

Theme III- Energy, Engineering and Information Technologies

Sub-theme 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 for 2023/24 Call for Proposals:

1.1 Computational intelligence and machine learning development

- Machine learning for 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.
- Formulating, developing, and enhancing information technologies for health, and agriculture.
- AI-augmented learning for individuals with disabilities: development of AI-driven innovations to improve human learning and education.
- Data system development and digitalization for manufacturing industries, agriculture, education, and healthcare sectors.

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

- Statistical modeling for disease, finance, marketing, agriculture and spatial modelling.
- Development and evaluation of statistical methodology through integration of statistical theory for biological sciences.

1.3 Wireless sensors and network applications

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

1.4. Cybersecurity

- Innovations and development of the cybersecurity for information security, database security, and network security.

1.5. Data science and data engineering

- Development of large software platforms running large scale statistical and machine learning algorithms.
- Designing and building systems for collecting, storing and analyzing data at scale for health, agriculture, finance, human resource and education.

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 2023/24 Call for Proposals:

2.1 Material development for agricultural applications

- Nanotechnology for plant production and productivity enhancement.
- Nanomaterials development for food packaging and agrochemicals.

2.2 Material development for energy, health and environmental applications

- Development of advanced materials for environmental monitoring: photocatalysis, sorption/desorption, ion exchange, antimicrobials, bio/chemo-sensors, and conversion of agricultural biomass wastes.
- Development of advanced materials for energy applications (improved materials for energy storage such as supercapacitors, batteries, etc.).
- Nanotechnology for medical and health applications (diseases detection, drug delivery systems, antimicrobial coatings, 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 2023/23 Call for Proposals:

3.1 Alternate energy sources development and utilization

- Bio-energy: biomass gasification, biogas generation from agricultural wastes, biodiesel production and utilization.
- Development of alternative energy source from locally available material as a partial substitution of coal for heavy industries.
- Improve quality and efficiency of local coal minerals for industry utilizations.

3.2 Energy conservation

- Conservation of energy in electrical networks, energy auditing, clean energy, saving and development, rural electrification for sustainable development, etc.

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 2023/24 research grant call:

- Agro-food processing technologies development.
- Improvement of postharvest handling and marketing system in Eastern Ethiopia along the value chain (high value and/or nutrient-dense crops).
- Utilization of neglected and new food sources.
- Improvement and promotion of the indigenous foods and processing practices.
- Evaluation of food quality and safety along the supply chain.
- Design, develop and evaluate innovative technology for bio-preservation of food.
- Production of fermented and nutrient rich foods using microorganism.

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 2023/24 Call for Proposals:

5.1 Technologies for agriculture and manufacturing industries

- Design and development of small-scale machineries for agricultural mechanization.
- 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.
- Manufacturing industries process improvement and product development.

5.2. Petrochemicals development and minerals assessment in Eastern Ethiopia

- Mapping of mineral and petrochemical resources in eastern Ethiopia.
- Petrochemicals towards value-adding, grading and processing.
- Mineral development and utilization: exploration, extraction, processing (value-addition), utilization, mining impact and sustainability management.