# AGRICULTURE'S TOMORROW AND TOMORROW'S AGRICULTURE

The Proposal from the Agricultural and Plantation Engineering Sectional Committee

Institution of Engineers, Sri Lanka

# Agriculture's Tomorrow and Tomorrow's Agriculture

#### **1.0 Introduction**

Agriculture is a vital sector in Sri Lanka's socio-economy, contributing to economic growth, exports, and livelihoods of a significant portion of the population. The agriculture sector accounted for 7.5% of the GDP, 21.8 % of national export earnings, and employed 26.5% of the labor force according to 2022 statistics. Agriculture plays a crucial role in alleviating poverty in rural areas. It employs over half the workforce and supports food security of Sti Lanka too. The agriculture in Sri Lanka is mainly divided into food crop sector predominantly engaged by significant small holder farmers and a plantation sector by a few corporates.

The Institution of Engineers, Sri Lanka (IESL) has recognized need of engineering intervention to agriculture sector with the need of mechanization of the sector way back in 1986 and instrumental in establishing a sectional committee on Agriculture and Plantations Engineering.

In today's tech-driven world, agriculture is being revolutionized through mechanization and diffusion of modern and latest technologies leading to more efficient, sustainable, and productive enterprises. With the development of technology and in Industry 4.0 era, agriculture is one of the fastest growing industries which embraces smart technologies to facilitate global food security in challenging contexts of increase of global population and climate change. Therefore, IESL sectional committee on A&PE has realize that its timely to revamp the contributions from Engineering inputs towards Sri Lanka's agriculture sector by infusing latest technological developments and associated concepts which have already started to use in other disciplines.

#### 2.0 Challenges and Issues

At present, Sri Lanka confronts many challenges in the field of agriculture. Such challenges and issues are.

- Increase of demand on locally produced food due to the population growth
- Price fluctuations in global markets due to inflation
- Pressure on hard earned foreign currency to import different food commodities which even can be produced locally
- Deviation of young generations from agriculture as their livelihood
- Economic imbalances and unsustainable livelihoods of farming community
- Harmful environmental and social impacts due to extensive use of agrochemicals,
- Land fragmentations and competition for land with other industries,
- Lack of exposure to adapt appropriate and smart technologies for the agri-food value chain
- Lossing international markets due to illegal practices, adulterations and non-compliance with international standards, issues resulted on low quality food products, food safety and food security,
- Climate change impacts on seasonal patterns, natural disasters, hazards related impacts
- Lack of inclusiveness in national agricultural policy to facilitate wider coverage to enhance agriculture value chain

- Insufficient number of vital resources such as workable human resources, infrastructures and finance,
- Lack of collaboration and coordination between the research institutes and non-availability of updated databases,
- Considerable post-harvest losses
- Poor soil and land management practices on water and land pollution, conflicts with wild animals

Strategic approaches should be applied to minimize the negative influences posed by existing challenges and issues to increase contributions from agriculture to Sri Lankan GDP. Introduction of appropriate smart technologies are paramount to further enhancement to the Sri Lankan economy by agriculture sector. Thus, focusing on potentials and alternatives for establishing a sustainable agriculture system as to uplift the socio-economic stability of the country, there should be an engineering intervention in modernization of agriculture sector of the country.

#### **3. Proposed Strategies**

The agricultural and Plantation Engineering Sectional Committee of IESL suggests a shortterm/long-term strategy to transform and position the agriculture sector on a sustainable growth trajectory through engineering intervention

- Diffusion of modern and smart technologies to wider agricultural community
- Ascertain the educational and skill requirements of agricultural engineering
- Identify Research, Development, and Innovation (RD&I) needs
- Develop a National Agricultural Mechanization Policy in Sri Lanka.

#### 3.1 Diffusion of modern and smart technologies to wider agricultural community

While smart agriculture has introduced technological infrastructures such as hydroponics, robotics etc., Internet of things [IoT] has facilitated communication between these devices and the cloud, thereby enabling data gathering, tracking, monitoring and automating farming processes. Resulting end goal is to increase the quality and quantity of the crops while optimizing human labor and other resources such as water, fertilizer and land. The concept of smart agriculture is relatively new to wider farming community. However, many countries, including developing countries have already implemented smart farming with successful results.

*Hydroponics*: This leading smart agriculture method uses water-based cultivation instead of soil. This approach offers numerous advantages, including space efficiency, reduced chemical usage, and the ability to farm indoors. Nutrients crucial for plant growth are delivered directly through a water solution, enhancing absorption and minimizing waste. Smart hydroponics integrates sensors and automation, allowing real-time monitoring of pH, nutrients, and environmental conditions. Automated systems optimize water circulation and environmental factors for diverse plant varieties. Despite initial costs, the long-term benefits, such as lower water consumption and higher yields, position hydroponic farming as a sustainable and innovative solution for the future of agriculture.

Automated Green House: Another use of efficient smart agriculture is the use of automated greenhouse operations. Various sensors installed in greenhouses track different parameters inside the greenhouse such as soil moisture, lux level and humidity. Greenhouse operators can adjust these parameters as required after referring to the data gathered from the sensors. By automating tasks such as ventilation, lighting and irrigation, ideal conditions for plant growth can be changed as per the data gathered from sensors.

*Agricultural Drones*: Agricultural drones are heavily used in mass scale agriculture. Apart from surveillance capabilities, these drones can perform tasks that require human labor such as seed broadcasting, planting crops, agriculture spraying, fighting infections and crop monitoring.

*Robotics:* The world of robotics has already entered the sphere of smart agriculture. Automated harvesters, tractors, and other machines that can operate without human intervention have taken over labor intensive tasks such as planting seeds, weeding, and watering and reaping harvest.

**Data Analytics Tools:** The applications of smart agriculture keep increasing and with the correct tools and management, the opportunities seem endless. Data analytics tools used in smart agriculture help farmers predict the behavior of harvest in advance. By harnessing cutting-edge technologies like IoT, AI, and data analytics, farmers can enhance productivity, optimize resource utilization, and make informed decisions in real-time thus enabling increased profitability.

## 3.2 Ascertain the educational and skill requirements of agricultural engineering

Agricultural extension and advisory services have become specialized, with customized messages tailored to clients' needs. State institutions must adapt agricultural education and training to meet these needs. Agricultural engineering is the engineering discipline that applies engineering science and technology to agricultural production and processing.

*Establishment of Agricultural Engineering Degree Programme:* Only the Faculty of Engineering of the Open University of Sri Lanka has a degree programme on Agriculture and Plantations Engineering. This programme too needs upgrading the academic programme and relaunch it to attract more youth, specially the new generations of the farming community. Other faculties of engineering of state or private universities could be motivated to establish agricultural engineering departments and to support/collaborate with existing Agriculture engineering programs offered by the agriculture faculties

*Establishment of Agricultural Technology Degree Programme:* Some faculties of technology of state universities and private universities have already started agricultural technology degree programs. It is required to revisit their academic programmes and align them for future agriculture.

*Establishing Post-graduate Degree Programme for Agricultural Engineering:* Considerable number of engineers are working in agriculture related government sector specially Department of Agriculture, National Institute of Post harvest Management, Department of Irrigation, Mahaweli Authority of Sri Lanka and R&D institutions. Some engineers work with the companies that manufacture and supply equipment, feeds, fertilizers, and pesticides. Others work for companies that provide services to farmers, such as developing irrigation and drainage

systems or erecting buildings, storages and facilities. Some others work with food-processing, packaging, transporting, and distributing companies. However, they do not have an opportunity to improve their knowledge on smart agriculture practices.

*Introduction of Agricultural Engineering related Courses:* Agricultural engineering combines the disciplines of production, mechanical, civil, electrical and chemical engineering. Faculties of engineering could include some agricultural engineering related courses in above academic programmes even as elective courses. Then, those engineers working in the above agriculture related engineering sector could perform their duties effectively.

## 3.3 Identify Research, Development, and Innovation (RD&I) needs

It is widely accepted that scientific and technological advancement is a significant driver of any sector development and thereby economic growth in any nation. It is required to make strategic investments in basic and applies research, technology development, start-ups, advancing technology, training/capacity building of R&D workforce, and research infrastructure.

*Establishment of National Committee on Agricultural Engineering:* Sri Lanka Council for Agricultural Research Policy (SLCARP), is the government organization entrusted to formulate policies and strategies relevant to different disciplines in the Agricultural Sector and Identify national level research priorities. They have several national committees to promote agriculture. Government can establish National Committee on Agricultural Engineering for promoting agricultural engineering research and development activities.

*Research and Technology Grants:* National Science Foundation (NSF) and National Research Council (NRC) are the main government funding organizations in the country. The government could give priority to research and innovations in the agricultural engineering sector through these two funding organizations.

*Establishment of Research Engineer cadre Positions:* Government could establish cadre positions in agriculture sector R&D organization for Research Engineers where mechanization is required like Coconut Research Institute, Rubber Research Institute, Rice Research and Development Institute. To get the optimum output from these Research Engineers, there is a need for considerable enhancement of facilities as well as attractive packages in remuneration. At present recruitment and retention of Engineers is a major task for these crop research Institutions

# 3.4 Develop a National Agricultural Mechanization Policy in Sri Lanka.

Agricultural mechanization is the process of driving energy between man and materials in a farm production system powered by engine or motorized equipment. It simplifies and reduces heavy work, compensates for labor shortages, enhances productivity and may contribute to the mitigation of climate-related threats. Mechanization is playing an important role in the gradual transition to efficient, profitable and commercial agriculture and ensuring sustainable food and nutrition security

Preparation of national agricultural mechanization policy is a paramount task as demand for modern machinery and latest technologies are increasing at present. Further expansion of this sector was marked by the National Agricultural Mechanization Policy through tax relief, credit facilities, regulation for machine hiring charges, regulations for use of technologies like agricultural drones.

## 4. Implementation and Collaborations

The successful implementation of the above strategies requires a collaborative effort between the government, the IESL, academia, and the private sector. The IESL, being an expert organization with many qualified engineers in different engineering disciplines including agricultural engineering, could facilitate and support this national level task. proposes the following measures to facilitate collaboration:

## **Establishment of Steering Committees**

Steering committees should be established comprising representatives from government, the IESL, academia, and the private sector as follows. These committees will deeply study the requirements through wider stakeholder discussions and consultations for preparing working documents to submit to the government.

- Steering Committee for identifying the level of diffusion of modern and smart technologies to wider agricultural community
- Steering Committee for ascertaining the educational and skill requirements of agricultural engineering
- Steering committee for identifying Research, Development, and Innovation (RD&I) needs
- Steering Committee for development of a National Agricultural Mechanization Policy in Sri Lanka.
- Steering committee for exploring opportunities for and enhancement of value addition of agricultural products.
- It is expected that these steering committees will work in collaboration and synergize with each other when executing their tasks.

# 5. Conclusion

Sri Lanka should aim to revolutionize agricultural development by utilizing modern and smart technologies. Greenhouse automation, smart farming sensors, agriculture drones, precision agriculture, remote sensing, satellite imagery, robotics, and agricultural data analytics can optimize input use schedules and crop yields. Mobile agriculture services provide weather forecasts and market pricing, while blockchain ensures supply chain transparency. E-commerce sites boost revenue and supply, while intelligent irrigation systems and automated farming increase farm productivity. Knowledge-sharing platforms and end-to-end smart farm management systems could simplify farm operations and maximize outputs. By addressing the structural challenges and leveraging technological advancements, these interventions can create a resilient agricultural sector capable of withstanding short, medium and long -term challenges.

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