НАЦИОНАЛНА АГЕНЦИЈА ЗА ЕВРОПСКИ ОБРАЗОВНИ ПРОГРАМИ И МОБИЛНОСТ

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Innovative training
Augmented reality for green food

PROJECT RESULT 1
MODULE 1
PRACTICES TO MANAGE BIODIVERSITY IN THE AGRICULTURAL FIELD

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Introduction

Organic agriculture is an integrated production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity (FAO/WHO Codex Alimentarius Commission, 2007). It emphasizes the use of natural inputs (i.e. mineral and products derived from plants) and the renunciation of synthetic fertilizers and pesticides. Organic agriculture follows the principles and logic of a living organism, in which all elements (soil, plant, farm animals, insects, the farmer and local conditions) are closely linked to each other. This is accomplished by using, where possible, agronomic, biological and mechanical methods, following the principles of these interactions, using natural ecosystem as a model.

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Introduction

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This course introduces the learners to the skills, strategies and advice on farming methods to grow organic foods. Whether they want to grow their own vegetable garden or do it on behalf of someone else, this course will be of great help. Learners will be able to a position to grow their favourite vegetables on their own. They will be able to define important terms in relation to the natural characteristics of an area and know how to identify biodiversity information needs and gaps. This course aims to provide an overview of the diversity of life, the evolutionary relationships between organisms, and the ecology of species, populations, and ecosystems.

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Introduction

The course will be an essential platform for more detailed study of evolution and ecology later on in degree courses. This module deals with the key Biodiversity and Conservation issues and will contribute to an understanding of the scientific processes that underpin much of conservation and ecology. The module particularly focuses on global biodiversity, measuring biodiversity, threats to biodiversity and how biodiversity can be conserved.

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Overview

The importance of this topic in sustainable agriculture and the potential impact of augmented reality technologies will be highlighted. In organic production, a good understanding of the natural environment surrounding and constituting farms is key to being successful. A fairly good knowledge of organic production standards and regulations as well as of the markets that host these standards is very important for meeting market obligations and getting products to the marketplace. This is true for successful organic farmers in developed or developing countries, whether small, medium or big. Organic farming is a highly professional activity and, as such, it takes study and practice to master before farmers can be fully prepared to do it successfully. This is highly challenging because, in the meantime, farmers must continue to make their living based on agricultural production.

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Overview

Learning to farm organically is a process that can take several years. Fortunately, as more and more farmers have successfully met this challenge, there is now plenty of information on the key elements to take into consideration when embarking on an organic initiative. This module presents an overall vision of the key factors that an organic farmer needs to know, and plan for, when converting to organic production. These issues include options for production methods, ways to plan and implement the conversion process, the most common challenges during the conversion period, the importance of quality assurance in organic products and the role of certification within the context of the organic markets. With a good grasp of the issues laid out in this module, anyone planning to take on the challenge of starting up an organic venture should be well prepared for avoiding the mistakes that have riled organic enterprises in the past.

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Overview

Organic farming requires study and practise in order to be successfully pursued and this module is designed to address that fact. At a scientific level, there are several different “schools” of organic farming that have developed an ample selection of technologies and methods. In addition, an immense quantity of local and indigenous farming methods and techniques, successfully developed and applied in developing countries for many centuries, are indeed organic. The conversion period is a key factor in attaining success, especially in addressing the adjustment of the agro-ecological system back to a natural balance.

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Overview

Before commencing the transition to organic, it is important to have a general understanding of organic agriculture, the aspects that distinguish it from other farming systems, and the efforts required in conversion. An interested party should take into consideration:

Potential markets;

- Standards and regulations in those markets;
- Necessary modifications to the current production
- System;
- Support possibilities.

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Objectives

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- To improve the basic and applied concepts and knowledge of food quality and processing applied to raw materials produced according to organic practices
- To enhance technical knowledge required to optimize process and technologies to organic raw materials of organic production and the factors that need to be taken into account.

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Objectives

- To develop knowledge and skills on food quality criteria applied to organic produce Implement modern sustainability concepts
- To know the importance of understanding the legal context for conservation management.
- To know the main elements of the legal framework that underpins biodiversity conservation nationally and internationally.

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Objectives

- To know the various national and international categories and designations that can apply to protected areas, and how they affect biodiversity conservation
- To understand the meaning of the term ‘stakeholder’ and the roles that various stakeholders can plan in biodiversity conservation management.
- To understand the meaning of the term ‘governance’ and the relevance of governance to biodiversity conservation.

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Objectives

- To define key terms relevant to applied biodiversity conservation.
- To know the main elements of a protected area management plan and planning process

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Objectives

By achieving the learning objectives, this module enhances understanding of sustainability in food value chains, emphasizing environmental and cost considerations in food processing. Proficiency in Life Cycle Analysis for organic food evaluation, awareness of organic food distinctions, and exploration of augmented reality applications in green food production are key goals.

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Unit 1
Biodiversity in Agriculture
Meaning and Importance

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1.1. Meaning and Importance of the Biodiversity

In this section, learners will learn about biodiversity in general and how and why biodiversity management should be implemented. They will receive an overview and description of various measures as well as the difference between good and very good practices and their significance for biodiversity. Biodiversity is the basis of agriculture. Its maintenance is essential for the production of food and other agricultural goods and the benefits these provide to humanity, including food security, nutrition and livelihoods.

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Biodiversity is the origin of all crops and domesticated livestock and the variety within them. Biodiversity in agricultural and associated landscapes provides and maintains ecosystem services essential to agriculture. Agriculture contributes to conservation and sustainable use of biodiversity but is also a major driver of biodiversity loss. Farmers and agricultural producers are custodians of agricultural biodiversity and possess the knowledge needed to manage and sustain it.

Sustainable agriculture both promotes and is enhanced by biodiversity. Sustainable agriculture uses water, land and nutrients efficiently, while producing lasting economic and social benefits. Barriers inhibiting its widespread adoption need to be reduced.

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Agricultural producers respond to consumer demands and government policies. To ensure food security, adequate nutrition and stable livelihoods for all, now and in the future, we must increase food production while adopting sustainable and efficient agriculture, sustainable consumption, and landscape level planning that ensure the preservation of biodiversity.

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From the products we buy to the food we consume, agricultural production is an integral part of everyone’s life. Agriculture provides humans with food and raw materials for goods such as cotton for clothing, wood for shelter and fuel, roots for medicines, and materials for biofuels and with incomes and livelihoods, including those derived from subsistence farming. Worldwide there is now a huge diversity of agricultural systems ranging, for example, from rice paddies of Asia, to dry land pastoral systems of Africa, and hill farms in the mountains of South America.

Biodiversity is the source of the plants and animals that form the basis of agriculture and the immense variety within each crop and livestock species. Countless other species contribute to the essential ecological functions upon which agriculture depends, including soil services and water cycling.

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However, the Earth's biodiversity is being lost at an alarming rate, putting in jeopardy the sustainability of ecosystem services and agriculture, and their ability to adapt to changing conditions. The conservation and sustainable use of biodiversity is essential for the future of agriculture and humanity. At the same time, since agricultural lands extend across such a considerable proportion of the Earth's surface and harbour significant biodiversity, the conservation of biodiversity within agricultural landscapes must play an important part in global conservation strategies.

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As custodians of land and natural resources, including biodiversity, farmers and agricultural producers manage agricultural biodiversity and their associated landscapes. Generally, managers of biodiversity aim to achieve sustainability to preserve resources for future generations. Where this does not occur, the root causes often lie outside their control.

Farmers and producers are allies in global efforts to manage biodiversity better. Agricultural livelihoods are based on the use of agricultural produce directly for subsistence and, or, on income derived from work and produce.

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Agricultural livelihoods are the oldest mode of humans' subsistence and remain the principal form of livelihood in many regions today. A major challenge will be to increase agricultural production over the coming decades to adequately feed the growing world population and meet the rising expectations of economically improving societies.

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Biodiversity is the variability among living organisms and the ecological complexes of which they are part, including diversity within species (genetic diversity), between species, and of ecosystems. A description of each of these three levels of biodiversity is provided in the first column of Table I. Biodiversity provides both the basis of agriculture the species and genetic variation of crops and livestock and, through its role in ecosystem functions and services, the underpinning of production.

Agricultural biodiversity is a term that includes all components of biodiversity at genetic, species and ecosystem levels that are relevant to food and agriculture and that support the ecosystems in which agriculture occurs (agro ecosystems).

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This includes the crop and livestock species, and the varieties and breeds within these, and also includes those components that support agricultural production. Components at the species level that support ecosystem services include earthworms and fungi that contribute to availability and cycling of plant nutrients through the breakdown and decomposition of organic material. Examples of agricultural biodiversity, at each level of biodiversity, are provided in Table I.

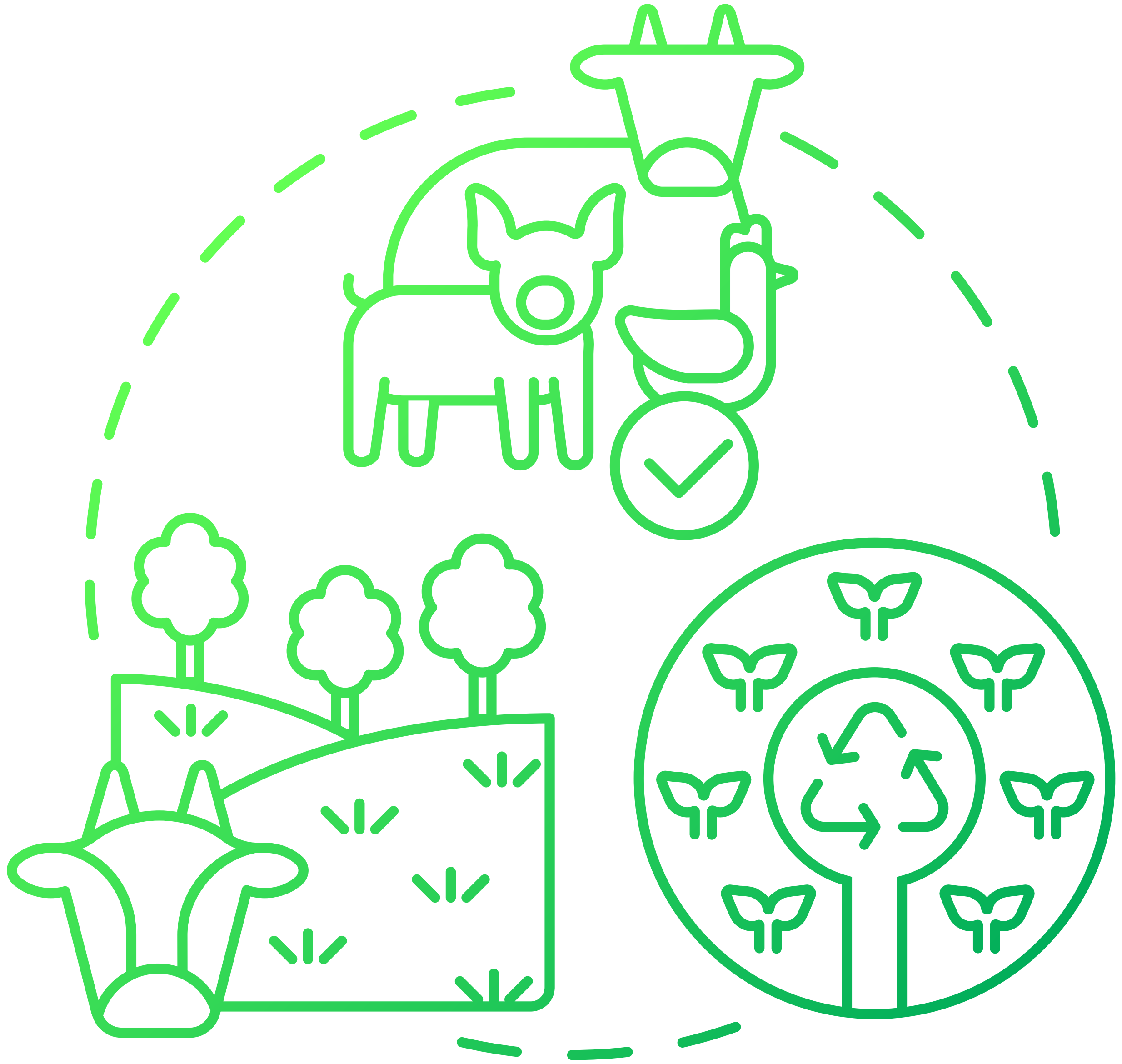

Table 1. BIODIVERSITY AND AGRICULTURAL BIODOVERSITY

Biodiversity	Agricultural Biodiversity
An ecosystem is a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. Different types of eco-systems includeforests, grasslands, wetlands, mountains, costal areas, lakes and deserts.	The diversity of agro-ecosystems partly results from both agricultural land and water uses. Examples of agro-ecosystems include rice paddies, pastoral systems, aquanculture systems, and cropping systems and the broader ecosystems within which these are based. Elements of these systems may be combined to form mixed systems.

Table 1. BIODIVERSITY AND AGRICULTURAL BIODOVERSITY

Biodiversity	Agricultural Biodiversity
A species is a group of morphologically similar ogranisms that are able to interbreed and produce fertile off-spring. A diverse number of species exists for plants, animals and micro-organisms.	The diversity of plants and animals used in agriculture resulted from human management of biodiversity for food, nutrition and medicinal purposes. For example, domesticated livestock include cattle, sheep, chickens, and goats. Examples of crop species include wheat, banana, cabbage, sweet potato, and ground nuts.

Table 1. BIODIVERSITY AND AGRICULTURAL BIODOVERSITY

Biodiversity	Agricultural Biodiversity
Genetic diversity is the variation of genes for all individuals within a species; it determines the uniqueness of each individual, or population, within the species. The expression of DNA into traits, such as the ability to tolerate drought or frost, facilitates adaptation to changing conditions.	The diversity within species partly results from the selection by farmers based on specific traits to meet environmental and other conditions. For example, many varieties of corn, or maize, have been developed based on such traits such as taste, height, color and productivity. Many of these are now maintained as distinct populations entirely within agriculture.

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Key Points

Biodiversity in agricultural and associated landscapes delivers and maintains key ecosystem services to agriculture.

Agriculture helps to biodiversity protection and sustainable usage, but it is also a major cause of biodiversity loss.

Biodiversity is the source of all crops and domesticated livestock, as well as their variation.

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Key Points

Agricultural lives are based on either directly using agricultural produce for sustenance or on revenue gained from work and produce.

Farmers and agricultural producers are agricultural biodiversity stewards with the knowledge to manage and sustain it.

Distinguish between biodiversity and agricultural biodiversity.

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Unit 2

Development of Digital Competencies for Farmers and Educators/ Tools and Applications for Biodiversity Management

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This is important to ensure that the farmers get to know the latest information and technology to breed their plants and crops progressively. Everyone needs to have practical skills in using technology to access, manage, manipulate and create information in an ethical and sustainable way. It is a continual learning process because of constant new applications and updates are conducted from time to time. The current trend which are using the digital platforms in delivering information to the society makes everyone realize that the basic information skills are very much needed to be obtained.

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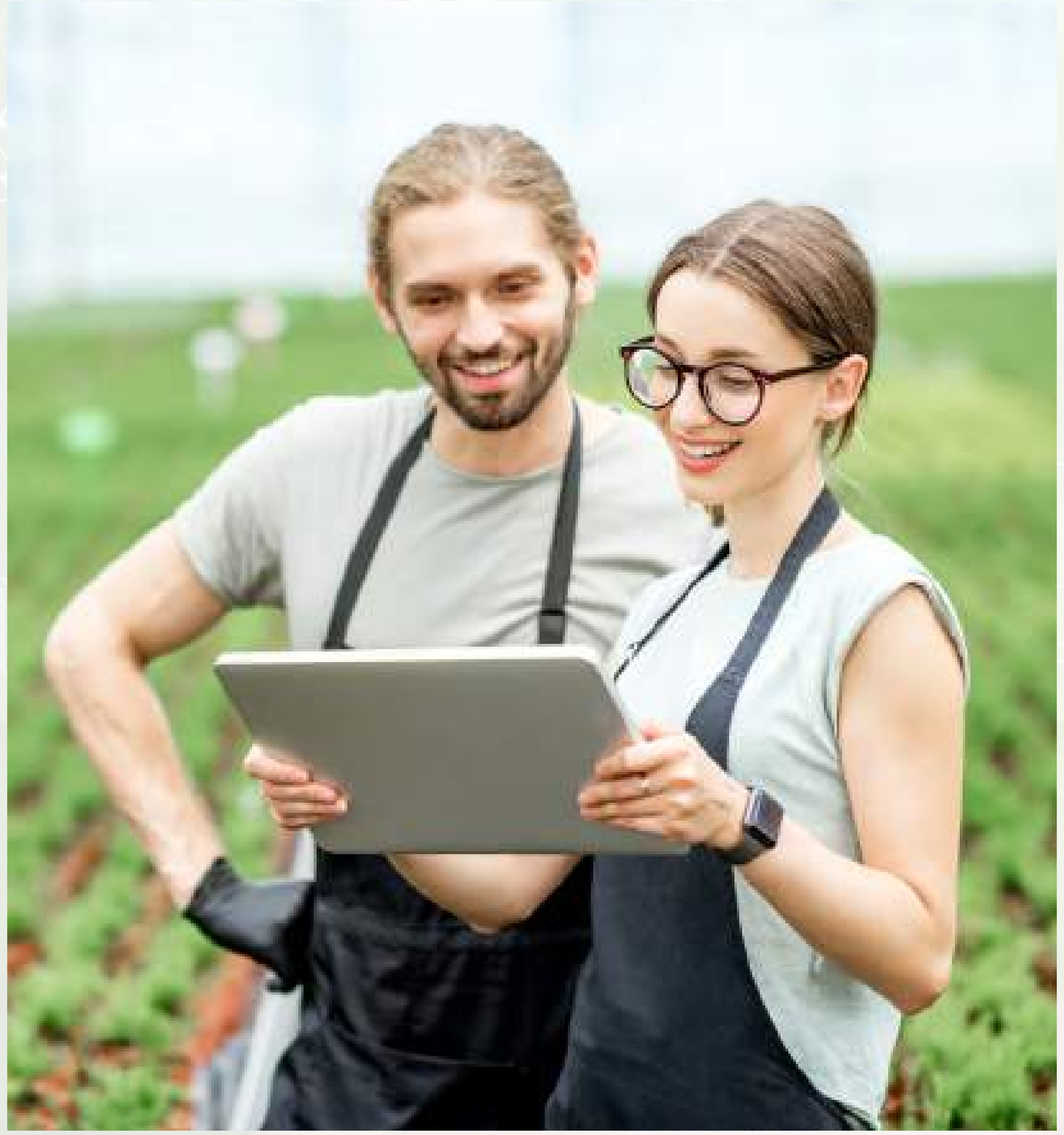
Same goes to the digital agricultural information that would be used by the farmers all over the world. Some of the countries in the modern world have already employ the technology in enhancing their crop's plantations from small to a huge scale of trading. Basic digital literacy must be acquired by the farmers to materialize this effort. Then only the sustainability of the food security in various places can be extended globally. Each farmer has different skills and experience into adoption of smart agriculture technologies. They need to be trained and educate towards the latest basic technology.



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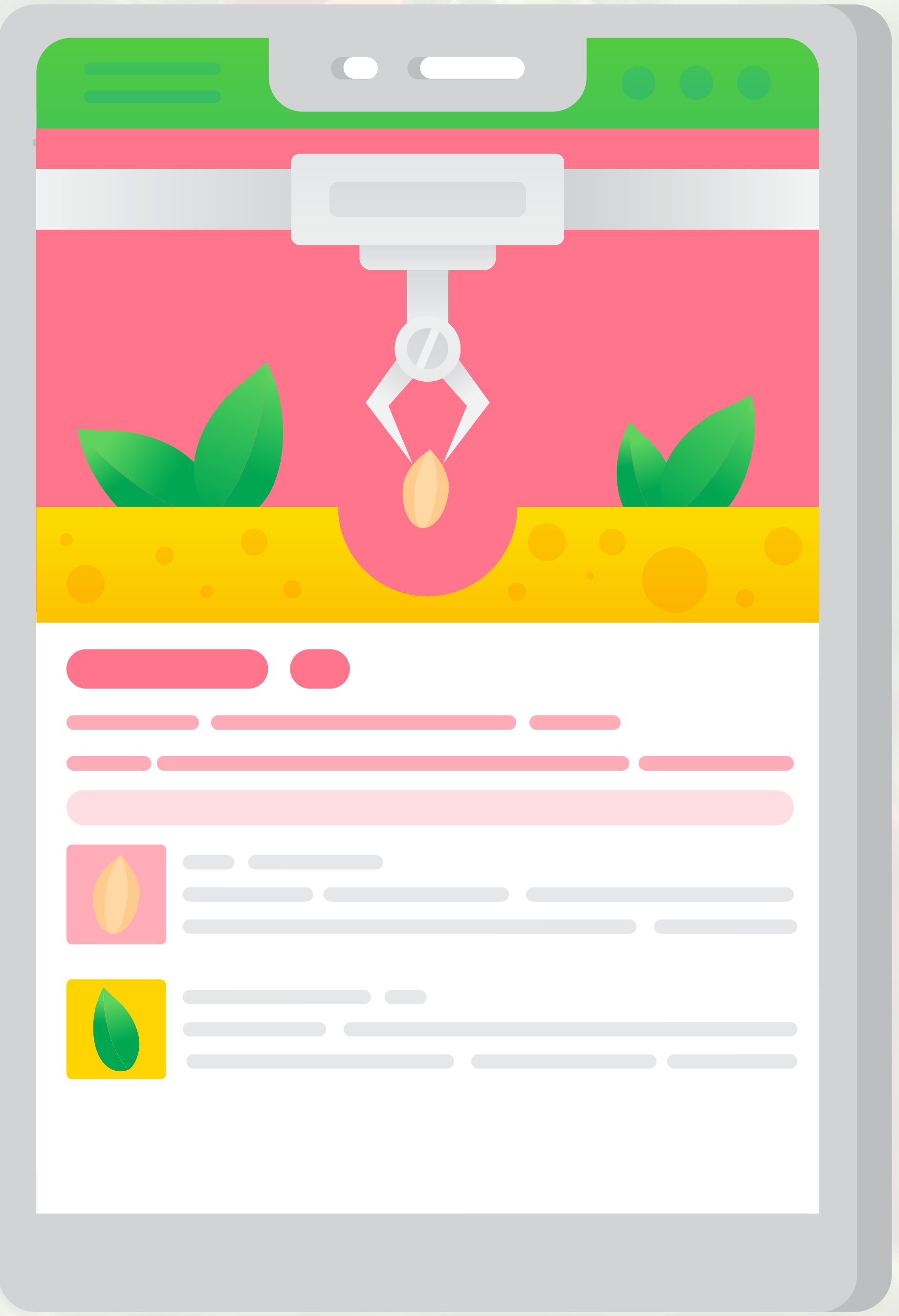
2.1. 4 Principles of Digital Literacy



Heick (2013) informs that digital literacy is related to the ability to make sense of digital media. This happens through expressive and supportable intake and curation patterns that increase an individual's prospective to add to a genuine community. In ensuring this to happen, the community should have the capability to analyse, prioritize, and act upon the immeasurable digital media 21st century nations encounter on a daily basis.

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According to Heick, digital literacy can be divided into four (4) principles namely:

1. **Comprehension:** The first principle of digital literacy is simply comprehension – the ability to extract implicit and explicit ideas from a media.
2. **Interdependence:** The second principle of digital literacy is interdependence – how one media form connects with another, whether potentially, metaphorically, ideally, or literally. Little media is created with the purpose of isolation, and publishing is easier than ever before. Due to the sheer abundance of media, it is necessary that media forms not simply co-exist, but supplement one another.

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3. **Social Factors:** Sharing is no longer just a method of personal identity or distribution, but rather can create messages of its own. Who shares what to whom through what channels can not only determine the long-term success of the media, but can create organic ecosystems of sourcing, sharing, storing, and ultimately repackaging media.

4. **Curation:** Speaking of storing, overt storage of favored content through platforms such as pinterest, pearltrees, pocket and others is one method of “save to read later.” But more subtly, when a video is collected in a YouTube channel, a poem ends up in a blog post, or an infographic is pinned to pinterest or stored on a learnist board, that is also a kind of literacy as well – the ability to understand the value of information, and keep it in a way that makes it accessible and useful long-term.

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Elegant curation should resist data overload and other signs of “digital hoarding,” while also providing the potential for social curation – working together to find, collect, and organize great information.

Smart agriculture is a theory of management of modern farming using smart/digital techniques to monitor, to optimize, and to control progressions of agricultural production. To manage farm right now, the literacy in smart agricultural technologies is important so that farmers need to progress themselves to adopt smart technologies for farming.

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2.2. Tools and Applications for Biodiversity Management

For nearly 50 years, NatureServe has been developing standard methods for collecting and tracking the status of imperilled species and ecological systems, and tools that embody these methods.

- **Biodiversity Dashboards:** Dashboards are interactive tools that visualize the health and trends of biodiversity and track conservation performance at regional, national, basin, and site scales. The dashboards monitor the status of key biodiversity indicators for any part of the world, signalling both where and what conservation action is needed.

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Developed together with the Biodiversity Indicators Partnership (BIP) and UNEP-WCMC, the BIP Dashboard harnesses NatureServe's strengths in information technology and data visualization to allow exploration of progress in achieving the Aichi Biodiversity Targets of the Strategic Plan for Biodiversity

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- **iMapInvasives:** Invasive species pose a significant and growing threat to native biodiversity. They compete with native species for resources and often have no native predators to keep their numbers in check. Any large scale effort to protect biodiversity and the environment must be able to deal with the effects of invasive species. Early detection is often the key to successful eradication.

iMapInvasives is a cloud-based application for tracking and managing invasive species. Developed by NatureServe and partners in the iMapInvasives Network, it gives resource managers the power to know about the latest observations of an invasive species, in real time, so they can respond to new threats to the ecosystems they manage.

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With the newest release, iMapInvasives will share information with other invasive species mapping platforms, empowering decision-making at county, state, national, and international levels. Its tools assist citizen scientists and natural resource managers working to protect natural resources from the threat of invasive species.

iMapInvasives is an online, GIS-based data management system used to assist community scientists & natural resource professionals working to protect our natural resources from the threat of invasive species.

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iMapInvasives is an online, mobile-friendly, GIS-based data management system that is used for tracking and managing invasive species. iMapInvasives is used by natural resource professionals and citizen scientists to quickly and easily report information about invasive species.

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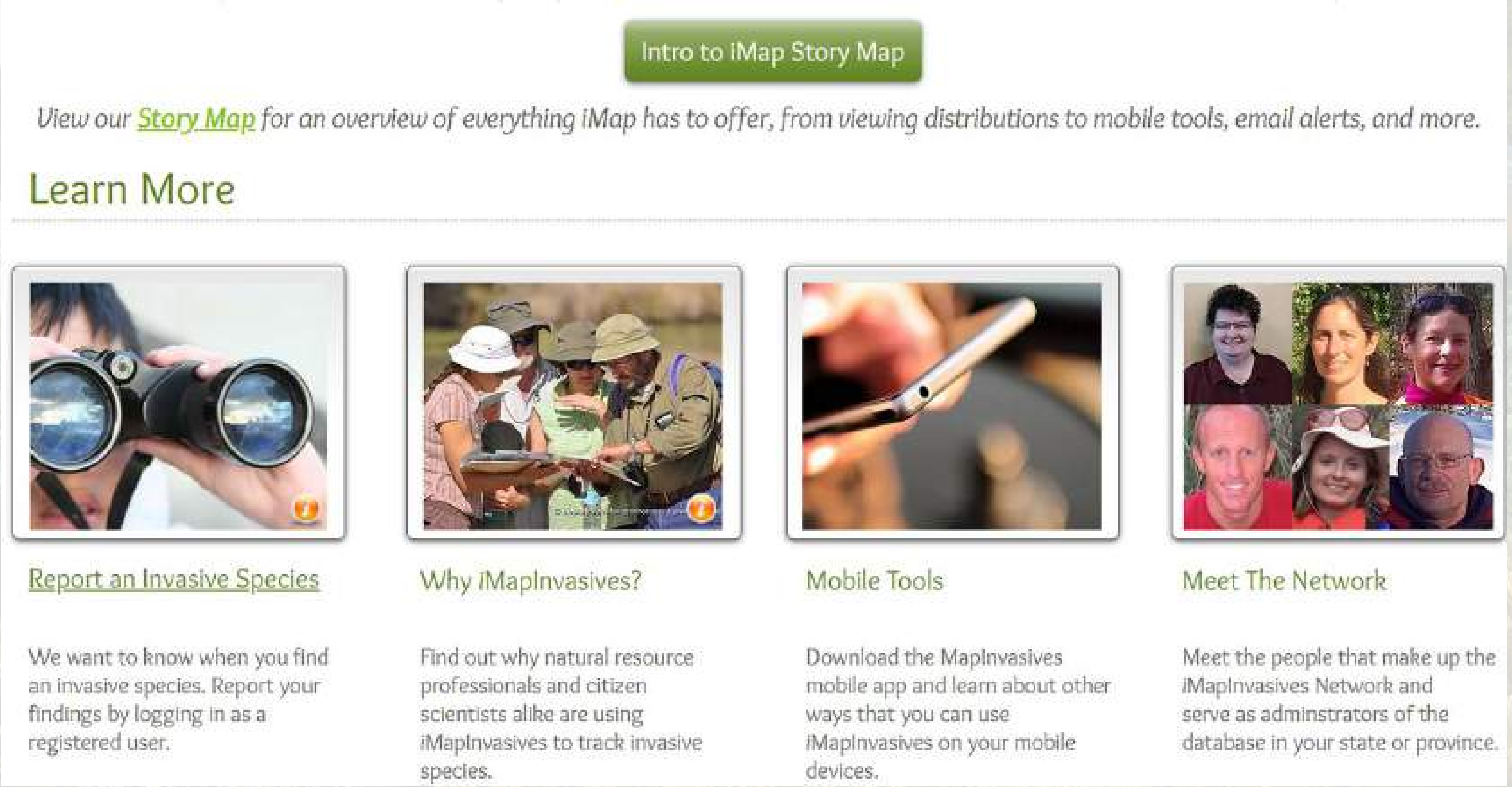

iMapInvasives is used by natural resource professionals and citizen scientists to quickly and easily report information about invasive species. The platform enables real-time tracking of infestations and improves management decisions to protect native species and ecosystems.

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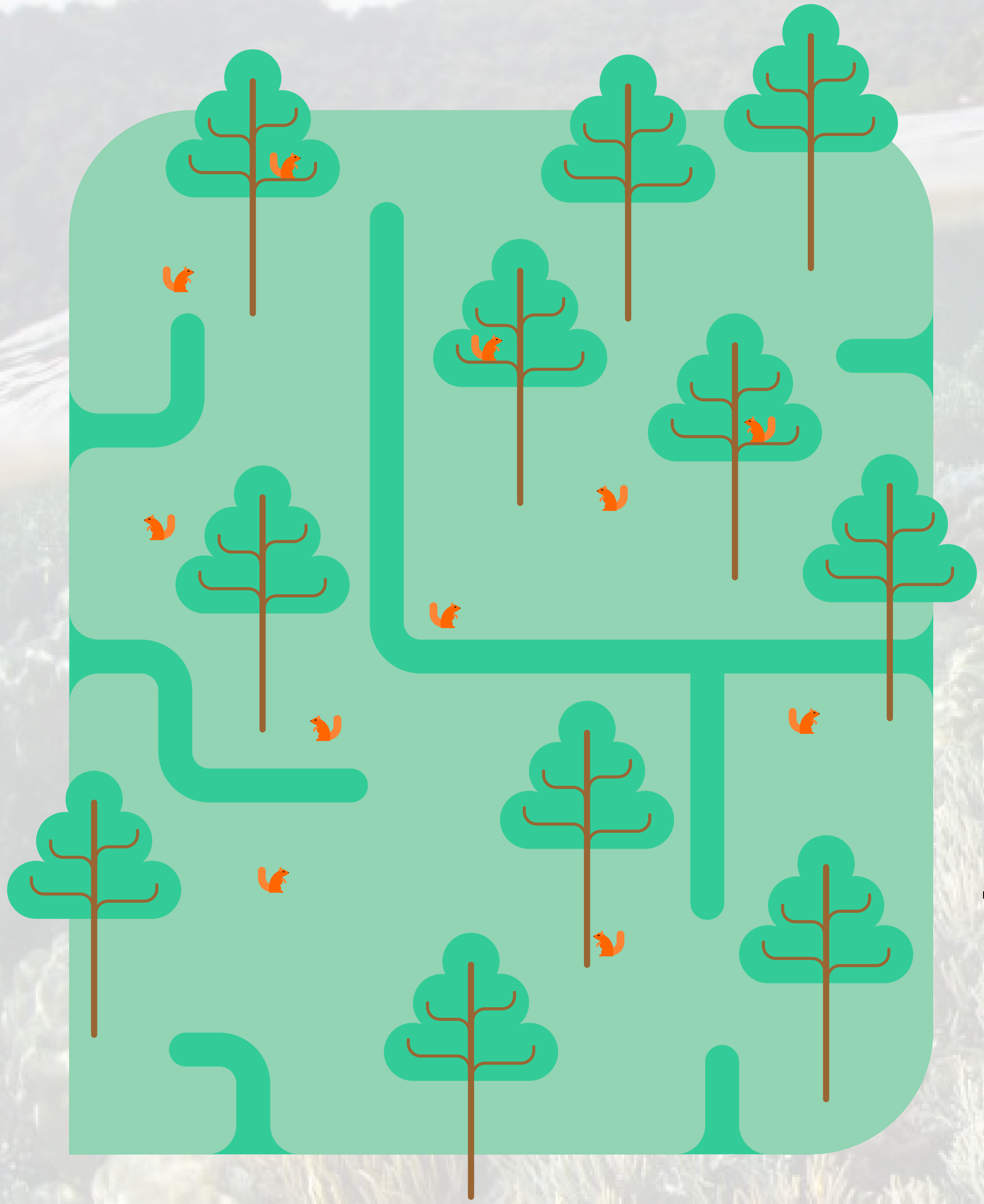

Since many regulatory and budgetary decisions about invasive species are made at the state or province level, each participating jurisdiction can customize their iMapInvasives platform, including the creation of custom species lists. You can learn more about iMapInvasives at http://www.imapinvasives.org . To sign up for a free account and explore the iMapInvasives application, visit imapinvasives.natureserve.org .

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2.3. Application Logic and Tools

OpenBioMaps is mostly used to digitize and manage biodiversity data collected in the field. Its toolkit follows the life cycle of the data and offers a range of customisable solutions at all levels (Fig. 1).

These levels are:

1. Database initialisation,
2. Filling the database with data,
3. Data curation and organisation,
4. Data processing and evaluation
5. Data sharing and supporting the publication process.

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Database Initialisation

- Deploying Servers
- Creating databases
- Designing data structures

Filling the database with data

- Submitting new observation data
- Import existing data

Data curation

- Validation
- Metadata
- Extending attributes

Processing data

- Local analysis tools
External analysis Tools

Sharing Data

- Supporting the publication process
- Sharing raw data

Fig. 1.
OpenBioMaps overview from a data lifecycle perspective

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1. Database projects with new custom structure and settings (access, visualisation, upload-forms) can be created via the Web UI. And can be maintained through a Web based system administrator application and there is and other Web UI application for the project management.

2. Data collection is supported by a mobile application that allows offline data collection for Android and iPhone users. The mobile application manages data collection forms according to the settings of individual database projects and can display the collected data. Data collected by other tools can also be uploaded through the Web UI, also using customisable forms that allows for the processing of various files.

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3. Once uploaded, the data can be further organised and transformed (e.g. validation, extending attributes, adding metadata) automatically using background processes (any kind of non-interactive software can be integrated as a background job), or manully using map or data filters and modification tools.

4. Data stored in the database can be accessed from Postgres/Postgis client applications and the map data can be accessed by WMS, WFS clients. All the stored data can be accessed with external tools through OBM API which let users integrate the data workflow into external applications.

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There is an OBM R package that makes data access easy and scriptable in an R environment, and a built-in R Shiny application interface that helps to review the contents of data tables using interactive charts. Also, there is an interface to run analysis remotely, managing access to distributed computing capacity and providing tool support for computationally intensive analyses.

5.Web UI provides interface to place analyses files, processed data or raw data in remote repositories with detailed metadata to support publication tasks. Web UI also provides interface with persistent identifiers for raw data sharing. These features help improve the data find ability and, while also, opens the way towards the reusability.

Key Points

Interdependence how one media form connects with another, whether potentially, metaphorically, ideally, or literally.

Social Factors can create organic ecosystems of sourcing, sharing, storing, and ultimately repackaging media.

4 principles of digital literacy: Comprehension, Interdependence, Social Factors and Curation.

Comprehension the ability to extract implicit and explicit ideas from a media.

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Key Points

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Biodiversity Dashboards Dashboards are interactive tools that visualize the health and trends of biodiversity and track conservation performance at regional, national, basin, and site scales. The dashboards monitor the status of key biodiversity indicators for any part of the world.

iMapInvasives is a cloud-based application for tracking and managing invasive species. Developed by NatureServe and partners in the iMapInvasives Network, it gives resource managers the power to know about the latest observations of an invasive species, in real time

OpenBioMaps is mostly used to digitize and manage biodiversity data collected in the field. Its toolkit follows the life cycle of the data and offers a range of customisable solutions at all levels.

Curation should resist data overload and other signs of “digital hoarding,” while also providing the potential for social curation – working together to find, collect, and organize great information.

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Unit 3

Increased Awareness of New Agriculture Production Technologies That Can Maximize Crop Capacity While Minimizing Negative Impacts on Biodiversity

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Through case studies and real-world examples, learners will gain insights into how working alone or in combination, drones, sensors, cameras, low-power radio networks, and satellite technology can remotely monitor wildlife behaviour and habitat changes in real time, tracking and monitoring the environment down to the level of individual animals to stop illegal poaching and habitat destruction. The impact of technology on agriculture is better demonstrated with the automation of irrigation systems. These systems have revolutionized how water is supplied to crops, improving the efficiency of water distribution and the quality and quantity of agricultural production. The learners will be able to understand how technology has helped the ecosystem.

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3.1. Five Technological Advancements That Are Making a Big Impact in Agriculture

Today, the impact of technology on agriculture is undeniable. Engineers and researchers are continuously working hard to develop new technologies that solve farming, crops, and livestock management problems.

Here are five technological advancements that are making a big impact in agriculture:

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1. Precision Agriculture

Precision agriculture involves using GPS and other technological tools to collect data on crops and soil to optimize inputs (water, fertilizer, etc.) based on specific conditions. By monitoring and responding to variability in factors like moisture levels, crop growth can be improved while also reducing wastage. It helps farmers be more precise with inputs, reducing waste and saving money.

This is one of the most widely used technological advancements in agriculture, especially in large-scale farming, where every input matters. Farmers who embrace precision farming see higher yields, better soil health, and improved environmental impact. For instance, by using available tech to monitor soil health, farmers can avoid overfertilizing the land, which can be wasteful and cause disease.

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2. Industrial Automation

This involves using robotics and other automated processes to perform tasks like precision field seeding, planting, fertilizing, spraying pesticides/herbicides, and harvesting crops. This technological advancement in agriculture has allowed farmers to increase yields of agricultural produce by increasing efficiency on farmlands. They can now use drones to map crops, monitor crop growth, and improve irrigation systems.

Drones are also used for aerial surveys to get a bird’s eye view of the land, assess fallow fields or monitor irrigation levels across large areas. More farmers are turning to drones to map out their land for optimal grow times, crop rotation schedules, and harvesting needs. In livestock farming, robotics have also allowed the development of machines that can milk cows, shear sheep, and more.

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3. Automated Irrigation Systems

The impact of technology on agriculture is better demonstrated with the automation of irrigation systems. These systems have revolutionized how water is supplied to crops, improving the efficiency of water distribution and the quality and quantity of agricultural production. Advanced irrigation systems provide water when it's needed most without wasting any resources.

This precision allows for more efficient water distribution and better crop yields. Farmers in regions with water shortages due to drought or climate change can benefit the most from this technological advancement in agriculture. With irrigation becoming a key driver of agricultural success, the future looks promising for farmers and their crops. Farmers who embrace this can be ahead of the game.

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4. Remote Monitoring of Crops Using Sensors

Remote monitoring of crops using sensors such as drones and satellites is becoming increasingly popular. This allows farmers to monitor their fields from home, improving productivity by catching problems earlier and allowing for more efficient use of water and fertilizers. Crop sensors enable farmers to monitor their crops remotely from anywhere in the world using an app or web browser.

With such technological advancement in agriculture, farmers save on labor costs and increase their crop yields, making it possible to end food scarcity. Remote monitoring of crops using sensors is not only for large-scale farmers but also for smallholder farmers. A recent study showed that remote sensing could improve the accuracy of yield predictions by smallholder farmers in Africa by up to 30%. This will help these farmers make better decisions about their farming practices.

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5. Genetically Modified Crops

Genetically modified crops are one of the most significant technological advancements in the agricultural sector. These types of plants have been altered to contain specific traits that will benefit farmers and consumers alike. They offer lots of benefits for farmers producing specialty crops like fruits and flowers. These include increased resistance to pests and diseases, tolerance to herbicides, better nutritional value, and resilience to adverse weather conditions.

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Merging Datasets

Datasets can be merged and analyzed to uncover new results that may have been overlooked or discover relationships between various datasets that were not known before.

One example of how merging datasets is used in agriculture is the work done with genomic data. Genomic data is becoming increasingly important in agriculture as researchers learn more about various crops and livestock genomes.

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Key Points

Industrial Automation involves using robotics and other automated processes to perform tasks like precision field seeding, planting, fertilizing, spraying pesticides/herbicides, and harvesting crops.

Precision agriculture involves using GPS and other technological tools to collect data on crops and soil to optimize inputs (water, fertilizer, etc.) based on specific conditions.

The impact of technology on agriculture is better demonstrated with the automation of irrigation systems.

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Key Points

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Remote monitoring of crops using sensors allows farmers to monitor their fields from home, improving productivity by catching problems earlier and allowing for more efficient use of water and fertilizers.

Automated Irrigation Systems have revolutionized how water is supplied to crops, improving the efficiency of water distribution and the quality and quantity of agricultural production.

Genetically modified crops increased resistance to pests and diseases, tolerance to herbicides, better nutritional value, and resilience to adverse weather conditions.

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UNIT 4.
New Agriculture Production Technologies

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Agriculture is becoming more integrated in the ago-food chain and the global market, while environmental, food safety and quality, and animal welfare regulations are also increasingly impacting on the sector. It is faced with new challenges to meet growing demands for food, to be internationally competitive and to produce agricultural products of high quality.

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Today, farmers, advisors and policy makers are faced with complex choices. They are faced with a wide range of technologies that are either available or under development; they must deal with the uncertainties of both the effects these new technologies will have throughout the agri-food chain and the impact that a whole range of policies will have on the sustainability of farming systems.

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4.1.Main types of agricultural technologies

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Learners will learn about main types of agricultural technologies:

- Land management practices include technologies and techniques in land alteration and natural resource management. Soil is considered a natural resource in agriculture, so practices like soil tillage, terrace farming, irrigation, the use of cover crops, and other soil preservation techniques are included in this category.

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- Machinery and infrastructure technologies are comprised of farming equipment used in the field as well as in crop processing and storage. These technologies tend to reduce manual labor costs by increasing productivity through mechanization with equipment like harvesting combines and tractors. Agricultural infrastructure includes water pumps for irrigation, storage systems like silos, and even spatial technologies like GPS.

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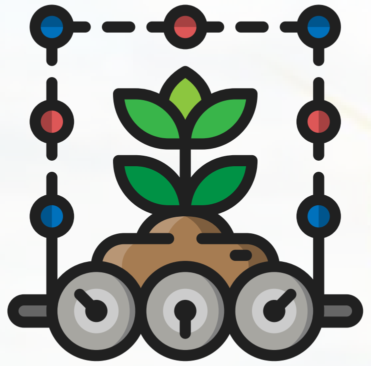

- Agrochemical technologies include fertilizers, pesticides, and herbicides. These chemical inputs are developed to increase soil fertility and to improve crop health and yields. They typically replace inherent soil functions when agricultural intensification is too great to be supported by natural soil processes.

- Biotechnologies include some of the more recent advancements in agricultural technology, like genetically engineered crops and the use of antibiotics, vaccines, and hormone treatments in animal husbandry.

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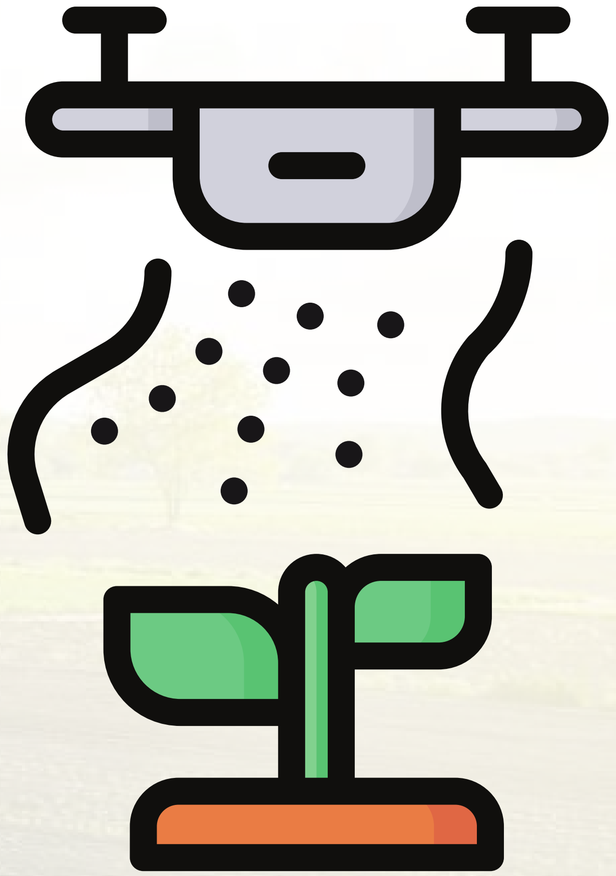
Impact of Technology on Agricultural Production

Advancements in technology have unquestionably shaped the trajectory of agriculture throughout human history. From our beginnings of using sticks to poke holes in the soil for seed planting, to our use of automated self-driving tractors, agriculture has undergone incredible transformations. However, positive impacts on the production of food are counterbalanced by many negative impacts on the environment.Contemporary agriculture is now faced with the task of addressing this ever-pressing asymmetry.



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Modern Agricultural Technology and Machinery usage in Agriculture:

- **Autopilot Tractors**: New GPS tractors and sprayers machines can accurately drive themselves through the field without drivers. On the board of computer system, a user has told how wide a path a given piece of equipment will cover he will drive a short distance setting A and B points to make a line. The GPS system will have a track to follow and it extrapolates that line into parallel lines set apart by the width of the tool in use. The tracking system is tied to the tractor steering, automatically keeping it on track freeing the operator from driving. This allows the operator to keep a closer eye on other things.

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- **Drones:** Theuse of dronesin agriculture will continue to grow and evolve as producers harness thisis very powerfultechnology in various aspects of their production. Drones can carry a wide array of sensors andcameras that can continually monitor crop growing conditions.

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- **Crop sensors:** Crop sensors are going to help farmers apply fertilizer in a very effective manner, maximizing uptake. Sensing how your crop is feeling and potential leaching and runoff into groundwater. This is taking variable rate technology to the next level. Instead of making a prescription fertilizer map for a field before you go out to apply in real time. Optical sensors are able to see how much fertilizer a plant may need based on the amount of light reflected back to the sensor.

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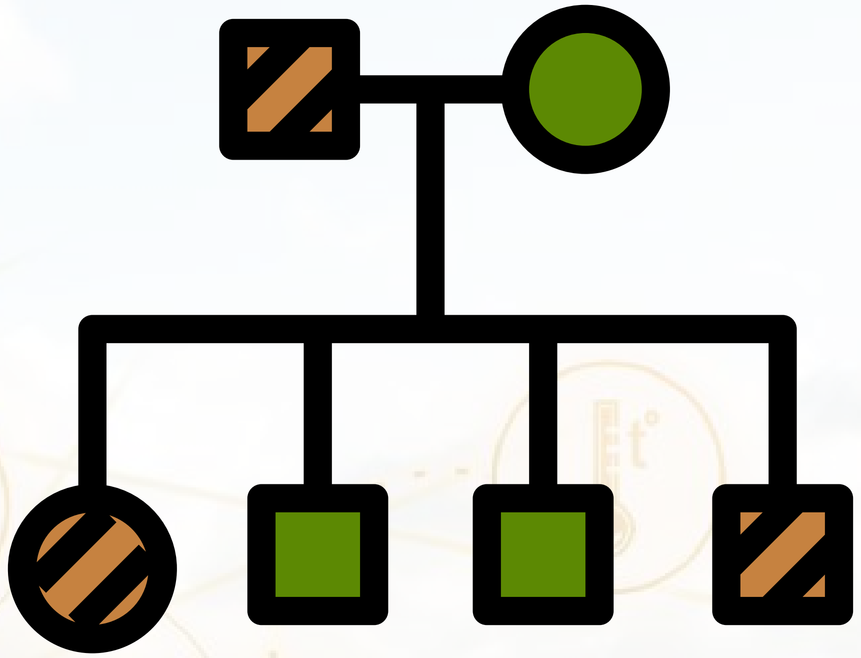
- **Biotechnology:** Biotechnology or genetic engineering is not new technology, but it is an important technology with much more potential yet to be unleased. The form of genetic engineering, most of the people have probably heard of is herbicide resistance. Crops can be made to express toxinsthat control particular pests. Biotechnology provides farmers with tools that can make production cheaper and more manageable. Biotechnology crops can be engineered to tolerate specific herbicides, which makes weed control simpler and more efficient.



- **Ultrasounds for livestock:** Ultrasound is not only for checking of baby animals in the womb, also can be used to discover what quality of meat might be found in an animal before it goesto market. The testing of DNA helps producers to identify animals with good pedigrees and other desirable qualities. For improving the quality of the herd, this information can be used to helps the farmer to improve quality.

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Key Points

By adopting technology farmerchange their sowing method from manual to mechanical.

Tunnel forming is a basicperception for the production of the off-season vegetables.

Due to technology, we can provide nutrient to plant on their calculated requirement

Through technologyincrease the profitof farmer and reduce the cost operation.

Through technologyincrease the profitof farmer and reduce the cost operation.

Supply water according to the requirements of crop.

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Conclusion

The agricultural sector faces several challenges, including food sustainability, environmental degradation and climate change. Growing concerns about the adverse health and environmental impacts of input-intensive conventional farming led to an increasing interest in organic farming. By abstaining from using chemical inputs and by promoting practices such as crop rotation and vegetative buffer zones, organic farming offers the potential to regenerate agricultural land and to counteract biodiversity loss.

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Conclusion

More widespread uptake of organic farming requires a better understanding of the drivers and barriers to its adoption. Information constraints have often been identified as a key barrier to the adoption of agricultural technologies. Providing farmers with information can increase problem awareness and knowledge of new techniques, both are prerequisites for subsequent adoption. Extension programs and training are a frequently used policy intervention to remove information constraints, to change perceptions about innovations and to promote the adoption of new agricultural technologies.

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Useful links in the topic

- http://cmsdata.iucn.org
- https://portals.iucn.org
- http://press.anu.edu.au
- https://www.unido.org/sites/default/files/files/2018-09/module_2_organic_production.pdf

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