Agriculture 4.0: Equipping young NEETs with basic & advanced digital and green skills

Module 8

Digital Farming: Driving productivity and a more sustainable way of farming

Developed by

BALKAN BRIDGE

Disclaimer:

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1. Introduction

Following the analysis of the findings from the literature review and field research activities there is a strong need to train and upgrade rural young people to become attractive, employable and to take up central positions in the circular and regenerative economy.

Adapted training material will be further described and developed for practical implementation within our project. The training material will provide young / women NEETs with a package of digital learning resources designed based on the concept of micro-learning: short and coherent learning nuggets delivered in multimedia formats aiming to promote blended learning methodologies. The digital learning nuggets will include a variety of resources such as interactive games, podcasts, e-learning videos, interactive case studies, infographic resources, etc.

2. Content

Main objectives

- Introducing the Digital Farming as a solution to the nowadays challenges that Agriculture face
- Providing the target group with fundamental knowledge of the main tools used in the Sustainable Farming

Learning contents

The module consists of 5 submodules:

8.1 Sustainable Farm Management

8.2 Knowledge and Information Services

8.3 Digital Farmer Profiling Platforms and Services

8.4 Digital Technology and Sustainable Agriculture: “Fog computing model” and Organic pesticides

8.5 WUE (Water Use Efficiency/Effectiveness): Definitions and key formula

Learning outcomes

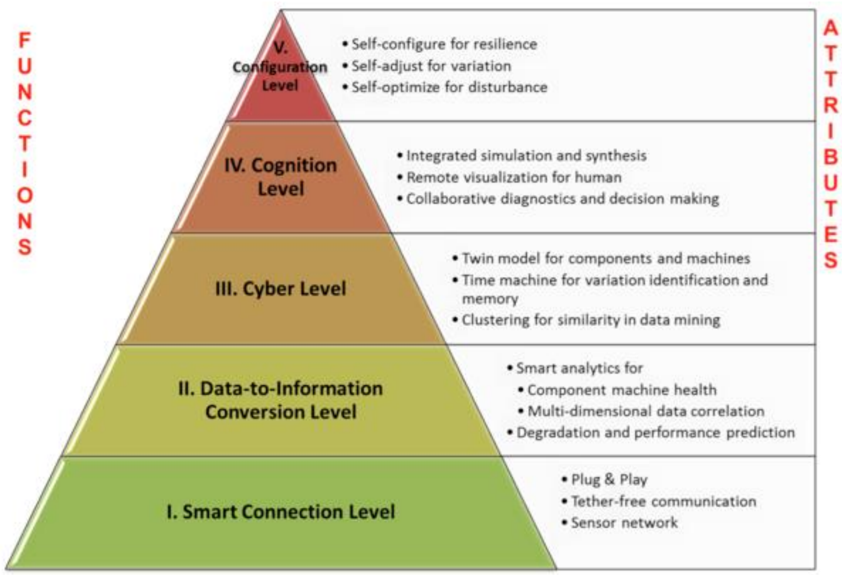
Target group will gain knowledge of the essential aspects of Agriculture 4.0 emphasizing its sustainable approach. Learning outcomes:

- Knowledge of tools for prevention the development of unhealthy soil by monitoring soil moisture and humidity, nutrient levels, temperature, and acidity
- Mobile applications to disseminate different crops and livestock information
- Platform service managing farmers’ data
- Examples of Bio pesticides and herbicides that are used in alignment with European legislation
- Introduction to the “Fog computing model”
- WUE (Water Use Efficiency) importance]

Sustainable Farm Management

Agriculture depends to a large extent on the services provided by ecosystems. Sustainable agriculture approaches, therefore focus on optimizing production while minimizing negative environmental impacts and promoting actions for the protection, conservation, enhancement and efficient use of natural resources.

Industry 4.0 digital transformation in agriculture integrates IoT (Internet Of Things), cyber-physical systems, AI, Big Data, Machine Learning and Cloud computing with agricultural machinery. It is more common to precision agriculture whereby innovative ICT solutions and IoT components such as sensors monitor spatial and temporal variability in farm production. Site-specific farm management provides an understanding of soil and crop characteristics unique to each field, thus enabling farmers to apply farm inputs (such as irrigation, fertilizers, pesticides and herbicides) in small portions where needed for the most economical production.



The sustainability of a farm depends on effectively integrating a diversity of plant and animal systems to create farming systems that accommodate the preferences of farmers and their families, as well as meet societal and economic needs of the communities and societies within which and for which they function.

Also, the sustainable farm must be managed holistically, as an integrated system rather than a collection of specialized components and functions. Holistic Management, a decision-making process developed by Alan Savory, provides the most clearly-defined process for sustainable farm or ranch management.

The management process begins by defining the "Whole Under Management," or span of management control. The purpose of the particular farming operation is defined by a holistic, three-part quality of life, production, and resource goal—consistent with the social, economic, and ecological dimensions of sustainability. The basic principles or laws of nature that govern sustainable systems are reflected in ecosystem processes of community dynamics, water cycles, mineral cycles, and energy flow. These principles must be respected in all farm management decisions.

The management process then moves to various tools for planning and managing the farm's agroecosystem and guidelines for managing the social and economic functions of the whole-farm system. Next comes specific guidelines for managing the spatial and temporal arrangement of the diverse components of the sustainable farming system. Spatial arrangements of enterprises are changed or rotated over time so that each enterprise benefits from and provides benefits to whatever preceded and follows it in the systematic rotation. Crop rotations, intercropping, cover crops, rotational grazing, multispecies gazing, are all examples of spatial and temporal relationships that can be managed for agricultural sustainability.

Knowledge and Information Services

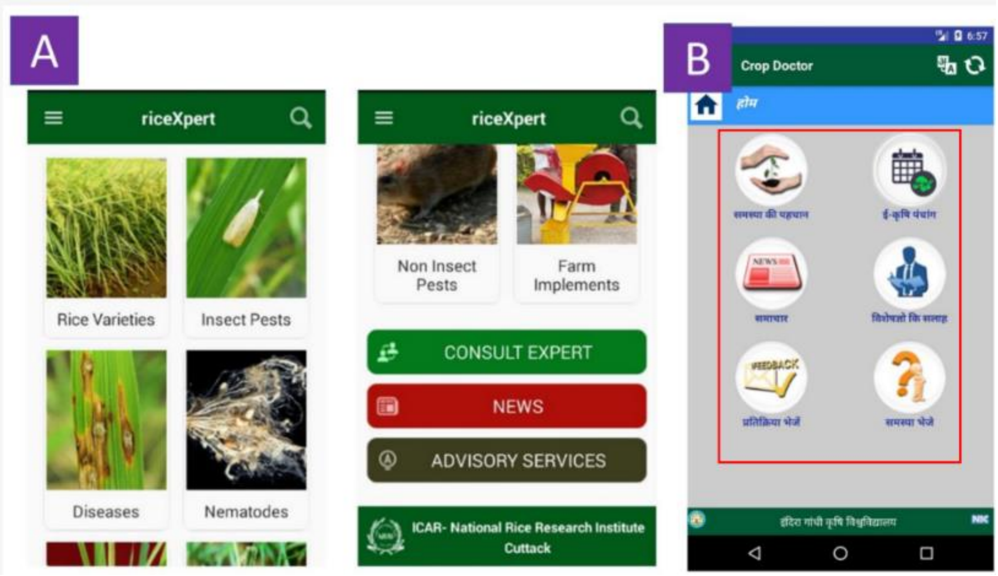
Knowledge and Information Services include the essential for the sector of Agriculture disseminating information to most rural smallholder farmers through ICT, including management information systems, knowledge management systems and expert systems. The existing farmers' applications cover various agriculture-related sectors, including horticulture, livestock management, farm management, irrigation monitoring, soil health monitoring and agricultural marketing.

Common features of smartphone applications available to farmers:

Weather forecast: The Meghdoot application provides information to farmers on weather and cloud formation detected by satellite sensors that will help in planning their farming practices;

Crop pest and disease diagnosis: The recommendations to mitigate and prevent major pest and disease infestations and nutritional deficiencies through the uploading of the specific crop's image. As shown in Figure above, riceXpert and Crop Doctor applications deliver solutions to the farmers' problems through expert knowledge reviewed by entomologists and pathologists along with preloaded photographs and recommendations.

Figure 2. Well-known farmer smartphone applications (**A**) riceXpert and (**B**) Crop Doctor. The Crop Doctor application is available in both Hindi and English. It assists Indian farmers in crop protection by providing information on pests, diseases, and nutritional deficiencies. (Figures are taken from their respective application play store page. The access link is given in **Table 3**).



Other popular mobile applications to disseminate different crops and livestock information are: Krishi Vigyan, KVK Mobile App, Krishi Kisan, and Mobile Farm Solutions (Q&A) They assist in disseminating agriculture-related information to the farmers and connecting them with KVKs and educational institutions.

Digital Farmer Profiling Platforms and Services

Platform service managing farmers' data based on blockchain technology to allow farmers to share their data with other stakeholders (such as credit and insurance companies), such platforms shall be described further in the following section:

CGIAR Big Data Platform in Agriculture

In late 2017, during the First Annual CGIAR Convention on Big Data in Agriculture, CGIAR revealed the prototype of a searchable CGIAR-wide data harvester. CGIAR recognized that as many as 185,000 surveys are conducted each year within their own network of affiliated research institutes (Brian King, 2017). They needed a platform to organize their own data and make it discoverable, re-usable, and interoperable.

i2i Data Portal

i2i, a global resource center that seeks to improve financial inclusion through the smarter use of data, was launched in 2015 and is jointly hosted by Cenfri and FinMark Trust. It is funded by the Bill & Melinda Gates Foundation in partnership with The MasterCard Foundation. i2i launched their i2i Data Portal to share insights from the CGAP Smallholder Farmer Diaries and other national survey data. i2i intends to make additional relevant datasets and tools publicly available through this data portal.

Smallholder Finance Product Explorer

In 2017, the MIX Market, One Acre Fund, and the RAF Learning Lab collaborated on the design of a data framework to categorize a diverse set of smallholder finance products and allow comparison and benchmarking of financial products. Currently in beta form, the Smallholder Finance Product Explorer provides information from nearly 30 financial services providers in ten countries. They plan to continue to add to the Explorer database as other smallholder finance providers share their data. This will enable greater learning by all database users, with the goal of reducing the financing gap for smallholder farmers.

Global Open Data for Agriculture and Nutrition (GODAN)

GODAN was launched in 2013 and has nine core partners: US Government, the UK Department for International Development, the Government of the Netherlands, FAO, CTA, Global Forum on Agriculture Research, The Open Data Institute, CGIAR, and the Centre for Agriculture and Biosciences International. Most efforts by GODAN have been to build high-level support for open data among governments, policymakers, international organizations, and businesses. A recent effort by GODAN and other actors has been to launch a beta version of the Agriculture Open Data Package (AgPack) which aims to help provide governments with a roadmap to publish agriculture data as open data Most recently, USAID, DFID, and the Bill & Melinda Gates Foundation launched a joint effort (as funders of international agricultural research) to develop more harmonized approaches towards open data.

Digital Technology and Sustainable Agriculture: "Fog computing model" and Organic pesticides

High level of sustainability using the most cutting-edge technology to control farm inputs such as fertilizers, irrigation, herbicides and pesticides improving product quality, reducing input cost. Agricultural operations and business models for increased profit while minimizing the use of agrochemicals to promote a healthy environment and higher production quality. The submodule will provide examples of some Botanical Pesticides for Organic Farming:

1) Neem

Neem is a botanical pesticide derived from the neem tree, a native of India. This tree supplies at least two compounds, azadirachtin and salannin, that have insecticidal activity and other unknown compounds with fungicidal activity. The use of this compound is new in the United States, but neem has been used for more than 4,000 years for medicinal and pest control purposes in India and Africa. It is not highly toxic to mammals.

2) Nicotine Sulphate

Nicotine is extracted from tobacco or related Nicotiana species and is one of the oldest botanical insecticides in use today. It's also one of the most toxic to warm-blooded animals and it's readily absorbed through the skin. (Wear gloves when applying it, follow label directions and keep pets away from application areas.) It breaks down quickly, however, so it is legally acceptable to use on organically grown crops.

3) Sabadilla

Sabadilla, another botanical insecticide, is derived from the seeds of the sabadilla lily. The active ingredient is an alkaloid known as veratrine. Sabadilla is considered among the least toxic of botanical insecticides, but its dust can be highly irritating to the eyes and can produce sneezing if inhaled. No residue is left after application of sabadilla because it breaks down rapidly in the sunlight.

4) Rotenone

Rotenone is a resinous compound produced by the roots of two members of the Leguminoceae family. Its common use is to control various leaf-feeding caterpillars, beetles, aphids and thrips on a wide variety of vegetables and small fruits. A slow-acting chemical, rotenone requires several days to kill most susceptible insects, but insect feeding stops shortly after exposure.

5) Pyrethrum/Pyrethrins

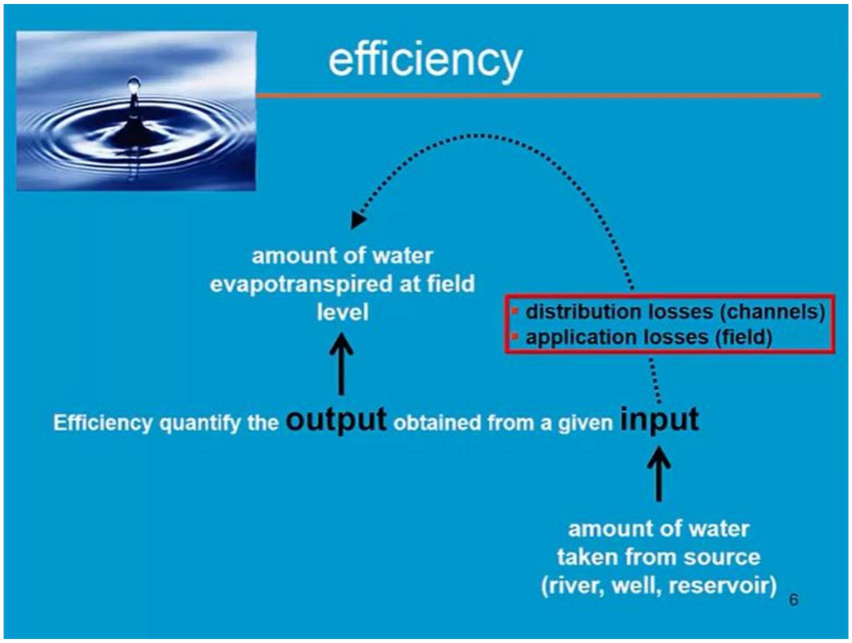
Pyrethrum is the most widely used botanical insecticide in the United States. The active ingredient, pyrethrin, is extracted from a chrysanthemum plant, grown primarily in Kenya, Rwanda, Tanzania and Ecuador. Most insects are highly susceptible to pyrethrin at very low concentrations. The compound acts rapidly on insects, causing immediate knock down. Flying insects drop almost immediately after exposure. Fast knock down and insect death don't, however, always go hand in hand; many insects recover after the initial knockdown phase.

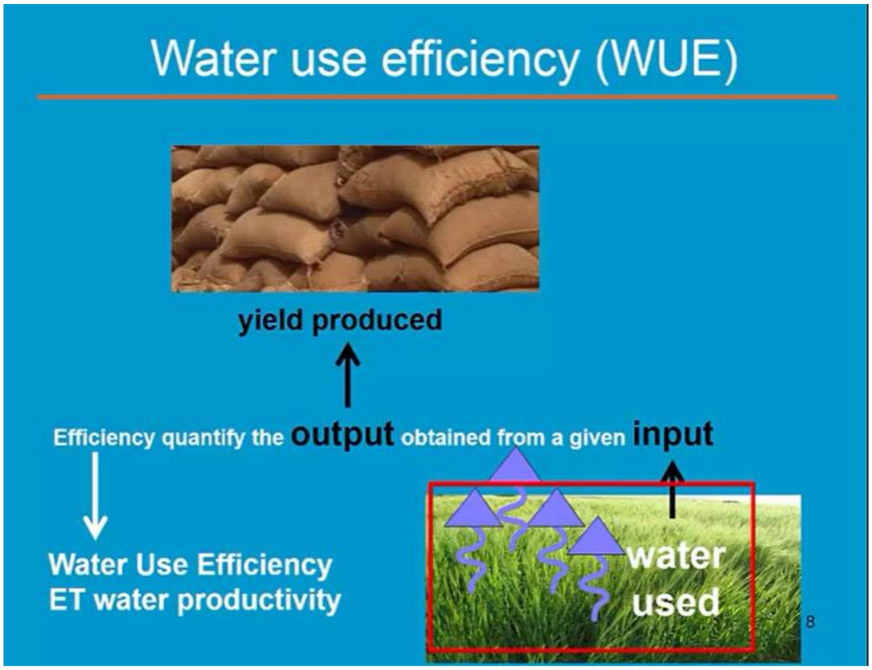
"**Fog computing model**" is useful for a clean environment in smart agriculture. Unlike cloud computing, the fog computing model reduces carbon emissions through energy-efficient digital hardware and renewable energy resources since data are processed closer to where it is collected. Fog computing aims to push processing capabilities closer to target consumers, prevent overuse of cloud resources, and further reduce operational loads. The proposed approach to fog computing is applicable to the evolving field of precision agriculture, along with all agricultural land management strategies.

WUE (Water Use Efficiency/Effectiveness) - Definitions and key formula

WUE is basically defined at an input/output ratio as a measure of productivity. Main aspects such as Improving Management Capacity; Scientific Irrigation Scheduling; Managed Deficit Irrigations and Full Season Drought Management are a combination of better water management and drought-tolerant varieties that could greatly enhance the crops' resilience in future climates and enable its cultivation in regions where little or no food is currently grown, or during dry months when farmland now lays fallow.

WUE is calculated by dividing 'annual water usage' by the 'energy consumption of the IT computing equipment' The units of WUE are liters/kilowatt-hour (L/kWh).





In irrigation, Water Use Efficiency (WUE) represents the ratio between effective water use and actual water withdrawal. It characterizes, in a specific process, how effective is the use of water.

Efficiency is scale and process dependent. Along a canal, the conveyance efficiency is the ratio between the volume of water at delivery points and inflow at entrance. At field level, effective water use is the water transpired by the crop and some other special requirements (land preparation, salt leaching). Runoff, deep percolation and evaporation from bare soil or standing water in paddy fields, are losses.

Methodology – activities

https://www.youtube.com/watch?v=iloAQmroRK0

https://www.youtube.com/watch?v=xFqecEtdGZ0

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