nearby lakes, rivers, spring and wetlands. A major concern of the presence of polluting elements in the aquatic environment is related to the negative health effects they may cause in humans, animals and plants. Therefore, water pollution assessment, estimation of pollution level

and extent, assessment of pollutant dynamics in water bodies as well as studying methods to reduce pollution of water resources is not only a necessity but a must.

3.6 Mismanagement of Solid and Liquid Waste

The situation of inadequate waste management is pervasive in many developing countries. It is one of the largest environmental challenges that societies have faced. In lower-income countries as well as poorer parts of middle-income nations, about 30 to 50% solid waste produced in urban areas is left uncollected. Poor waste management practices such as dumping of waste in water bodies and uncontrolled dump sites aggravates the problem across the country. Research components under this problem may emphasize on:

- Urban solid waste management (plastics, electronics, others);
- Urban liquid waste treatment and management.

3.7 Climate Change Adaptation and Mitigation

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects. It includes adjustments to moderate harm from, or to benefit from, current climate variability as well as anticipated climate change. The climate change mitigation, on the other hand, will produce rapid discovery of the scientific knowledge base needed to quantify the potential for purposeful carbon sequestration/ GHGs removals, and will be a critical component of future climate change mitigation programs and will contribute to efforts to slow down the increase in atmospheric greenhouse gas concentrations. Research components under this problem may emphasize on:

- Development of resilient farming systems;
- Advance understanding of the opportunities and challenges of implementing adaptation;
- Create effective and innovative approaches to measure and value the monetary and non-monetary aspects of short- and long- term adaptations and mal-adaptations and compare these across groups, sectors, regions and timeframes;
- Investigate a range of evaluation criteria for prioritizing adaptation decisions;
- Conduct studies on communication, participation and capacity building for CCA;
- Research into mitigation options in agriculture and forestry and other land use (AFOLU);
- Development of production systems with enhanced carbon sequestration ;
- Agro-forestry investigation of the potential for low-rainfall tree species to be integrated into farming systems;
- Development of technologies for the production of bio-energy and other bio-products from agricultural and forest biomass;
- Examination of soil carbon dynamics in forests;
- Development of improved models of sequestration for dry-land forest species and mixed-species re-vegetation;
- Development of acceptable methods for inclusion of wood products in carbon trading schemes, acknowledging their important role in continuing carbon sequestered during forest growth;
- Conducting Technology Need Assessment (TNA) for CC Mitigation.