PROJECT IMPLEMENTATION PLAN

06 July 2018

1. Project Code	18-AG-23-GE-DLN-A-06
2. Title	Self-learning e-Course on Smart Farm Mechanization
3. Reference	Project Notification 18-AG-23-GE-DLN-A dated 9 January 2018
4. Time and Duration	15 November 2018–14 May 2019 (six months)
5. Implementing Organizations	APO Secretariat and National Productivity Organizations (NPOs)
6. Number of Overseas Participants	Minimum of 400 participants
7. Self-registration	Self-registration opens from 10:00 AM Japan Standard Time on 15 November 2018 on the eAPO's web portal: http://eAPO-tokyo.org Note: Participants can register directly from this portal on the APO website. Those who are already registered can access the course by using the assigned username and password. If you have forgotten your username and password, please refer to the help page on the home page of the portal.

8. Objectives

The course is designed to build the capabilities of a critical mass of stakeholders by offering advanced knowledge of farm mechanization to enhance agricultural productivity and the competitiveness of the agriculture sector in APO member countries. At the end of the course, the participants will:

a. have a better understanding of agricultural machinery applications from preharvest to postharvest phases and their role in sustainable growth in the Asian context;

b. understand the concept and philosophy of precision agriculture and how it can help make efficient use of agricultural inputs, especially by minimizing fertilizer and pesticide applications; and

c. be able to adopt smart agricultural machinery and disseminate methods for its use at the community level.

9. Background

The agricultural sector in Asian countries is facing the critical challenge of aging farmers

without successors and the lack of interest in farming by the younger generation. For example, 420,000 ha of farmland was abandoned in Japan in 2017, which was twice as much as in the previous 20 years. The rapid decline in farm labor has also led to a doubling of the workload for each farmer regardless of the increased risk to their health and safety as they age. Smart agricultural machinery has the potential to resolve labor shortages and assist the aging farm workforce in Asian countries to increase agricultural productivity on a sustainable basis. This can also help attract youth to agriculture for the establishment of profitable business enterprises.

Many companies in developed member countries like the ROC, Japan, and the ROK are pursuing the development of smart farm machinery. Major Japanese machinery companies like Kubota, Yanmar, and Iseki are leading those efforts by developing systems incorporating GPS, automated steering, and yield monitoring capabilities. Kubota has also introduced the Kubota Smart Assisted System cloud service with potential for data extraction and user connectivity throughout Japan. Similarly, Yanmar has introduced the Smart Assist System.

Agricultural machinery applications are divided into preharvest and postharvest operations. In the preharvest preparation phases, soil sampling and analysis, field preparation, transplantation or broadcasting, and crop scouting and intercultural operations could be mechanized. The postharvest phases cover harvesting, yield monitoring, transportation, threshing, drying, storage, parboiling, milling, and packaging. Machinery companies and original equipment manufacturers are attempting to offer more smart applications involving user registration for the tracking of harvesting, drying, threshing, milling, and packaging operations, ensuring the traceability of products from farm to table. In commercial agriculture, traceability through smart applications could make food supply chains safer, enhance consumers' confidence in safety of the products they buy, and improve the performance of food supply chains.

This course is being organized to enhance individuals' understanding of the opportunities available for smart agricultural machinery applications, allowing them take new enterprise and technology initiatives as they and their organizations face tremendous challenges in an era of rapid technological transformation.

10. Scope and Methodology

Scope
The tentative course structure is as follows:

Module 1: Smart Agricultural Mechanization (Preharvest to Postharvest Applications)

This module is designed to understand at a glance the preharvest to postharvest phases involved in mechanized agricultural operations. The smart application concept is introduced to reduce the use of agricultural inputs (labor, seed, fertilizers, and water).

Contents: Introduction to smart agricultural mechanization; driving factors for mechanization; machinery in agricultural processes: field preparation, transplanting, seeding, and harvesting; multitasking machinery; and concept of precision agriculture to minimize fertilizer, pesticide, and herbicide applications.

Module 2: Soil Sampling and Analysis (Preharvest Phase 1)

This is the first step in smart agriculture machinery application, involving soil sampling devices.

The module explains methods of soil sample analysis using conventional versus smart soil sensing technologies with mapping to apply fertilizers at the right place, right time, and right quantity. It covers soil properties for crop production, including primary nutrients such as nitrogen, phosphorous, and potassium; secondary nutrients (calcium, magnesium, and sulfur). Soil pH, which influences the availability of nutrients, and soil sampling frequency are discussed.

Contents: Soil fertility and nutrients; soil pH; how pH influences the availability of nutrients; electrical conductivity; soil survey mapping; methods of soil sampling and analysis; grid sampling; grid centers; grid cells; and soil sampling frequency.

Quiz 1 (for self-assessment based on questions from Modules 1 and 2)

Module 3: Applications in Field Preparation and Soil Mapping (Preharvest Phase 2)

Field preparation covers smart applications for the conservation of soil and water as well as nutrient applications such as fertilizer. The timing of application, soil pulverization, and conservation of organic matter are significant points. The smart applications of soil moisture sensors and soil quality mapping are introduced. In primary and secondary tillage operations, utilization of the Internet of Things (IoT) and cloud applications for monitoring soil quality are highlighted. GPS-based machinery for auto steering and field preparation is covered.

Contents: Smart applications in field preparation as well as primary and secondary tillage; soil pulverization and conservation; traffic control; compaction; conservation of organic matter; soil moisture measurements; GPS guidance; and smart applications using the IoT for soil quality mapping and monitoring.

Module 4: Transplantation or Broadcasting (Preharvest Phase 3)

This module introduces the transplanting or broadcasting of seedlings or seeds after field preparation. The basic core level, points to keep in mind when transplanting and broadcasting, placement of seedlings, and seed germination rates are important. Machine orientation and follow-up transplanting procedures are explained.

Contents: Types of smart transplanters and functions; seedling arrangements; broadcasting; machine utilization for broadcasting; seeding devices; and regulators and plant germination rates.

Quiz 2 (for self-assessment based on questions from Modules 3 and 4)

Module 5: Crop Scouting and Intercultural Operations (Preharvest Phase 4)

In module 5, crop scouting and intercultural operations are introduced from the conventional and smart application perspectives. Smart applications mainly focus on how to reduce chemical fertilizers using site-specific crop management and variable-rate application. Spraying and atomization of agricultural chemicals are introduced as an easier application method.

Contents: Crop scouting; intercultural operations: weeding, spraying, and fertilizer application; sprayer calibrations; sprayer components; and droplet-sized distribution.

Module 6: Harvesting, Yield Monitoring, and Transportation (Postharvest Phase 1)

Harvesting machinery of the head feeder type, reapers, and mini combines are examined from the Asian perspective. Harvesting, yield monitoring, and optimum moisture content for grains are discussed. Transportation logistics and postharvest losses are also addressed in this module. The focus is on smart applications based on combines equipped with monitoring and mapping capabilities.

Contents: Combine harvesters; types of harvesters, mini combines, and reapers; grain moisture contents; yield monitoring and mapping; transportation logistics; and smart applications of data sharing for harvested grains.

Quiz 3 (for self-assessment based on questions from Modules 5 and 6)

Module 7: Drying (Postharvest Phase 2)

The drying process and methods to reduce the water content of grains are introduced. Moisture content analysis, use of the Kubota Smart Assisted System, and onsite utilization of dryers are included in this module. Batch dryers, mechanical dryers, solar dryers, and other processes are described briefly.

Contents: Drying concepts; water activity; how moisture content affects grain quality; recent developments in drying with smart applications; and introduction to batch dryers, bin dryers, tunnel dryers, solar dryers, and sun-drying processes.

Module 8: Storage (Postharvest Phase 3)

Storage techniques and the preservation of grains including monitoring of grain quality are covered in module 8. Points to ensure safe grain storage are explained.

Contents: Storage principles; silos; air movement; equilibrium moisture content; safety measures to avoid alfa toxin contamination during grain storage; IoT applications for monitoring grains and other crops during storage; and applications of mapping for yield production.

Quiz 4 (for self-assessment based on questions from Modules 7 and 8)

Module 9: Threshing, Parboiling, Milling, and Packaging (Postharvest Phase 4)
In this module, basic concepts of threshing, parboiling, milling, and packaging are introduced and opportunities for smart applications to ensure traceability are discussed. Threshing is important to reduce postharvest losses while separating rice grains from straw. Parboiling is popular in South Asian countries, especially for *Indica* rice. Milling is another significant process for shaping rice kernels and minimizing postharvest losses. Packaging, which is important to improve supply chain functions and ensure food safety, is discussed along with smart applications for traceability.

Contents: Threshing machines; power trains for threshing; threshing capacity and estimating losses; parboiling; milling of grains; milling equipment; and packaging of grains and

traceability of products.

Module 10: Farm Mechanization as a Business

This module discusses the entrepreneurship concept with the contract hiring of agricultural machinery and smart applications in agriculture from the Asian perspective. Agribusiness models based on machinery hiring are described as methods to reduce farm labor requirements, along with shared machine utilization through cooperatives or personal initiatives.

Contents: Farm mechanization practices in agribusiness and setting up profitable enterprises; contract hiring of agricultural machinery; machinery markets; the IoT with farm mechanization; and case studies.

Quiz 5 (for self-assessment based on questions from Modules 9 and 10)

Module 11: Final Examination

This course consists of self-learning e-modules. The modules are supplemented with additional learning materials for participants, quizzes for self-assessment, assignments, and a final examination to earn the APO certificate.

11. Qualifications of Candidates

The target participants are entrepreneurs, agricultural extension officers, managers of SMEs involved in farm machinery development who want to scale up their businesses, and consultants, trainers, or other professionals in charge of developing and promoting farm machinery and mechanization.

12. Eligibility for e-Certificate

A minimum score of 70% on the final examination is required to qualify for the APO e-certificate.

Note: Participants from nonmember countries are welcome to take the course for self-development, although APO e-certificates will not be provided.

Dr. Santhi Kanoktanaporn
Secretary-General