

Theme III- Energy, Engineering and Information Technologies

Subtheme 1. Information Technology and Computing

Science and technology developments fundamentally alter how people live, work, connect and communicate, with profound effects on socio-economic advances and improvements in health systems, education and infrastructure. In this regard, statistical science, information and communication technology (ICT), as a key component and enabler in science and technology, are increasingly simplifying the accessibility of information, financial service, and others to change people's lives in unprecedented ways. ICT is also changing the way how companies do business, transforming public service delivery, and fostering nations to move toward good governance. In the education sector, statistical science and ICT play an integral role. To address the problem of societies through well-developed statistical models and managed ICT applications and services; the following focus areas of research are identified.

1.1 Computational Intelligence and Machine Learning Development

- Machine Learning for Sciences (biology, physics, health sciences, and social sciences) and multi-modal learning.
- Electronic health record as a reliable risk predictor Machine learning application for land-use and land-change, and biodiversity monitoring.

1.2 Applied statistics in agriculture, environmental sciences, biomedical sciences, education and social welfare

- Disease, economics, agriculture, education and environmental modelling, spatial modelling, biostatistics and bioinformatics.
- AI-augmented learning for individuals with disabilities - development of AI-driven innovations to improve human learning and education.

1.3 Wireless sensors and network applications in agriculture and health

- Wireless sensor development and integration for smart system applications.
- Development and automation of electrical and microcontroller operations for industry's system and solution development.

Sub-theme 2: Advanced Materials Research and Development

The major challenge we face as a nation is a poor productivity due to the traditional mode of agricultural systems that have been practiced hitherto. Haramaya University, as one of the leading agricultural and one of the research universities in Ethiopia, is expected to lead the research in modernizing our agriculture commensurate to its position via the involvement of emerging technologies such as nanotechnology. In this regard, research related to increased plant and animal production and productivity is important. The energy problem has contributed to food shortage and curtailed economic development. Environmental pollution is another formidable challenge that hampers the socio-economic development of our country. The following priority research area has been identified for this call.

2.1 Material development for agricultural applications

- Plant production and productivity enhancement; animal production and productivity; Postharvest technology; Nanobiotechnology, Food processing and packaging.

2.2 Material development for energy and environmental applications

- Environmental monitoring: photocatalysis; sorption/desorption; ion exchange; photo-disinfection; antimicrobials; bio/chemo-sensors; conversion of agricultural biomass wastes.
- Development of advanced materials for energy (improved materials for energy storage such as supercapacitors, batteries, etc.).

Sub-theme 3: Energy Resources Development and Utilization

Energy is the main input to the technological, industrial, social and economic development of a nation, which stimulates the economic development of a country. The Ethiopian energy sector is faced with the double challenge of limited access to modern energy and the heavy dependence on traditional biomass energy sources to meet growing demand. In this new era, renewable energy sources are an extremely attractive and desirable option in the energy sector due to the rising price of oil, natural gas and coal, as well as environmental concerns in terms of greenhouse gas emissions and global warming. Besides, the lack of alternative energy, which has brought

deforestation, land degradation and food insecurity in Ethiopia, has led to the search for a new technological way of energy utilization. There is a general acceptance of the need to diversify the energy supply to confront these challenges by developing advanced, cleaner, more efficient, and cost-effective renewable energy technologies, including superior and cleaner fossil fuel technologies. The following priority research area has been identified for this call.

3.1 Alternate energy sources development and utilization

- Bio-energy: biomass gasification; biogas generation from agricultural wastes; biodiesel production and utilization, stability of biodiesel and its blends.

3.2 Energy conservation

- Conservation of energy in electrical networks, energy auditing, energy, cleanenergy, saving and development, rural electrification for sustainable development, etc.
- Industrial boilers renovation, optimization and applications (the case of Dire Dawa Food Complex, Hamaressa Edible Oil Share Company, etc.),
- Energy-saving and recovery design and development for industrial applications.
- Improve quality and efficiency of local coal minerals for industry utilizations.

Sub-theme 4: Postharvest Technology, Processing and Food Analysis

In Ethiopia, the postharvest management system is in dire conditions characterized by poor quality products and large losses. As a result, the local market is inundated with poor-quality products. Thus, the research in postharvest management must focus on minimization of losses, quality improvement, product development, and processing technologies of industrially and economically important crops. In addition, research in food science, engineering and technology must focus on safeguarding the quality of food from production to consumption. Besides, the development of food quality standards, improvement of quality of fresh produce, as well as the development of new food products from wild, indigenous and traditional food resources is crucial. Furthermore, food and nutrition security problems in developing countries like Ethiopia must be addressed through different approaches. Therefore, priority shall be given to introduction, adoption, and utilization and creating awareness of technologies, nutritionally rich foods, and food safety practices to improve the food system. Moreover, improving and scale-up

indigenous/traditional foods and processing techniques are also vital to increase their role in the national economy. Therefore, the following priority research area has been identified for this call.

- Agro-food processing technologies development and adoption for sustainable food and nutrition security (postharvest technologies, processing technologies, quality and safety management as well monitoring, food processing firm's technology gap assessment and solutions, etc.).
- Development, fortification and promotion of nutritionally rich food products.
- Improve the food postharvest handling and marketing system in Eastern Ethiopia along the value chain (high value and/or nutrient-dense crops: onions, mangoes, potatoes, etc.).
- Integrated food system development for the alleviation of food and nutrition challenges (integrated system from production to fork).
- Utilization of underutilized or neglected and new food sources to alleviate food and nutrition insecurity.
- Improving and promoting the traditional or indigenous foods and processing practices.

Sub-theme 5: Civil Infrastructure, Manufacturing and Industrial Technology

Production and quality management has been recognized as an important factor in a country's economic growth. Rapid changes in technology have posed numerous opportunities and challenges, which have resulted in the enhancement of manufacturing capabilities through new materials, facilities, techniques and procedures. Hence, managing a service/production system has become a major challenge in the global competitive environment. Production and quality management leads the way for organizations to achieve their goals with minimum effort. Equally, computer-aided manufacturing and control systems (automation) or robotics is a current global trend as it is capable of reducing the cost of production, waste, and hazard and increasing accuracy, productivity as well as process capability in different industries. Attention shall also be given to small and medium manufacturing enterprises (SMMEs) as they contribute a lot to job creation and support the national economy of a country. Currently, SMMEs are organized and expanding in Ethiopia on the basis of agricultural-economy to industrial-economy transformation. Hence, the design and renovation of modified, cost competent and demand-driven technologies in areas of crop harvesting and after-harvest processing, as well as construction equipment, are

highly required in these manufacturing enterprises and markets to gear up the economy. Accordingly, the following prioritized research areas are identified for this call:

5.1 Manufacturing for agricultural transformation and development

- Machinery control and interface design, development and improvements for industrial application (electrical, mechanical, process and control systems, and process design integrated research).
- Design and development of waste plastic recycling machine.
- Design and development of light-duty vehicles.

5.2 Transforming the community's livelihood and farming environment

- Low-cost rural housing and energy source, roof rainwater harvesting for rural

5.3 Petrochemicals development and minerals assessment in Eastern Ethiopia

- Mapping of mineral and petrochemical resources in eastern Ethiopia.
- Minerals and petrochemicals towards value-adding, grading and processing.
- Geomaterials for green construction technologies.

5.4 Advanced water and wastewater treatment technologies

- Efficient and cost-effective desalination technologies for agricultural water.
- Replacement of imported bleaching powder with locally available materials for industrial wastewater treatments and other food refining processes, such as oil.