ReGrow

Rebuilding Growth in Agriculture in
Post-Conflict Ukraine & Transitioning Georgia

D4.2: ReGrow MSc Program Course Framework

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Co-funded by
the European Union

Document Information

Grant Agreement No.	101179755
Project Acronym	ReGrow
Project Title	Rebuilding Growth in Agriculture in Post-Conflict Ukraine & Transitioning Georgia
Type of action	ERASMUS Lump Sum Grants
Call Topic	ERASMUS-EDU-2024-CBHE-STRAND-2
Project Start Date	01.11.2024 · Project End Date: 31.10.2027
Project Officer	Mr. Xavier Flament
Project Coordinator	Prof. Anastasios Michailidis
Project Website	https://regrow-project.com/
Work Package	WP4: Development of the ReGrow MSc Curriculum & Virtual Learning Environment (VLE) Frameworks
WP Leader	Metropolitan College (MC)
Deliverable type[1] | Dissemination level[2]	R – Document, report | PU – Public
Due Date	28 February 2026
Deliverable Submission Date	28 February 2026
Version	Final
Reviewer(s)	[Anastasios Michailidis, Smaragda Nikouli, Veriko Khomeriki, Nino , Larysa Kalachevska, Vladyslav Zubko, Mykola Kravchuk, Kateryna Skyba, Fotios Chatzitheodoridis, Georgios Kountios]

[1] *Please check DoA for the deliverable type. Available options are: R: Document, report; DEM: Demonstrator, pilot, prototype, plan designs; DEC: Websites, patents filing, press & media actions, videos, etc.; DATA: Data sets, microdata, etc; DMP: Data management plan; ETHICS: Deliverables related to ethics issues; SECURITY: Deliverables related to security issues; OTHER: Software, technical diagram, algorithms, models, etc.*

[2] *Please check DoA for the dissemination level. Available options are: PU – Public, fully open, e.g. web (Deliverables flagged as public will be automatically published in CORDIS project's page); SEN – Sensitive, limited under the conditions of the Grant Agreement; Classified R-UE/EU-R – EU RESTRICTED under the Commission Decision No2015/444; Classified C-UE/EU-C - EU CONFIDENTIAL under the Commission Decision No2015/444; Classified S-UE/EU-S – EU SECRET under the Commission Decision No2015/444*

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Executive Summary

This Deliverable (D4.2) presents the academic framework for the ReGrow MSc in Precision Agriculture and Digital Farming, developed under Work Package 4 (WP4) of the Erasmus+ CBHE ReGrow project. The document outlines the institutional capacities of participating Higher Education Institutions, the structure and specifications of the 90 ECTS (EQF Level 7) MSc programme, and the design of the complementary Professional/VET course.

During the reporting period, partners collaboratively defined the programme architecture, including module structure, learning outcomes, credit allocation, internship and dissertation requirements, as well as governance and quality assurance mechanisms. The curriculum was developed in alignment with WP3 findings, ensuring that it addresses identified skills gaps in digital agriculture, precision technologies, and sustainable farming practices.

The main outcome of this Deliverable is a harmonised, accreditation-ready MSc curriculum aligned with the Bologna Process and national regulatory frameworks of the partner countries. The document serves as an implementation guide for programme adoption, accreditation procedures, and long-term sustainability, supporting the modernisation of agricultural higher education and workforce upskilling in the project regions.

Glossary of terms and abbreviations used

List of Abbreviations and Description	
AUTH	Aristotle University of Thessaloniki (Greece), Project Coordinator
CBHE	Capacity Building in Higher Education (Erasmus+ Action)
Dissertation	Independent research project completed in the final semester of the MSc
ECTS	European Credit Transfer and Accumulation System
EQF	European Qualifications Framework
EQF Level 7	Master's level qualification descriptor within the European Qualifications Framework
FMIS	Farm Management Information System
GA	Grant Agreement
GIS	Geographic Information Systems
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HEI	Higher Education Institution
IoT	Internet of Things
JAC	Joint Academic Committee
LMS	Learning Management System
MSc	Master of Science
PA	Precision Agriculture
ReGrow	Rebuilding Growth in Agriculture in Post-Conflict Ukraine & Transitioning Georgia (Project Acronym)
Remote Sensing	Acquisition of information about objects or areas from a distance, typically using satellite or aerial sensors
Smart Farming	Use of digital technologies and data-driven approaches to improve agricultural productivity and sustainability
UAV	Unmanned Aerial Vehicle (Drone)
VET	Vocational Education and Training
VLE	Virtual Learning Environment
WP	Work Package

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1. Introduction

The development of the ReGrow Master of Science (MSc) Programme in Precision Agriculture and Digital Farming is grounded in the evidence and analytical outcomes generated during earlier stages of the project, particularly Work Package 3 (WP3). The WP3 needs assessment and comparative benchmarking identified substantial gaps in digital competences, precision technologies, data-driven agricultural management, and sustainability-oriented practices against European curricula highlighted the importance of interdisciplinary integration, applied learning components, and strong links between academia, industry, and agricultural stakeholders.

In response to these findings, and in alignment with the objectives of the Erasmus+ Capacity Building in Higher Education (CBHE) in Eastern Neighbourhood Action, Work Package 4 (WP4) focuses on curriculum modernisation, institutional capacity strengthening, and the promotion of innovation-driven agricultural education. The MSc Programme has therefore been designed to address identified regional needs, support digital transformation in agriculture, and foster climate-resilient and sustainable production systems, while ensuring compliance with the Bologna Process and the European Qualifications Framework standards.

This Deliverable presents the comprehensive academic framework of the ReGrow MSc in Precision Agriculture and Digital Farming, developed collaboratively by partner institutions in Georgia and Ukraine in cooperation with partners from Greece and Germany. It documents the agreed programme structure, governance principles, pedagogical approach, and quality assurance mechanisms that underpin the joint Master's degree.

The Deliverable is structured in two main parts. Part 1 provides an institutional overview of the participating Higher Education Institutions, outlining their academic structures, capacities, and regulatory frameworks relevant to programme implementation. Part 2 presents the MSc Programme specifics, including:

A. Detailed description of the ReGrow MSc Programme
B. Comprehensive course unit details for each module
C. Design of the Professional/VET Course outline

The document concludes with annexes containing the standardised templates developed to ensure cohesion between modules, transparency, and long-term sustainability of the programme across partner institutions.

Disclaimer on Curriculum Framework and National Adaptation

This Deliverable (D4.2) presents the common academic framework of the ReGrow Master of Science (MSc) in Precision Agriculture and Digital Farming, jointly developed by the project consortium in accordance with the objectives of the ReGrow project and the principles of the Bologna Process.

The curriculum structure, module composition, and indicative ECTS allocation described herein constitute a reference framework intended to guide programme development, quality assurance, and academic coherence across partner institutions.

In line with national higher education legislation and accreditation requirements, participating Higher Education Institutions retain the right to adapt the detailed curriculum structure, including the introduction of additional mandatory modules and the internal redistribution of ECTS credits (e.g. between taught modules, internship, and dissertation), provided that the overall learning outcomes, EQF Level 7 alignment, and the core digital and innovation-driven character of the ReGrow MSc are preserved.

Such adaptations will be implemented during the subsequent programme development and accreditation phases, ensuring full compliance with national regulatory frameworks while maintaining consistency with the jointly agreed ReGrow MSc academic profile, as further elaborated in Section 3.1.7 and Chapter 4 of this Deliverable.

2. Institutional Overview

This section provides a thorough introduction to the participating educational institutions, including their names, locations, academic calendars, and administrative structures. It also outlines general enrolment procedures, details the available degree programmes, explains the credit allocation corresponding to the expected learning outcomes, and describes the support systems for academic guidance.

2.1 Aristotle University of Thessaloniki (AUTH)

2.1.1 General Institutional Information

Institution name: Aristotle University of Thessaloniki
Faculty/Department: Faculty of Agriculture, Forestry and Natural Environment / Department of Agriculture
Country: Greece

2.1.2 Academic Structure and Regulations

Degree structure offered (ECTS model)[3]:

Postgraduate studies at Aristotle University of Thessaloniki (AUTH) are organised as semester-based Programmes of Postgraduate Studies (PPS / MSc programmes) leading to the award of the Diploma of Postgraduate Studies. The institutional framework governing all MSc programmes is defined by the AUTH Senate Regulation for Postgraduate Studies, as published in the Government Gazette (FEK 4084/B/23.06.2023), in alignment with Law 4957/2022. Each individual MSc programme further specifies its academic structure through an approved internal regulation.

Duration of studies

- The minimum duration of postgraduate studies is two (2) academic semesters.
- MSc programmes may have a normal duration of 3 or 4 semesters, depending on their academic design.
- The maximum duration of studies may not exceed double the normal duration of the programme.
- Part-time attendance is formally permitted, primarily for working students and, in exceptional documented cases, for non-working students with serious objective impediments.
- Suspension of studies may be granted upon request for up to two (2) consecutive semesters, which do not count towards the maximum duration.

ECTS structure and workload

AUTH follows the European Credit Transfer and Accumulation System (ECTS), whereby:

[3] *https://pss.auth.gr/wp-content/uploads/2025/04/FEK-2023-4084-%CE%9A%CE%91%CE%9D%CE%9F%CE%9D%CE%99%CE%A3%CE%9C%CE%9F%CE%A3-%CE%A0%CE%9C%CE%A3-%CE%91%CE%A0%CE%98.pdf*

- 60 ECTS correspond to one full academic year,
- 30 ECTS correspond to one academic semester.

Accordingly, MSc programmes at AUTH may be structured as:

- 90 ECTS programmes (most common), typically organised as:
    - 2 semesters of taught courses (60 ECTS) and
    - 1 semester dedicated to the Master's Diploma Thesis (30 ECTS).
- 120 ECTS programmes, usually extending over four semesters, particularly in interdisciplinary or professionally intensive fields.
- 75 ECTS programmes, including intensive or accelerated MSc programmes, which may cover one full calendar year, including summer months, where explicitly approved by Senate decision.

The exact ECTS allocation (courses, electives, thesis, practical components) is always explicitly defined in the internal regulation of each MSc programme.

Assessment system and minimum pass grades

Postgraduate courses are assessed through written examinations, oral examinations, coursework, assignments, or combinations thereof, as defined per course.

- The grading scale ranges from 0 to 10.
- The qualitative grading categories are:
    - Excellent: 8.5–10
    - Very Good: 6.5–8.49
    - Good: 6.0–6.49
- The minimum passing grade for any course and for the Master's Diploma Thesis is 6.0.
- A student must successfully complete all required courses and ECTS to be eligible for the award of the Diploma.

Academic calendar[4]:

The academic year at AUTH is formally defined on an annual basis by the University Senate and published through the University's official academic calendar. The academic year runs from 1 September to 31 August of the following calendar year and is divided into two main semesters — the winter (fall) semester and the spring semester – each comprising a period of teaching followed by formal examination periods.

Structure of the academic year

- Start / End of calendar year:

  The academic year officially begins on 1 September and ends on 31 August of the next year.

[4] https://www.auth.gr/en/academic-calendar-en/

- Two main teaching semesters:
    1. Winter Semester (Fall Semester):
        - Courses typically begin in the last week of September and continue until late January.
        - This semester normally includes 13 weeks of instruction, followed by the first exam period.
    2. Spring Semester:
        - Courses usually begin in mid-February and conclude by the end of May.
        - Similar to the winter semester, it includes 13 weeks of teaching plus the associated exam period.

Note: Exact start and end dates, including specific weekdays and weekends, are set each year by the Senate and published in the official calendar in advance.

Admission requirements for MSc students:

Admission to postgraduate (MSc) programmes at Aristotle University of Thessaloniki (AUTH) is governed by university regulations in conjunction with the internal rules of each individual programme. The general framework (as guided by Senate decisions and institutional practice) covers educational background, language proficiency and documentation, while specific selection criteria may vary by programme and department.

Bachelor's degree and academic eligibility

- To be eligible for admission to an MSc programme, applicants must hold a Bologna first-cycle degree (Bachelor's degree) from a recognised Higher Education Institution in Greece (A.E.I.) or an equivalent undergraduate qualification from an internationally recognised institution abroad. The relevant degree should normally be in a related academic or scientific field to the MSc for which the candidate is applying.
- Each MSc programme may specify additional academic prerequisites — such as specific subject backgrounds, minimum grade averages, or demonstrable experience — which are outlined in its internal programme documentation and admissions calls. For example, certain programmes may require a minimum overall bachelor's grade (e.g., ≥ 6.0 on the 0–10 Greek scale or an equivalent GPA).

Teaching language(s):

Greek, English

2.1.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

(e.g., UAV lab, GIS lab, sensor lab, robotics, weather stations)

Within the School of Agriculture / Department of Agriculture at AUTH, several laboratories and facilities can support teaching and research activities relevant to precision agriculture, particularly in informatics, remote sensing/GIS and agricultural engineering:

- Laboratory of Informatics in Agriculture – supporting the use of digital tools, data processing and computational applications in agricultural education and research.
- Laboratory of Remote Sensing and GIS - supporting geospatial analysis, satellite and aerial data processing, spatial modelling and GIS applications in agriculture.
- Agricultural Engineering Laboratories – while not exclusively precision agriculture focused, they belong to the Department and typically cover machinery, soil science and engineering aspects foundational for precision systems. These labs are the following:
  - Laboratory of Agricultural Engineering - supporting teaching and research on agricultural machinery, mechanisation and technological systems relevant to modern and precision-oriented farming practices.
  - Laboratory of Agricultural Structure and Equipment - covering agricultural infrastructure, equipment and technical systems used in agricultural production and experimentation.
  - Laboratory of General and Agricultural Hydraulics and Land Reclamation - relevant to irrigation systems, water management and land improvement, providing foundational knowledge for resource-efficient and precision-based agricultural management.
  - Laboratories of Soil Science and Applied Soil Science - supporting soil analysis, soil–plant interactions, land evaluation and soil management practices relevant to site-specific agricultural decision-making.
  - Laboratory of Alternative Energy Resources in Agriculture - supporting research and teaching on energy efficiency and sustainable energy technologies applied to agricultural systems.

Available field sites / training farms / demo farms:

AUTH benefits from a large University Farm used extensively by the Department of Agriculture for practical teaching, experimental research and field demonstrations:

- AUTH University Farm – located near Thessaloniki with approximately 1.8 km^2 of agricultural land, it supports experimental crop cultivation, animal production, machinery use and hands-on field exercises for students and researchers.
- The Farm includes 21 buildings housing laboratories and field research spaces where teaching and experimental activities are conducted.

This site serves as the primary field location for agronomy courses and is foundational for precision agriculture fieldwork.

The Department of Agriculture operates within a broad experimental and educational infrastructure supported by:

- laboratory equipment related to soil science, hydraulics, agricultural engineering, environmental monitoring and energy systems,

- agricultural machinery and equipment used at the University Farm for teaching, training and research purposes.

Detailed inventories of specialised Precision Agriculture equipment (such as UAVs, GNSS-enabled machinery, IoT-based systems) are managed internally by the relevant laboratories and field facilities.

Human resources / teaching staff expertise:

The School of Agriculture is supported by a multidisciplinary academic and technical staff with expertise relevant to Precision Agriculture and related digital and engineering domains.

- GIS specialists
- UAV / Remote sensing experts
- Agricultural engineering & mechanisation experts
- Soil science & land management specialists
- Irrigation, hydraulics & land reclamation experts
- Energy systems in agriculture specialists
- Data-driven agriculture / informatics specialists
- ICT engineers & technical support staff

2.1.4 National Accreditation Requirements

According to Greek national legislation governing postgraduate studies and AUTH institutional regulations, MSc programmes must include the following mandatory components:

- A clearly defined curriculum structure, consisting of compulsory and/or elective taught courses, each assigned ECTS credits.
- Learning outcomes aligned with the National and European Qualifications Frameworks.
- A transparent assessment and grading system, based on the national grading scale (0–10).
- Clearly defined admission requirements, evaluation criteria and study regulations.
- Where applicable, the inclusion of a Master's Diploma Thesis as an integral academic component of the programme.
- Formal approval of the MSc programme and its regulation by:
    - the competent Department bodies,
    - the Faculty/School,
    - and the AUTH Senate, in compliance with national accreditation requirements.

Special rules for MSc thesis / project:

When an MSc programme includes a Master's Diploma Thesis, the following national and institutional rules apply:

- The thesis is assigned following a formal student application, including a proposed title, topic description and supervisor.

- Supervision and evaluation are conducted by a Three-Member Examination Committee, one member of which is the supervisor, in accordance with national law and AUTH regulations.
- The thesis:
  - carries a defined ECTS value (commonly 20–30 ECTS, depending on programme structure),
  - must demonstrate independent academic work and research competence.
- The thesis is defended publicly or semi-publicly, as defined by the programme regulation.
- The final MSc degree grade is calculated as a weighted average of all course grades and the thesis grade, based on their respective ECTS credits.

2.2 Metropolitan College (MC)

2.2.1 General Institutional Information

Institution name: Metropolitan College
Country: Greece

2.2.2 Academic Structure and Regulations

Metropolitan College operates as a UK-transnational education provider and publicly states that it follows the traditional UK semester and credit system (BAC-accredited model). In practice, this means programmes are usually structured in two semesters per academic year (autumn/spring), with taught modules and an end-of-programme dissertation/project where applicable.

Academic calendar:

The academic year officially begins in the first week of October, and international students are expected to arrive at least one week earlier for Orientation Week. Orientation is typically held early October and mid-February. In particular:

- Late Sept: student induction
- Early Oct: autumn semester teaching starts
- Mid/Late Jan: revision week + exams
- Early/Mid Feb: inter-semester break
- Mid/Late Feb: spring semester teaching starts
- Late May / June: revision + exams

Detailed dates are issued via annual calendar PDFs.

Admission requirements for MSc students:

For international applications, MC requests an online application plus supporting documents including: passport/ID, academic transcript translated into English, English language qualification (for non-native speakers), and a photo.

MC states that for the majority of postgraduate programmes, the English requirement is typically IELTS 6.0 or 6.5 (or equivalent), depending on the programme. Programme pages may specify exact thresholds and accepted qualifications.

Other programme-level admission documentation is: relevant bachelor degree, reference letters, ID, English certificate (IELTS 6.0 or equivalent), and a personal interview-based evaluation.

Teaching languages:

Greek, English

2.2.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

Metropolitan College does not have a dedicated agriculture faculty or farm-based precision agriculture labs, but it has strong adjacent technical capacity that is relevant for a Precision Agriculture MSc (especially for data/ICT/automation components):

- Business & Computing Laboratories (modern computer labs, booking access, technical support)
- Architecture & Engineering Laboratories (specialised engineering labs aligned with module learning outcomes)
- Robotics and Automation Lab (robotics programming/mechatronics experimentation)

Available software licenses:

Software/tools relevant to digital/agri-tech-adjacent teaching include:

- SPSS
- Oracle platform (database systems development)
- MySQL access
- Web/multimedia development tools (e.g., DHTML, XML, .NET)
- 3D design/game tools (e.g., 3DS Max, Game Maker)
- Programming/debugging tools (C++, Java)
- MATLAB
- Microsoft and Adobe suites
- Robotics software (e.g., ROS, RoboDK, KUKA EKI) in the Robotics & Automation Lab.

Human resources / teaching staff expertise:

- Data scientists / AI / Big Data (Faculty of Computing offers MSc Data Science, MSc Artificial Intelligence, MSc Big Data Technologies)
- ICT engineers / computing specialists (Faculty of Computing)
- Automation/robotics engineers (Engineering Department + Robotics & Automation Lab)
- Business analytics support (Business & Computing labs; analytics-oriented programmes)

2.2.4 National Accreditation Requirements

Maximum/minimum ECTS per semester allowed:

Metropolitan College's public institutional positioning is based on a UK semester/credit system (not a single published institution-wide ECTS rule).

Mandatory components required by national authorities:

College courses fall under the Greek framework for recognition of professional qualifications, with the competent authority being A.T.E.E.N. (Independent Department for the Implementation of European Legislation, Ministry of Education and Religious Affairs). It also lists licensing under the Greek Ministry of Education and BAC certification.

2.3 Hochschule Weihenstephan – Triesdorf (HSWT)

2.3.1 General Institutional Information

Institution name: Hochschule Weihenstephan-Triesdorf (University of Applied Sciences Weihenstephan-Triesdorf – HSWT)
Faculty/Department: Faculty of Sustainable Agriculture, Food and Nutrition (Campus Triesdorf)
Country: Germany

2.3.2 Academic Structure and Regulations

Degree structure offered (ECTS model)
Germany follows the Bologna Process:

- Standard MSc: **90 or 120 ECTS**
- 2 semesters per academic year
- 30 ECTS per semester (standard load)
- Master's thesis: typically **15–30 ECTS**
- Grading scale: 1.0 (very good) to 4.0 (pass), 5.0 (fail)
- Minimum pass grade: 4.0

Applied sciences universities emphasize:

- Practical components
- Fieldwork
- Applied research
- Industry cooperation

Academic calendar
Winter semester:

- October – February
- Exams: January–February

Summer semester:

- March – July

- Exams: June–July

Admission requirements for MSc students

- Recognized Bachelor's degree (agriculture, agribusiness, environmental sciences, engineering, or related fields)
- Minimum grade requirement (defined by program)
- English proficiency (for English-taught programs):
    - IELTS / TOEFL / equivalent
- German proficiency (if program is German-taught)
- No national entry examination required

Teaching language(s)

- German (primary language for most programs)
- English (selected MSc programs and international modules)
- Mixed format possible (depending on program)

2.3.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

HSWT (Campus Triesdorf) provides:

- GIS & Geoinformatics laboratory
- Agricultural machinery and technology labs
- Soil analysis laboratory
- Crop production experimental fields
- Livestock research facilities
- Weather monitoring stations
- Digital agriculture and farm management labs

Available field sites / training farms / demo farms:

- University-owned experimental farms
- Dairy and livestock demonstration units
- Arable crop trial fields
- Cooperation with regional Bavarian farms
- Applied research plots for precision agriculture trials

Available software licenses:

- QGIS (open source)
- ArcGIS (institutional licenses)

- Python (data analysis)
- R (statistical computing)
- Farm Management Information Systems (FMIS)
- Precision agriculture data platforms
- MS Office 365 (institutional)
- Moodle LMS
- UAVs / drones (for mapping & crop monitoring)
- GNSS-equipped tractors
- Soil moisture sensors
- Yield monitoring systems
- IoT-based agricultural sensors
- Portable field measurement tools
- Weather stations
- Digital farm monitoring devices

Human resources / teaching staff expertise:

Relevant expertise at HSWT includes:

- GIS & spatial data analysis specialists
- Remote sensing and UAV experts
- Agronomy professors (crop & livestock systems)
- Agricultural engineering specialists
- Agricultural economists
- Agribusiness and farm management experts
- Data analysts (R, Python)
- Sustainability and climate adaptation researchers
- Digital agriculture specialists

Strong linkage between:

- Applied research

- Industry collaboration
- EU-funded projects (Erasmus+, Horizon Europe)

2.4 Georgian Technical University (GTU)

2.4.1 General Institutional Information

Institution name: Georgian Technical University
Faculty/Department: Agricultural Sciences and Chemical Technology faculty
Country: Georgia

2.4.2 Academic Structure and Regulations

For the given period, the Georgian Technical University is implementing bachelor's (4 years - 240 ECTS), master's (2 years 120 ECTS) and PhD programs - the taught component is not less than 60 credits, and the minimum duration of study is 3 years. however, as is already known, in 2026 changes are planned to 3+1+1. Thesis is required mostly.

Academic calendar:

(Start/end dates of semesters, exam periods)

The first (fall) semester of the 2025-2026 academic year at the Georgian Technical University began on October 20, 2025 and will end in June-July.

The mid-term exam in the academic component was held from December 8 to December 13, ongoing activities are evaluated in the weeks specified in the relevant syllabus, final exams will be held from February 9 to February 21, 2026, and additional exams - from February 23 to February 28, 2026. The second semester begins on March 16, 2026.

Admission requirements for MSc students:

At GTU, admission requirements exist for Master’s degree programmes in the fields of Agricultural Sciences and Chemistry Technology, in accordance with the current legislation and the internal regulations of the University. Admission to the programme requires holding a Bachelor’s degree, preferably in Agricultural Sciences, Chemistry, or related fields.

Priority is given to graduates of Bachelor’s programmes in agricultural disciplines; however, graduates of other related fields may also be admitted based on an individual assessment of academic compatibility.

The teaching and learning process at the faculty is conducted in two languages — Georgian and English. English-taught instruction is particularly emphasized within the double-degree Master’s programme “Viticulture and Oenology”, which is delivered in compliance with international academic standards and enables students to obtain a double diploma with the SUPAGRO University. Applicants to English-taught programmes are required to demonstrate proficiency in the English language, either by submitting a recognized language certificate or by passing an internal language assessment, ensuring their full participation in the academic process.

Teaching languages:

Georgian, English

2.4.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

Georgian Technical University provides laboratory and research facilities relevant to Precision Agriculture. These include GIS and geospatial analysis laboratories, agrochemical and soil analysis laboratories, environmental and meteorological monitoring equipment, and modern laboratory instruments applicable to sensor-based measurements, agricultural experimentation, and applied research. The facilities are primarily supported by the Faculty of Agricultural Sciences and Biosystems Engineering, with additional support from relevant chemical laboratories of the University.

Available field sites / training farms / demo farms:

Georgian Technical University does not own dedicated training or demonstration farms. However, the University has established Memoranda of Understanding with private and public organizations operating in the agricultural sector. Within the framework of these partnerships, students participate in programme-required practical training, including fieldwork, on-farm activities, and applied agricultural practices at partner facilities.

In addition, practical training activities are supported by a training base located in Western Georgia, in the village of Didi Jikhaishi, where vocational retraining programmes in viticulture and beekeeping are implemented. This base is used for field-based training, demonstrations, and applied learning activities relevant to agricultural education.

Available software licenses:

Georgian Technical University provides access to a variety of software tools and digital resources relevant to Precision Agriculture and related research activities. These include widely used open-source platforms such as QGIS, Python, and R, which are employed for GIS applications, data analysis, modeling, and statistical processing.

In addition, spatial databases and tools such as PostgreSQL/PostGIS and computer vision libraries (e.g., OpenCV) are used to support data management and image-based analysis. Where relevant, introductory Farm Management Information Systems (FMIS) platforms and robotics-related software environments are utilized for teaching and applied research purposes.

The University also provides access to institutionally available licensed software through its IT services, supporting teaching and research activities in accordance with availability and academic needs.

Available equipment & hardware:

Georgian Technical University has a limited amount of equipment relevant to Precision Agriculture, including an unmanned aerial vehicle (UAV/drone) acquired within the framework of an educational project and used for teaching and research purposes. In addition, standard laboratory and field equipment is available and used for agricultural experiments and data collection.

Within the framework of the project, it is desirable to acquire additional Precision Agriculture equipment, such as GNSS-enabled tractors, fully equipped IoT systems, or other precision farming machinery.

Human resources / teaching staff expertise:

- GIS specialist - Zurab Laoshvili
- UAV/remote sensing expert
- Agronomy professors - Ketevan Rokva
- Viticulture - Nino Chkhartishvili
- Data scientists, ICT engineers - Lili Pertiashvili

2.4.4 National Accreditation Requirements

Maximum/minimum ECTS per semester allowed:

According to the national legislation of Georgia, the standard academic workload per semester is 30 ECTS credits, with a total workload of 60 ECTS credits per academic year. However, significant updates and revisions are planned within the framework of ongoing and future programme development, while the current regulations remain applicable at present.

Mandatory components required by national authorities:

Master's degree programmes must include mandatory taught components, research-oriented learning outcomes, and the completion of a Master's thesis or final project, in compliance with national higher education standards and accreditation requirements. At the current stage, these requirements are in force, while programme updates are envisaged in line with national and international developments.

Special rules for MSc thesis/project:

The Master's thesis/project is a mandatory component of the programme and is completed under the supervision of an academic advisor. It carries a defined number of ECTS credits in accordance with national regulations and must demonstrate the student's ability to conduct independent research and applied analysis. The thesis/project is evaluated based on established academic criteria and defended before an examination committee. Any future modifications will be implemented in accordance with national accreditation standards.

2.5 Samtskhe-javakheti State University (SJSU)

Institution name: Samtkhe-javakheti State University
Faculty/Department: Faculty of Agrarian and Natural Sciences
Country: Georgia

2.5.1 Academic Structure and Regulations

Degree structure offered (ECTS model):

SJSU offers Bachelor (4-year – 240 ECTS), Master (2-year – 120 ECTS) and Integrated (5-year – 300 ECTS) programs. However, according to the ongoing reform, it will be permissible to develop a one-year Master's program with a minimum of 60 ECTS. In addition, it will be possible to add an extra year, upon completion of which the student will be eligible to continue studies at the PhD level. With only a one-year or even a three-semester Master's program, students will most likely not be eligible to continue studies at the PhD level.

Academic calendar:

Autumn Semester starts in 15 th of September and ends in January. Spring semester starts in March and ends in July. The study period lasts 15 weeks, with the midterm examination held in the eighth week. Final examinations begin from the 16th week.

Admission requirements for MSc students:

To be admitted to the Master's program, applicants must hold a Bachelor's degree, pass the Unified Master's Examination, pass the internal entrance examination, and provide proof of English language proficiency at the B2 level, or alternatively pass an English language examination administered by the university.

Teaching language:

Georgian

2.5.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

The University operates an Entrepreneurship and Innovation Laboratory, which supports applied research, innovation-driven projects, startup development, and the integration of digital and business-oriented solutions relevant to precision agriculture and agri-innovation.

These facilities collectively provide a multidisciplinary environment that links agricultural technologies with innovation, data-driven decision-making, and entrepreneurial competencies, in line with the objectives of the ReGrow project.

Available field sites / training farms / demo farms:

Samtskhe-Javakheti State University has access to agricultural land and maintains cooperation with local farmers, agribusinesses, and regional stakeholders in the Samtskhe-Javakheti region. These field sites provide opportunities for practical training, applied research, and demonstration activities related to sustainable and precision agriculture, including soil management, crop monitoring, and pilot testing of innovative agricultural practices

Available software licenses:

The licenses for the listed software (ArcGIS, QGIS, Pix4D, FMIS platforms, MATLAB, Python, R) have not been purchased and the software is not currently in use. Nevertheless, the University already uses an LMS system for teaching, learning, and administrative purposes.

Available equipment & hardware:

The University possesses basic laboratory and field research equipment supporting agricultural and environmental studies

Human resources / teaching staff expertise:

- Agronomy professors – Zaira Tkebuchava,
- Soil Science professor - Nana Zubashvili

2.5.4 National Accreditation Requirements

Maximum/minimum ECTS per semester allowed:

According to the current legislation, the standard number of credits is 30 ECTS per semester and 60 ECTS per academic year.

Mandatory components required by national authorities:

Here are the mandatory components and requirements set by national authorities in Georgia for implementing Master's programmes, based on current legislation and quality assurance practice:

1. Minimum credit requirement:
    - Master's programmes must comprise at least 60 ECTS credits.
2. Alignment with National Qualifications Framework:
    - The programme must be designed in accordance with the Level 7 learning outcomes of the Georgian National Qualifications Framework (second cycle of higher academic education).
3. Inclusion of independent research / thesis:
    - Except for artistic or sport specialized programmes, a Master's programme must include independent research work that leads to the submission of a Master's thesis and/or research project appropriate to the discipline.
4. Admission prerequisites:
    - Access to Master's studies requires possession of a Bachelor's degree or equivalent.
    - Candidates must pass the Unified Master's Examination (Common Master Exam) and any additional institution defined exams.
5. Use of ECTS and regulated study load:

- The programme and study process must follow ECTS guidelines, with 30 ECTS per semester and 60 ECTS per academic year as standard.

6. Internal quality assurance and documentation:

- Higher education institutions must design, document, and internally regulate programme components (learning outcomes, curriculum structure, assessment, thesis requirements) consistent with national quality requirements, and these are subject to authorization by the National Center for Educational Quality Enhancement (EQE) before implementation.

7. Admission rules set by HEIs within national frameworks:

- While institutions can define additional admission conditions (such as internal entrance exams, language proficiency, portfolio or interview requirements), these must remain compliant with the national admission framework and programme authorization rules.

Special rules for MSc thesis / project:

The Master's thesis or project is a mandatory component of the programme and is completed under the supervision of an academic advisor. It is assigned a specific number of ECTS in accordance with national regulations. The thesis or project is evaluated based on established academic criteria and is defended before the Thesis Defense Committee.

2.6 Shota Meskhia State Teaching University of Zugdidi (ZSSU)

2.6.1 General Institutional Information

Institution name: Shota Meskhia Zugdidi State University
Faculty/Department: Faculty of Social Sciences and Health
Country: Georgia

2.6.2 Academic Structure and Regulations

Degree structure offered (ECTS model):

Shota Meskhia Zugdidi State University offers Bachelor (4-year – 240 ECTS), Master (2-year – 120 ECTS) and Integrated (5-year – 300 ECTS) programs. However, according to the ongoing reform, it will be permissible to develop a one-year Master's program with a minimum of 60 ECTS. In addition, it will be possible to add an extra year, upon completion of which the student will be eligible to continue studies at the PhD level. With only a one-year or even a three-semester Master's program, students will most likely not be eligible to continue studies at the PhD level.

Academic calendar:

Autumn Semester starts in October and ends in February. Spring semester starts in March and ends in July. The study period lasts 15 weeks, with the midterm examination held in the eighth week. Final examinations begin from the 16th week.

Admission requirements for MSc students:

(Language requirements, bachelor degrees accepted, entry examinations) To be admitted to the Master's program, applicants must hold a Bachelor's degree, pass the Unified Master's Examination, pass the internal entrance examination, and provide proof of English language proficiency at the B2 level, or alternatively pass an English language examination administered by the university.

Teaching language:

Georgian

2.6.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

The university has a chemistry laboratory where soil and other analyses can be conducted, as well as a veterinary laboratory.

Available field sites / training farms / demo farms:

The university has a separate campus for vocational education programs in Senaki (about 100 km from the main campus building), which includes 20 hectares of agricultural land. There are livestock and beekeeping farms, as well as demonstration plots and greenhouse facilities.

Available software licenses:

The licenses for the listed software (ArcGIS, QGIS, Pix4D, FMIS platforms, MATLAB, Python, R) have not been purchased and the software is not currently in use. However, if their use becomes necessary during the implementation of the program, the University will ensure their procurement as required. If any of the software tools are open-access resources, the relevant units will facilitate their operation for the benefit of students and staff. Nevertheless, the University already uses an LMS system for teaching, learning, and administrative purposes.

Available equipment & hardware:

Mobile soil analyzer

Human resources / teaching staff expertise:

- Agronomy professors – Demetre Lipartia
- Engineer-Ecologist-Technologist – Prof. Ketevan Lataria

2.6.4 National Accreditation Requirements

Maximum/minimum ECTS per semester allowed: According to the current legislation, the standard number of credits is 30 ECTS per semester and 60 ECTS per academic year.

Mandatory components required by national authorities:

Here are the mandatory components and requirements set by national authorities in Georgia for implementing Master's programmes, based on current legislation and quality assurance practice:

1. Minimum credit requirement:
    - Master's programmes must comprise at least 60 ECTS credits.
2. Alignment with National Qualifications Framework:
    - The programme must be designed in accordance with the Level 7 learning outcomes of the Georgian National Qualifications Framework (second cycle of higher academic education).

3. Inclusion of independent research / thesis:
   - Except for artistic or sport specialized programmes, a Master's programme must include independent research work that leads to the submission of a Master's thesis and/or research project appropriate to the discipline.
4. Admission prerequisites:
   - Access to Master's studies requires possession of a Bachelor's degree or equivalent.
   - Candidates must pass the Unified Master's Examination (Common Master Exam) and any additional institution defined exams.
5. Use of ECTS and regulated study load:
- The programme and study process must follow ECTS guidelines, with 30 ECTS per semester and 60 ECTS per academic year as standard.
6. Internal quality assurance and documentation:
- Higher education institutions must design, document, and internally regulate programme components (learning outcomes, curriculum structure, assessment, thesis requirements) consistent with national quality requirements, and these are subject to authorization by the National Center for Educational Quality Enhancement (EQE) before implementation.
7. Admission rules set by HEIs within national frameworks:
- While institutions can define additional admission conditions (such as internal entrance exams, language proficiency, portfolio or interview requirements), these must remain compliant with the national admission framework and programme authorization rules.

Special rules for MSc thesis / project:

The Master's thesis or project is a mandatory component of the programme and is completed under the supervision of an academic advisor. It is assigned a specific number of ECTS in accordance with national regulations. The thesis or project is evaluated based on established academic criteria and is defended before the Thesis Defense Committee.

2.7 Sumy National Agrarian University (SNAU)

2.7.1 General Institutional Information

Institution name: Sumy National Agrarian University
Faculty/Department: Faculty of Engineering and Technology / Agroengineering Department
Country: Ukraine

2.7.2 Academic Structure and Regulations

Degree structure offered (ECTS model):

Study under the second-cycle (Master's level) educational programme at Sumy National Agrarian University lasts for three semesters (90 ECTS credits). The first and second semesters include 30 credits each of lecture, practical and laboratory classes. The third semester includes 15 credits of lecture, practical and laboratory classes, 5 credits of pre-diploma practice and 10 credits for the completion and defense of the qualification (master's) thesis.

The educational programme is developed on the basis of the Higher Education Standard for the specialty *"Agroengineering"*, approved by the Order of the Ministry of Education and Science of Ukraine dated 10 July 2019.

The minimum passing grade for each educational component (course) is 60 points on a 100-point scale.

Requirements for the Master's Thesis:

General Description of the Master's Thesis

The master's qualification work as a mandatory component of the master's educational program is an original contribution to solving a problem through research carried out by the applicant under the guidance of a scientific supervisor to achieve the learning outcomes specified in the educational program. The qualification work is performed in the form of a written work.
The purpose of the master's qualification work is to develop in the applicant:

- specialized conceptual knowledge that includes modern scientific achievements in the field of professional activity/field of knowledge;- critical understanding of problems in the field and at the border of fields of knowledge;
- the ability to integrate knowledge and solve complex problems in broad or multidisciplinary contexts.

Structure of the Master's Thesis

The recommended length is 60–70 pages, excluding appendices.

Mandatory elements:

- title page;
- assignment for the qualification work;
- abstracts;
- table of contents;

Main Sections:

- Title page;
- Task;
- Abstract;
- Table of contents;
- List of symbols, symbols, units of measurement and terms (if necessary);
- Introduction;

- Main part (chapters and subsections);
- Conclusions;
- List of sources used;
- Appendices (if necessary).

Relevance of the research area

The topic should correspond to one of the following areas:

- design and modernization of agricultural machinery;
- intelligent machines and robotic platforms in agricultural engineering;
- energy-efficient soil cultivation systems;
- digital farming, GIS, machine vision;
- hydraulic and pneumatic systems of agricultural machinery;
- equipment for processing and post-harvest treatment of agricultural products.

Academic calendar:

1st semester – September 1 to January 20, 2026.
2nd semester – February 1 to June 20, 2026.
3rd semester – September 1, 2026 to January 20, 2027.

Admission requirements for MSc students:

Admission requirements are determined by the presence of a higher education degree of "Bachelor", "Specialist" or "Master" and the "Admission Rules for Higher Education at Sumy National Agrarian University".

Teaching language(s):

The language of instruction is Ukrainian.
The format of study is full-time.

2.7.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

Precision Agriculture Center named after M.Ya. Dovzhyk of Sumy National University (theoretical training class). Sections of HORSCH MAESTRO and PRECISION PLANTING sowing complexes, which are equipped with sowing control systems. A mobile meteorological station equipped with sensors to determine meteorological conditions of air and soil (temperature, humidity, wind speed and direction, solar radiation level, etc.). RAVEN navigation and guidance system for parallel guidance, autosteer, and precision agriculture applications which includes: Raven Control Terminal (Field Computer / Display); Raven GPS Receiver / GNSS Antenna; Steering Wheel with Drive. Samples of navigation equipment of John Deere machines (antennas, monitors, course indicators). Access to modern digital platforms for precision agriculture (ClimateFieldView, Cropio, Cropmonitoring, OneSoil, etc.). Also, AR and VR simulators for controlling equipment from world-famous manufacturers (John Deere, CLAAS, Case IH, etc.) are installed on the PC.

Precision Agriculture Center named after M.Ya. Dovzhyk of Sumy National University (classrooms for laboratory and practical training).The training uses both samples of modern agricultural machinery and their individual components and assemblies. In recent years, partner companies have provided: tractors of the John Deere, Case IH, CLAAS brands; John Deere combine harvesters; Leeb, John Deere and Case IH trailed and self-propelled sprayers; Horsch Maestro, Horsch Pronto, Vaderstad, Lozovskie mashiny and Elvorti seed drills; John Deere and Amazone solid mineral fertilizer spreaders; CLAAS round balers; soil tillage equipment of the companies Case IH, Horsch, Lemken, Lozovskie mashiny.

Smart polygon. The hangar with an area of 525 m2 is equipped with a ground channel. This test area is used to adjust machine complexes to specified operating parameters with the ability to simulate agrophysical and temperature parameters. It allows training to be conducted regardless of the season.

Virtual Reality and Robotics Module. The laboratory presents a fairly large set of modules, sensors and other equipment that can be connected to various microprocessors. A soldering station, a “third hand”, a special magnifying glass and various solders allow you to assemble sensors with a microprocessor. A 3D printer is used to create cases. Virtual and augmented reality is created to study technical agricultural equipment that may not be available in the classroom. Thus, the training module has virtual reality glasses: some are installed stationary, others are mobile. The laboratory also has the following equipment: Field controllers (data collector) for geodetic and GNSS measurements (Spectra Precision PM5 (V2), Trimble TSC2, Trimble GeoXT, Trimble PM5, Trimble 5700); telematics device for collecting data from agricultural machinery FieldView™ Drive; drones (sprayer drone XAG V40, DJI 3 mini).

Available field sites / training farms / demo farms:

Available software licenses:

- QGIS;
- SolidWorks;
- Climate Fieldview;
- Cropio;
- Cropmonitoring;
- OneSoil.

Available equipment & hardware:

- DJI 3 mini drone;
- sprayer drone XAG V40;

- Soil sensors;
- mobile meteorological station equipped with sensors (temperature, humidity, wind speed and direction, solar radiation level);
- HORSCH MAESTRO sowing control systems;
- RAVEN navigation and guidance system: Raven Control Terminal (Field Computer / Display); Raven GPS Receiver / GNSS Antenna; Steering Wheel with Drive;
- Field controllers (data collector) for geodetic and GNSS measurements (Spectra Precision PM5 (V2), Trimble TSC2, Trimble GeoXT, Trimble PM5, Trimble 5700);
- telematics device for collecting data from agricultural machinery FieldView™ Drive;
- Partner companies have provided: tractors of the John Deere, Case IH, CLAAS brands; John Deere combine harvesters; Leeb, John Deere and Case IH trailed and self-propelled sprayers; Horsch Maestro, Horsch Pronto, Vaderstad, Lozovskie mashiny and Elvorti seed drills; John Deere and Amazone solid mineral fertilizer spreaders.

Human resources / teaching staff expertise:

- GIS specialist
- UAV/remote sensing expert
- Doctors of Engineering Sciences, Professors
- Data scientists
- ICT engineers

List all relevant experts

- Faculty members of the department;
- Precision agriculture specialists from CLAAS, New Holland, John Deere, Case IH (a full cooperation agreement has been signed).

2.7.4 National Accreditation Requirements

Maximum/minimum ECTS per semester allowed:

30 ECTS per semester. 90 ECTS for the entire educational programme.

Mandatory components required by national authorities:

Mandatory components are determined independently by each higher education institution according to the established learning outcomes and the general and professional competencies defined by the Higher Education Standard for the specialty “Agroengineering”, approved by the Order of the Ministry of Education and Science of Ukraine dated 10 July 2019.

Special rules for MSc thesis / project:

The defense of the Master's thesis must be conducted publicly before a committee appointed by the higher education institution, which includes four professional faculty members from the graduating department and a specialist (usually the chief engineer of an agricultural enterprise), appointed by the Chair of the examination committee.

Schedule for the Implementation and Accreditation of the Master's Degree Programme

Accreditation of the educational programme (September – December 2026).

2.8 Polissia National University (PU)

2.8.1 General Institutional Information

Institution name: Polissia National University
Faculty/Department: Faculty of Agronomy, Department of Soil Science and Agriculture
Country: Ukraine

2.8.2 Academic Structure and Regulations

Degree structure offered (ECTS model):

90 ECTS credits; duration 1 year 4 months (3 semesters). Thesis defence is required for graduation

Academic calendar:

Semester 1: Sept-Dec;
Semester 2: Feb-June, practice Apr-July;
Semester 3: Sept-Dec and thesis

Admission requirements for MSc students:

Bachelor's degree (specialty 201 Agronomy or related); entrance examinations (specialty and foreign language).

Teaching language:

The language of instruction is Ukrainian.
The format of study is full-time.

2.8.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

Geoinformation Center & GIS lab, digital weather station. A precision agriculture laboratory is planned.

Available field sites / training farms / demo farms:

University research field and fields of partners (LLC "Korostyshivzeminvest")

Available software licenses:

ArcGIS (license), QGIS (open source), Moodle for e-learning, access to satellite monitoring platforms.

Available equipment & hardware:

UAVs: DJI Mavic-3Multispectral, agrodron MC-A22, digital weather station.

Human resources / teaching staff expertise:

- GIS specialist (P. Pivovar, P. Topolnitsky)
- UAV/remote sensing expert (M. Kravchuk)
- Agronomy professors (V. Didora, V.Moiisienko)
- Soil expert (L. Dovbysh)
- Agronomy expert (S. Zhuravel)
- Geodesy and Land Management Expert (I. Karas)

2.8.4 National Accreditation Requirements

Maximum/minimum ECTS per semester allowed:

30 ECTS per semester

Mandatory components required by national authorities:

General (12 ECTS) and Professional (40 ECTS) training; Practice (10 ECTS)

Special rules for MSc thesis/project:

Independent solution of complex agronomic problems using digital monitoring and innovation

2.9 Khmelnitsky National University (KHNU)

2.9.1 General Institutional Information

Institution name: Khmelnytskyi National University
Faculty/Department: Department of Industrial Machinery Engineering and Agro-Engineering
Country: Ukraine

2.9.2 Academic Structure and Regulations

Degree structure offered (ECTS model):

Study under the second-cycle (Master's level) educational programme at Khmelnytskyi National University lasts for three semesters (90 ECTS credits). Two semesters (60 ECTS credits) consist of theoretical training, and the third semester (30 ECTS credits) is dedicated to practical training as well as the preparation and defense of the qualification (master's) thesis.

The educational programme is developed on the basis of the Higher Education Standard for the specialty "Agroengineering", approved by the Order of the Ministry of Education and Science of Ukraine dated 10 July 2019.

The minimum passing grade for each educational component (course) is 60 points on a 100-point scale.

Requirements for the Master's Thesis:

1. General Description of the Master's Thesis

The Master's thesis is an independent scientific, design, or technological research project aimed at solving a relevant problem in agroengineering or precision agriculture using modern modelling methods, digital technologies, computer-aided design, and analytics.

The thesis must demonstrate:

- scientific novelty or practical significance;
- engineering justification of the selected solutions;
- the presence of an experimental component and data analysis;
- the ability to apply international standards, methodologies, and technologies.

2. Structure of the Master's Thesis

The recommended length is 60–70 pages, excluding appendices.

Mandatory elements:

- title page;
- assignment for the qualification work;
- abstracts;
- table of contents;

Main Sections:

1. Introduction.
2. Analytical literature review and problem statement
3. Technological section (improvement of the technological map for cultivating an agricultural crop).
4. Design-technological / engineering section.
5. Experimental research and data analysis.
6. Economic justification (according to industry standards).
7. Occupational safety and engineering safety.
8. Conclusions.
9. List of bibliographic sources.

10. Appendices (drawings, software, technical specifications, photos of the experimental setup, graphs.)

3. Relevance of the research area

The topic should correspond to one of the following areas:

- design and modernization of agricultural machinery;
- intelligent machines and robotic platforms in agricultural engineering;
- energy-efficient soil cultivation systems;
- digital farming, GIS, machine vision;
- hydraulic and pneumatic systems of agricultural machinery;
- equipment for processing and post-harvest treatment of agricultural products.

Academic calendar:

1st semester – September 1 to January 20, 2026.

2nd semester – February 1 to June 20, 2026.

3rd semester – September 1, 2026 to January 20, 2027.

Admission requirements for MSc students:

1. Bachelor's degree.
2. Passing the Unified Entrance Exam in a foreign language and general competencies. Registration for the exam takes place during May, and the exam is held during June.

Teaching language:

The language of instruction is Ukrainian.
The format of study is full-time.

2.9.3 Institutional Capacities

Available laboratory facilities relevant to Precision Agriculture

- *Laboratory of Agricultural Machinery* (equipped with precision seeding complexes).
- *Laboratory of Precision Agriculture Systems* (equipped with UAVs such as Mavic Air 2; QGIS mapping system; Climate FieldView system for field data collection and processing; programming language R and the R-Studio software environment for statistical data analysis; an educational machine-vision system based on a Raspberry Pi 5 microcomputer and the AI module RPI 5 AI HAT).

Available software licenses:

- QGIS;
- SolidWorks 2025;
- R;
- Python;
- Climate Fieldview

Available equipment & hardware:

- Mavic Air 2 drone;
- Soil sensors;
- John Deere 8400 tractor;
- Raspberry Pi 5;
- Tractors and combine harvesters by CLAAS, as well as access to the CLAAS precision farming system.

Human resources / teaching staff expertise:

- GIS specialist
- UAV/remote sensing expert
- Agronomy professors
- Data scientists
- ICT engineers

List all relevant experts

- Faculty members of the department;
- Precision agriculture specialists from CLAAS (a full cooperation agreement has been signed).

2.9.4 National Accreditation Requirements

Maximum/minimum ECTS per semester allowed:

30 ECTS per semester. 90 ECTS for the entire educational programme.

Mandatory components required by national authorities:

Mandatory components are determined independently by each higher education institution according to the established learning outcomes and the general and professional competencies defined by the Higher Education Standard for the specialty "Agroengineering", approved by the Order of the Ministry of Education and Science of Ukraine dated 10 July 2019.

Special rules for MSc thesis / project:

The defense of the Master's thesis must be conducted publicly before a committee appointed by the higher education institution, which includes four professional faculty members from the graduating department and a specialist (usually the chief engineer of an agricultural enterprise), appointed by the Chair of the examination committee.

3. Master of Science (MSc) in Precision Agriculture and Digital Farming

3.1 Detailed description of the MSc Programme

This section presents the administrative information of the MSc Programme, including the degree awarded and the academic level of the qualification, the specific entry requirements and regulations, and the main objectives and profile of the programme. It also includes career trajectories for graduates and further academic opportunities, as well as a thorough explanation of the assessment, grading system, and the criteria for graduation.

The programme is offered in full-time mode, structured over three academic semesters. Teaching methods include lectures, laboratory sessions, field demonstrations, industry-linked internship training, and supervised research.

Since the MSc Programme in developed under the ReGrow project (project no. 101179755), the Programme Director will be the Aristotle University of Thessaloniki (AUTH), as the Project Coordinator. AUTH will be responsible for:

- Academic coordination across partner institutions
- Quality assurance and curriculum harmonisation
- Oversight of joint governance mechanisms

The joint governance framework ensures coordinated academic standards, transparency, and sustainability of the programme.

3.1.1 Degree Awarded and Academic Level

The programme leads to the award of a Master of Science in Precision Agriculture and Digital Farming.

The qualification corresponds to:

- European Qualifications Framework (EQF) Level 7
- Second Cycle (Master's level) of the Bologna Process
- 90 ECTS credits[5]

[5] *According to the Grant Agreement (GA) of the ReGrow Project (no. 101179755) the MSc Programme will be in total of 120 ECTS. However, due to national regulations of Georgia and Ukraine, 90 ECTS is the maximum awarded points for an MSc. Respecting the national frameworks and the foreseen number by the GA, the Modules are structured in a way to fulfill the 120 ECTS, including though optional courses for students so they can reach 90 ECTS and not more.*

The degree is delivered as a joint Master's programme developed by Higher Education Institutions (HEIs) in Georgia and Ukraine, in collaboration with HEIs in Greece and Germany, within the framework of the Erasmus+ Capacity Building in Higher Education (CBHE) ReGrow project.

The joint programme structure, learning outcomes, assessment framework, and credit allocation are aligned across partner institutions to ensure academic comparability, transparency, and mutual recognition.

3.1.2 Admission Requirements and Academic Regulations

To be able to join the programme, applicants must:

1. Hold a recognised Bachelor's degree (or equivalent qualification) in:
   i. Agriculture or Agronomy
   ii. Agricultural Engineering
   iii. Environmental Sciences
   iv. Biology or Forestry
   v. Engineering or ICT (with relevant agricultural background)
2. Demonstrate adequate academic preparation in scientific and/or quantitative disciplines
3. Meet institutional language requirements, where applicable
4. Fulfil national regulatory of the awarding institution

Each partner institution applies its national regulatory framework for postgraduate admissions, while ensuring alignment with the jointly agreed academic profile of the programme.

The programme follows:

- The European Credit Transfer and Accumulation System (ECTS)
- National accreditation and quality assurance standards
- Institutional postgraduate regulations of the awarding institution

3.1.3 Programme Profile and Objectives

Table 1. Profile and Objectives of the MSc Programme

Aspect	Description
Programme Profile	The MSc is an interdisciplinary, research-informed and practice-oriented programme designed to respond to emerging technological, environmental, and socio-economic challenges in modern agriculture.
	Integrates agricultural sciences, geospatial technologies (GIS and Remote Sensing), robotics and automation, Internet of Things and digital farming systems, sustainability and climate-smart agriculture, applied research and innovation.
	Addresses skills gaps identified through the ReGrow needs assessment and promotes digital transformation and sustainable agricultural development in partner countries.
Programme Objectives	Develop advanced knowledge of precision agriculture technologies and systems

	Strengthen digital competences in agricultural production and management	
	Promote sustainable and climate-resilient agricultural practices	
	Enhance innovation and problem-solving capacity in the agri-food sector	
	Foster university-industry collaboration through applied training and internships	
	Prepare graduates for research, professional practice, and further academic study	
Programme-Level Learning Outcomes	**Type**	**Key-competences acquired**
	Knowledge	Demonstrate advanced understanding of precision agriculture systems and digital farming technologies
		Explain the scientific principles underpinning sustainable and climate-smart agriculture
	Skills	Analyse and interpret geospatial, sensor, and aerial data for agricultural decision-making
		Design and implement precision agriculture strategies using digital tools and IoT systems
		Evaluate technological solutions in terms of environmental, technical, and economic performance
		Conduct applied research using appropriate methodologies
	Competence	Manage innovation and digital transformation processes within agricultural enterprises
		Operate autonomously and responsibly in complex professional and research environments
		Collaborate effectively with multidisciplinary teams and stakeholders

3.1.4 Programme Structure and Credit Allocation

The MSc in Precision Agriculture and Digital Farming consists of 90 ECTS credits and it structured over three semesters. It combines core modules, optional specialisation modules, an applied internship, and a dissertation project. The following table outlines the credit allocation for each semester.

3.1.4.1 Programme Structure

Table 2. Programme Structure

Semester	Module Type	Modules	ECTS
Semester 1	Core	Fundamentals of Precision Agriculture	6
		Remote Sensing & Aerial Data Analysis	6
		Agricultural Robotics & Automation	6
		GIS & Spatial Analysis in Agriculture	6
		Smart Farming Technologies and IoT Systems	6
Semester 2	Core	Sustainable Agricultural Practices & Climate-Smart Farming	6
	Optional	Data Analytics in Agriculture	6
		Agricultural Economics & Agribusiness Management	6
		Soil Health & Nutrient Management	6

		Modelling and Design of Technological Processes, Machinery, and Equipment for Agricultural Production	6
		Advanced Plant Physiology	6
	Applied component	Applied Precision Agriculture Project – Internship	10
Semester 3	Dissertation	MSc Dissertation	20
Total Credits			90 ECTS

3.1.4.2 Credit Distribution Overview

Table 3. ECTS of the Programme[6]

Component	ECTS
Core Modules	36
Optional Modules	24
Internship	10
Dissertation	20
Total	90

3.1.5 Assessment and Grading System

3.1.5.1 Assessment Methods

Student performance is assessed through:

- Written exams
- Practical laboratory and field assessments
- Software-based analytical assignments
- Project reports and presentations
- Internship evaluation
- Dissertation submission and oral defence

Assessment methods are aligned with learning outcomes and ensure evaluation of theoretical knowledge, applied skills, research competence, and professional responsibility.

3.1.5.2 Grading System

The programme uses a 0-100 grading scale, aligning with the grading systems used in Georgia and Ukraine. In particular:

- 90-100 – Excellent
- 80-89 – Very Good

[6] To accommodate national requirements, the consortium agreed to adjust the ECTS allocation, reducing the volume of the Master's Dissertation and Internship components to 5 ECTS each for the Ukrainian HEIs, and increasing the flexibility within the optional module pool with the modules under Agroengineering and Agronomy. The proposed ECTS allocation can be found in Chapter 3.1.7.

- 70-79 – Good
- 60-69 – Satisfactory
- 50-59 – Pass
- Below 50 – Fail

All components, including modules, internship, and dissertation, must achieve a minimum passing grade of 50/100 for successful completion of the programme.

3.1.5.3 Graduation Requirements

To be awarded the MSc degree, students must:

1. Successfully complete all 90 ECTS credits
2. Pass all core and selected optional modules
3. Successfully complete the internship
4. Submit and defend the 30 ECTS MSc Dissertation
5. Fulfil all institutional academic and administrative requirements

3.1.6 Joint Governance and Quality Assurance Framework

The MSc is implemented under a joint academic governance structure agreed by the ReGrow consortium.

A Joint Academic Committee (JAC) composed of representatives from participating institutions is responsible for:

- Curriculum harmonization and periodic review
- Monitoring academic standards
- Esnuring alignment with EQF Level 7
- Reviewing student performance and feedback
- Coordinating module allocation and teaching responsibilities

Quality Assurance is ensured through:

- Compliance with national accreditation frameworks
- Annual academic review procedures
- Student evaluation of modules
- External stakeholder consulation (industry respresentatives and agricultural professionals)
- Transparent assessment and thesis evaluation procedures

This governance framework ensures academic coherence, transparency, sustainability, and long-term institutional integration of the programme beyond the duration of the ReGrow project.

3.1.7 National Compliance Adaptation, Disclaimer and Risk Mitigation Framework

The ReGrow MSc in Precision Agriculture and Digital Farming is developed as a joint academic framework aligned with European standards and the Bologna Process. However, in accordance with national accreditation requirements in Ukraine, particularly for specialties 201 "Agronomy" and 208 "Agroengineering," additional mandatory modules are required to ensure compliance with the National Education Standards.

The national accreditation methodology in Ukraine requires alignment with mandatory competencies and Programme Learning Outcomes (PLOs), which account for approximately 80–90% of the curriculum content[7]. In order to reconcile the joint European-oriented structure of the ReGrow MSc with national regulatory frameworks, the consortium has agreed to introduce an adaptive compliance mechanism.

Under this mechanism:

1. The core academic structure of the ReGrow MSc (digital, innovative and sustainability-oriented components) remains intact.
2. A defined credit pool within the 90 ECTS framework is reserved for national alignment modules.
3. Ukrainian Higher Education Institutions may incorporate the following nationally required modules within this allocated credit pool:
    - Modules Required for Specialty 208 "Agroengineering"
        - Foreign Language
        - Methodology of Scientific Research and Intellectual Property
        - Management in Agricultural Production
        - Occupational Safety and Ecology
        - Ukrainian Legislation and Law
        - Modeling and Optimization of Production Systems
        - Design and Calculation of Technological Systems
    - Modules Required for Specialty 201 "Agronomy"
        - Professional Foreign Language
        - Methodology and Organization of Scientific Research
        - Modern Technologies in Crop Production
        - Integrated Plant Protection in the Precision Agriculture System

These modules serve as a baseline for the individual accreditation trajectories of Ukrainian HEIs and will be further developed during the programme implementation phase. Their inclusion does not

[7] *See Annex I*

constitute a separate or double educational framework but represents a nationally required adaptation within the unified 90 ECTS structure. The refined ECTS allocation is:

Table 4. Revised ECTS allocation for the Ukrainian HEIs

Component	ECTS
Core Modules	36
Optional Modules	24
Internship	5
Dissertation	5
Total	70 (20 ECTS remaining will be covered from the modules proposed above)

This approach ensures:

- Full compliance with Ukrainian National Education Standards;
- Preservation of the digital and innovative core of the ReGrow MSc;
- No increase in total ECTS volume beyond 90 credits;
- Institutional flexibility during national accreditation procedures.

Furthermore, the programme structure remains adaptable to future changes in national legislation in participating countries. Any necessary modifications required by regulatory updates will be implemented at institutional level without altering the fundamental academic objectives and international orientation of the ReGrow MSc framework.

3.2 Academic Modules

This section provides comprehensive details for each module within the MSc in Precision Agriculture and Digital Farming. Each module is described with its title, classification as mandatory or option, delivery timing, and corresponding ECTS credits. This structured module overview ensures clarity regarding the academic content, assessment, and professional application of each course unit within the programme.

3.2.1 Module 1: Fundamentals of Precision Agriculture

Module Code:
Credits (ECTS): 6
Semester: 1
Status: Mandatory

3.2.1.1 Module Description

Provide a short paragraph describing what the module covers and how it contributes to the MSc program.

3.2.1.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 5. Types and Key Competences acquired

Type	Key competences

Knowledge	**K1.** Understand the fundamental concepts and principles of precision agriculture, including spatial and temporal variability in agricultural systems.
	K2. Understand the core technologies of precision farming, such as GNSS/GPS, remote and proximal sensing, yield monitoring, variable-rate technologies, and decision-support systems.
	K3. Understand the biological and agronomic foundations underlying sensor-based measurements and data-driven crop management decisions.
Skills	**S1.** Use simple precision agriculture tools and datasets to observe spatial or temporal variability in crops and fields under guidance.
	S2. Perform basic interpretation of sensor data outputs (e.g. maps, indices, charts) to support elementary crop management decisions.
	S3. Identify and describe potential applications of precision agriculture techniques to common crop management problems.
Competencies (Autonomy & responsibility)	**C1.** Critically compare and assess different sensing, data acquisition, and modeling approaches used in precision agriculture, including their strengths and limitations.
	C2. Independently select and justify appropriate precision agriculture methods for specific crop management scenarios.

3.2.1.3 Syllabus / Indicative Content

The module introduces the concept, principles of precision farming technologies, and their applications. Main topics include:

1. The concept of precision agriculture and recent technological developments;
2. Key supporting technologies, including remote sensing, geographic information systems (GIS), global positioning systems (GPS), navigation technologies, robotics and automation, communication technologies, sensors and sensor-carrying platforms, and variable-rate technology (VRT);
3. Measurement and management of soil spatial variability (e.g. nutrients and water);
4. Crop spatial variability (e.g. crop health and stress) and principles of site-specific crop management;
5. Basic principles of yield monitoring and quality assessment;
6. Introduction to plant phenotyping technologies and their applications;
7. Introductory concepts of data handling and analysis in precision agriculture and plant phenotyping;
8. Environmental and ecological implications of precision agriculture;
9. Economic aspects and adoption of precision farming technologies.

3.2.1.4 Teaching & Learning Methods

- The module is delivered through lectures, which provide a systematic introduction to the fundamental concepts, terminology, and theoretical basis of precision agriculture.
- **Case studies** are used to deepen understanding of selected topics and to encourage discussion and interaction among students.

- **Practical exercises** introduce basic applications of precision agriculture, including field visits and guided interpretation of soil and crop variability using selected sensor outputs and simple modeling approaches.
- The exercises include **computer-based sessions** focused on analyzing and interpreting results using pre-collected example datasets.
- **Group-based exercises** support collaborative learning, with students discussing results and observations with the instructor and classmates.

3.2.1.5 Assessment Methods

- Written exam: 70%
- Group project: 30%

3.2.1.6 Workload Distribution (ECTS Breakdown)

6 ECTS × 25 hours = 150 hours

- **Lectures: 36 hours** *(e.g. 3 hours/week × 12 weeks)*
- **Labs / practical sessions: 24 hours** *(computer-based exercises, guided data interpretation)*
- **Fieldwork: 20 hours** *(field visits, demonstrations, observation of sensors and variability)*
- **Independent study: 50 hours** *(literature reading, exam preparation, review of lecture materials)*
- **Assignments: 20 hours** *(case study reports, short exercises, group tasks)*

3.2.1.7 Required Resources

Software

- **Geographic Information Systems (GIS):** *e.g.* QGIS (introductory map viewing and basic spatial analysis)
- **Data analysis tools:** spreadsheet software and simple scripts (*e.g.* basic Python notebooks for demonstration only)

Equipment

- **Soil sampling tools:** *e.g.* soil probes for basic field observations
- **Positioning systems:** GPS/GNSS devices for field navigation and spatial referencing
- **Sensors and sensor platforms:** *e.g.* soil moisture sensors, crop sensors, and IoT-based monitoring devices

3.2.2 Module 2: Remote Sensing and Aerial Data Analysis

Module Code:
Credits (ECTS): 6
Semester: 1
Status: Mandatory

3.2.2.1 Module Description

Remote Sensing & Aerial Data Analysis provides an integrated introduction to the use of satellite and UAV-based Earth observation data in Precision Agriculture, including an overview of data-driven approaches used for the analysis and interpretation of agricultural imagery. The module focuses on supporting informed decision-making at farm, regional, and policy level by examining how remotely sensed data are used to monitor crop conditions, assess spatial variability, and support sustainable management of agricultural systems through indicators such as vegetation indices and spatial analysis outputs. Particular emphasis is placed on the economic value, environmental relevance, and governance context of remote sensing applications, including regulatory aspects of UAV use. Through applied examples and case studies, students develop the capacity to interpret aerial and satellite information as part of broader decision-support processes contributing to productivity, sustainability, and resilience in modern agriculture.

3.2.2.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 6. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Explain the fundamental principles of satellite- and UAV-based remote sensing for agricultural applications, including the role of vegetation indices, spatial analysis outputs, and data-driven approaches in crop monitoring and agricultural management.
	K2. Describe the economic, environmental and governance context of remote sensing applications in agriculture, including regulatory frameworks for UAV use and the relevance of data-driven imagery analysis for sustainable and policy-informed decision-making.
Skills	**S1.** Interpret satellite and aerial imagery outputs (e.g. vegetation indices, spatial variability maps) to support basic agronomic assessments and decision-making in Precision Agriculture contexts.
	S2. Assess the potential value and limitations of remote sensing and data-driven imagery applications by considering economic feasibility, environmental impact and local adoption conditions.
Competencies (Autonomy & responsibility)	**C1.** Critically evaluate the appropriateness of remote sensing and aerial data solutions for different agricultural scenarios, taking into account sustainability objectives, regulatory constraints, and resource availability.
	C2. Communicate remote sensing–based insights in an understandable manner to different stakeholders (e.g. farmers, advisors, policymakers), supporting informed decision-making and responsible adoption of Precision Agriculture technologies.

3.2.2.3 Syllabus / Indicative Content

1. **Introduction to Remote Sensing in Precision Agriculture**

Introduces the role of satellite and UAV-based remote sensing in addressing productivity, sustainability, and climate-related challenges in modern agricultural systems.

2. **Satellite and Aerial Image Acquisition for Agricultural Monitoring (Conceptual Overview)**

   Overview of satellite and drone imagery sources, types of sensors, spatial and temporal resolution, and practical considerations for agricultural use.

3. **Fundamentals of Vegetation Indices and Crop Condition Monitoring**

   Conceptual understanding of vegetation indices and their use in assessing crop status, stress detection, and spatial variability.

4. **Spatial Variability and Field-Level Decision Support**

   Interpretation of spatial patterns and maps derived from remote sensing data to support agronomic and management decisions.

5. **UAV Operations and Regulatory Frameworks**

   Introduction to UAV use in agriculture, including operational principles, safety considerations, and European and national regulatory requirements.

6. **Data-Driven Approaches in Agricultural Imagery (Introductory)**

   Overview of data-driven methods used in the analysis and classification of agricultural imagery, focusing on concepts and applications rather than technical implementation.

7. **Economic Value and Cost–Benefit Considerations of Remote Sensing Applications**

   Assessment of economic feasibility, efficiency gains, and return-on-investment considerations related to the use of remote sensing in agriculture.

8. **Environmental Sustainability and Resource Management**

   Use of remote sensing indicators to support environmentally sustainable practices, resource efficiency, and monitoring of environmental impacts.

9. **Technology Adoption, Local Context and Policy Implications**

   Barriers and drivers for adoption of remote sensing technologies, local adaptation challenges, and relevance for agricultural policy and governance.

3.2.2.4 Teaching & Learning Methods

- Lectures
- Group project work
- Case-based learning
- Problem-oriented discussions
- Independent study and guided reading

3.2.2.5 Assessment Methods

- Written exam: 60%
- Applied analytical report (based on case studies provided datasets): 20%
- Group project: 30%

3.2.2.6 Workload Distribution (ECTS Breakdown)

6 ECTS × 25 hours = 150 hours

- **Lectures:** 30 hours
- **Guided applied sessions / case analysis:** 20 hours
- **Independent study:** 68 hours
- **Assignments and project work:** 30 hours
- **Exams:** 2 hours

3.2.2.7 Required Resources

Software

- **Geographic Information Systems (GIS):** *e.g.* QGIS (introductory map viewing and basic spatial analysis)
- **Data analysis tools:** spreadsheet software and simple scripts (*e.g.* basic Python notebooks for demonstration only)
- **Remote sensing data platforms - Open-access platforms** providing satellite imagery and derived products for educational use (*e.g.* Copernicus Sentinel data viewers)

Equipment

- **Aerial monitoring platforms** (*e.g.* UAVs/drones)
- **Positioning systems:** GPS/GNSS devices for field navigation and spatial referencing
- **Sensors and sensor platforms:** *e.g.* soil moisture sensors, crop sensors, and IoT-based monitoring devices

3.2.2.8 Bibliography

Required reading:

- Food and Agriculture Organization of the United Nations (FAO) & Joint Research Centre, European Commission. (2021). Handbook on remote sensing for agricultural statistics. FAO. https://openknowledge.fao.org
- Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M.-J. (2017). Big Data in Smart Farming – A review. *Agricultural Systems, 153*, 69–80. https://doi.org/10.1016/j.agsy.2017.01.023

- European Commission. (2020). Precision agriculture handbook for beginners. Erasmus+ Programme. https://ec.europa.eu/programmes/erasmus-plus
- Zhang, J. (2025). The principles, applications, and development trends of GIS and remote sensing technology in precision agriculture. *Theoretical and Natural Science.* https://direct.ewa.pub
- Sishodia, R. P., Ray, R. L., & Singh, S. K. (2020). Applications of Remote Sensing in Precision Agriculture. Remote Sensing, 12(19), 3136. Provides a comprehensive review of remote sensing systems, vegetation indices, and PA applications (irrigation, nutrients, yield, pest/disease monitoring). https://www.mdpi.com/2072-4292/12/19/3136
- Papadopoulos, G., Arduini, S., Uyar, H., Psiroukis, V., & Fountas, S. (2024). Economic and environmental benefits of digital agricultural technologies in crop production: A review. Agritech, 100441. https://www.sciencedirect.com/science/article/pii/S2772375524000467

Recommended reading:

- Lottering, R., Peerbhay, K., & Adelabu, S. (2025). Remote sensing applications in agricultural, earth and environmental sciences. *Applied Sciences, 15*(8), 4537. https://doi.org/10.3390/app15084537
- Anand, S., Yadav, S., Lal, P., Mishra, P., & Rani, U. (Eds.). (2026). Sustainable agriculture development and management through geospatial technologies. Springer. https://link.springer.com/book/9789819563739
- Copernicus Programme – European Commission. Sentinel data and services for agriculture (open-access platform). https://www.copernicus.eu
- Computers and Electronics in Agriculture (Open-access journal). https://www.sciencedirect.com/journal/computers-and-electronics-in-agriculture
- Phang, S. K., Chiang, T. H. A., & Happonen, A. (2023). *From Satellite to UAV-Based Remote Sensing: A Review on Precision Agriculture.* IEEE Review. https://www.researchgate.net/publication/375479065_From_Satellite_to_UAV-based_Remote_Sensing_A_Review_on_Precision_Agriculture
- Nature Reviews Article (2026). Reviewing the evidence on precision agriculture and sustainability https://www.nature.com/articles/s44264-026-00128-x

3.2.3 Module 3: Agricultural Robotics & Automation

Module Code:
Credits (ECTS): 6
Semester: 1

Status: Mandatory

3.2.3.1 Module Description

This module introduces students to advanced principles and applications of robotics and automation in modern agriculture. It focuses on autonomous agricultural machinery, intelligent robotic systems, sensor technologies, artificial intelligence, and precision farming solutions. The module emphasizes system integration, critical analysis, and evaluation of state-of-the-art agricultural automation technologies. Students acquire advanced theoretical knowledge and practical competencies required to design, implement, and assess robotic and automated solutions that enhance sustainability, productivity, and efficiency in agricultural production.

3.2.3.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 7. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Analyze and compare advanced concepts, architectures and methodologies of Agricultural robotics and automation systems used in modern farming.
	K2. Evaluate the role and impact of artificial intelligence, sensor technologies and autonomous machinery on precision agriculture and sustainable agricultural production.
Skills	**S1.** Design and develop integrated robotics and automated solutions for complex agricultural operations based on data-driven and intelligent control approaches.
	S2. Analyze and interpret sensor data and system performance metrics to optimize robotic and automated agricultural processes.
Competencies (Autonomy & responsibility)	**C1.** Critically evaluate alternative robotic and automation technologies and independently justify their selection for specific agricultural applications.
	C2. Critically evaluate alternative robotic and automation technologies and independently justify their selection for specific agricultural applications.

3.2.3.3 Syllabus / Indicative Content

1. Introduction to Agricultural Robotics and Automation
2. Types of Agricultural Robots (field robots, harvesting robots, UAVs, UGVs)
3. Sensors and Actuators in Smart Farming
4. Autonomous Navigation and Control Systems
5. Artificial Intelligence and Machine Vision in Agriculture
6. Robotics in Crop Monitoring and Precision Farming
7. Automated Irrigation and Fertilization Systems
8. UAVs and Drones for Agricultural Applications
9. Safety, Ethics, and Legal Aspects of Agricultural Robotics
10. Sustainability and Environmental Impact of Automation
11. Case Studies and Industry Applications
12. Future Trends in Agricultural Robotics

3.2.3.4 Teaching & Learning Methods

- Lectures
- Laboratory sessions
- Practical demonstrations
- Field practice
- Problem-based learning
- Group project work
- Software-based simulations

3.2.3.5 Assessment Methods

- Written exam: 40%
- Lab report: 20%
- Practical assessment: 20%
- Group project: 30%

3.2.3.6 Workload Distribution (ECTS Breakdown)

6 ECTS × 25 hours = 150 hours

- **Lectures:** 30 hours
- **Labs/practical sessions:** 30 hours
- **Fieldwork:** 15 hours
- **Independent study:** 45 hours
- **Assignments:** 30 hours

3.2.3.7 Required Resources

Software

- Python (including libraries such as OpenCV),
- R,
- PostgreSQL / PostGIS,
- MATLAB/Simulink (where institutionally available),
- Robot Operating System (ROS / ROS2 – introductory level),
- Introductory Farm Management Information Systems (FMIS) platforms.
- edX.org

3.2.3.8 Bibliography

Required reading:

- **OpenCV Python Tutorial (Docs)** - https://docs.opencv.org/master/d6/d00/tutorial_py_root.html
- **Python.org Tutorials** - https://docs.python.org/3/tutorial/
- **Introduction to R (CRAN Manual)** - https://cran.r-project.org/doc/manuals/r-release/R-intro.html
- **R for Data Science (online version)** - https://r4ds.had.co.nz/
- **PostgreSQL Official Documentation** -https://www.postgresql.org/docs
- **PostGIS Quick Start** - https://postgis.net/docs/manual-3.3/
- **Learn PostGIS (Boundless / OpenGeo Online Courses)** - https://www.osgeo.org/
- **ROS2 Tutorials (ROS Wiki)** - https://docs.ros.org/en/rolling/Tutorials.html
- **Open Data Kit (ODK) Tutorials** - https://docs.getodk.org
- **QGIS Training Manual (Free PDF)** - https://docs.qgis.org/latest/en/docs/training_manual/
- **ArcGIS Learn (Free Resources)** - https://learn.arcgis.com/en/

Recommended reading:

Recommended readings include open-access resources and academic publications available via university libraries:

- Szeliski, Computer Vision: Algorithms and Applications, 2th edition, 2022, Springer: https://library.huree.edu.mn/data/202295/2024-06-03/Computer%20Vision%20-%20Algorithms%20and%20Applications%202nd%20Edition,%20Richard%20Szeliski.pdf;
- VanderPlas – Python Data Science Handbook
- Geospatial Analysis (de Smith et al.), Dr Michael J de Smith, Prof Michael F Goodchild Prof Paul A Longley & Associates 7th edition, 2025, - https://www.spatialanalysisonline.com/extractv7.pdf;
- Open Access Journals:
    - Computers and Electronics in Agriculture;
    - Sensors *(MDPI);*
    - Precision Agriculture;
    - Springer Handbook of Robotics;
    - Programming Robots with ROS (O'Reilly);
    - Precision Agriculture Technology (CRC Press);
    - Database System Concepts.

3.2.4 Module 4: GIS & Spatial Analysis in Agriculture

Module Code:
Credits (ECTS): 6

Semester: 1
Status: Mandatory

3.2.4.1 Module Description

This module provides advanced knowledge and practical skills in the application of Geographic Information Systems (GIS) and spatial analysis for modern agricultural systems. Students learn how to manage and analyse geospatial data, perform spatial interpolation, develop soil and crop maps, and create field zoning and management maps for precision agriculture. The module emphasises integration of GIS outputs with Farm Management Information Systems (FMIS) to support data-driven decision-making, sustainability, and efficient resource use in crop production systems.

3.2.4.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 8. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Explain GIS database structures, spatial data models, and geospatial modelling techniques used in precision agriculture.
	K2. Describe spatial variability of soils and crops and its implications for precision fertilisation, irrigation, and sustainable farm management.
	K3. Explain the role of GIS-based decision support within FMIS, policy frameworks (CAP, Green Deal), and environmental compliance.
Skills	**S1.** Collect, manage, and analyse geospatial data from GNSS, sensors, UAV-derived products, and field sampling.
	S2. Apply spatial interpolation and classification methods to produce soil maps, crop maps, and management zones adapted to local conditions.
	S3. Generate prescription and management maps and integrate them into FMIS platforms for operational use.
	S4. Perform basic cost–benefit and ROI analysis of GIS-based precision agriculture interventions.
Competencies (Autonomy & responsibility)	**C1.** Independently design GIS-based workflows for agricultural decision-making, combining agronomic, technical, and digital inputs.
	C2. Critically evaluate spatial analysis results from a sustainability, economic, and regulatory perspective and communicate them effectively to stakeholders.

3.2.4.3 Syllabus / Indicative Content

1. Role of GIS in digital and precision agriculture systems.
2. Spatial data models, GIS databases, and data quality issues.
3. Data acquisition: GNSS, soil sampling, yield monitoring, sensors, UAV-derived data.
4. Integration of IoT and sensor data into GIS workflows.
5. Spatial interpolation methods (IDW, Kriging, spline) and uncertainty analysis.
6. Soil property mapping and localisation to soil and crop types.
7. Crop variability, yield mapping, and stress detection.
8. Field zoning and delineation of management zones.
9. Development of management and prescription maps (fertilisation, irrigation, crop protection).
10. Integration of GIS outputs with FMIS platforms and API-based data exchange.

11. Environmental sustainability, Green Deal objectives, and compliance considerations.
12. Economic evaluation, ROI of PA solutions, and industry case studies.

3.2.4.4 Teaching & Learning Methods

- Lectures
- GIS software laboratories (hands-on, data-driven)
- Practical exercises using real or demo datasets
- Field-based data collection demonstrations (where infrastructure allows)
- Problem-based learning and case studies

3.2.4.5 Assessment Methods

- Written exam: 30%
- Practical assessment: 70%

3.2.4.6 Workload Distribution (ECTS Breakdown)

6 ECTS × 30 hours = 180 hours

- **Lectures:** 16 hours
- **Labs/practical sessions:** 30 hours
- **Independent study:** 134 hours

3.2.4.7 Required Resources

Software

- QGIS / ArcGIS
- FMIS platform (educational or demo version)

Equipment

- GPS / GNSS receivers
- Computers with GIS capability
- Soil sampling tools
- Sensors / UAV data (own or provided datasets)

3.2.4.8 Bibliography

Required reading:

1. Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2021). *Geographic information science and systems* (4th ed.). Wiley. https://www.wiley.com/en-us/Geographic+Information+Science+and+Systems%2C+4th+Edition-p-9781119128458
2. Lamine, S., Srivastava, P. K., Kayad, A., Muñoz-Arriola, F., & Pandey, P. C. (Eds.). (2023). *Remote sensing in precision agriculture: Transforming scientific advancement into innovation*. Elsevier. https://www.elsevier.com/books/remote-sensing-in-precision-agriculture/lamine/9780323910682
3. Triantakonstantis, D. T., & Tziachris, P. (Eds.). (2022). *Integrating GIS and remote sensing in soil mapping and modeling*. MDPI. https://www.mdpi.com/books/reprint/6428-integrating-gis-and-remote-sensing-in-soil-mapping-and-modeling
4. Food and Agriculture Organization of the United Nations, & Joint Research Centre (European Commission). (2021). *Handbook on remote sensing for agricultural statistics*. FAO. https://openknowledge.fao.org
5. Mueller, T. G., & Sassenrath, G. F. (Eds.). (2022). *GIS applications in agriculture, Volume 4: Conservation planning*. CRC Press. https://www.routledge.com/GIS-Applications-in-Agriculture-Volume-Four-Conservation-Planning/Mueller-Sassenrath/p/book/9781032098807

Recommended reading:

1. Rajput, V. D., Singh, A., Minkina, T., Singh, A. K., & Singh, N. P. (Eds.). (2025). *Geoinformatics: An emerging approach for sustainable crop production and food security*. Apple Academic Press / CRC Press. https://www.appleacademicpress.com/geoinformatics-an-emerging-approach-for-sustainable-crop-production-and-food-security/9781774916285
2. Anand, S., Yadav, S., Lal, P., Mishra, P., & Rani, U. (Eds.). (2026). *Sustainable agriculture development and management through geospatial technologies*. Springer. https://link.springer.com/book/9789819563739
3. European Commission. (2020). *Precision agriculture handbook for beginners*. Erasmus+ Programme. https://ec.europa.eu/programmes/erasmus-plus
4. Lottering, R., Peerbhay, K., & Adelabu, S. (2025). Remote sensing applications in agricultural, earth and environmental sciences. *Applied Sciences, 15*(8), 4537. https://doi.org/10.3390/app15084537
5. Zhang, J. (2025). The principles, applications, and development trends of GIS and remote sensing technology in precision agriculture. *Theoretical and Natural Science*. https://direct.ewa.pub
6. MDPI. (2025). *Applications of GIS and remote sensing in soil environment monitoring*. MDPI. https://mdpires.com/bookfiles/book/8273/Applications_of_GIS_and_Remote_Sensing_in_Soil_Environment_Monitoring.pdf

3.2.5 Module 5: Smart Farming Technologies & IoT Systems

Module Code:
Credits (ECTS): 6
Semester: 1
Status: Mandatory

3.2.5.1 Module Description

This module introduces smart farming technologies with a strong hands-on focus on IoT systems tailored to the operational realities of agriculture in Georgia and Ukraine. Students learn how sensor-based systems are installed, configured, maintained, and integrated into farm-level decision-making. Emphasis is placed on low-cost, scalable IoT solutions, real-time data acquisition, and the use of sensor data to support sustainable and climate-smart agricultural practices. The module directly addresses identified skills gaps in digital agriculture, bridging agronomic needs with practical technological implementation.

3.2.5.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 9. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Describe IoT architectures, sensors, and communication technologies used in precision agriculture, with emphasis on practical deployment constraints.
	K2. Explain how IoT-generated data supports agronomic decision-making, sustainability, and resource efficiency.
Skills	**S1.** Install, configure, and maintain basic agricultural IoT sensor systems (soil, climate, crop monitoring).
	S2. Collect, visualise, and interpret IoT data to support irrigation, fertilisation, and crop management decisions.
Competencies (Autonomy & responsibility)	**C1.** Select appropriate IoT technologies for specific farming contexts, considering cost, scalability, and environmental impact.
	C2. Apply IoT-based solutions responsibly to improve farm productivity and sustainability, working independently or in multidisciplinary teams.

3.2.5.3 Syllabus / Indicative Content

1. **Smart Farming Concepts and Precision Agriculture Needs**

   Introduces the role of smart farming in addressing productivity, sustainability, and climate challenges in modern agriculture.

2. **IoT Components for Agriculture: Sensors, Nodes, Gateways**

   Explains the core components of IoT systems and their functions within agricultural monitoring networks.

3. **Agricultural Sensor Types: Soil, Weather, Crop, Livestock**

   Presents common sensor technologies used to monitor environmental, crop, and livestock parameters in real time.

4. **Sensor Installation, Calibration, and Maintenance**

   Focuses on practical methods for installing, calibrating, and maintaining agricultural sensors to ensure data accuracy.

5. **Communication Technologies for Rural Areas**

   Examines communication protocols suitable for long-range, low-power data transmission in agricultural environments.

6. **Data Acquisition and Cloud-based Dashboards**

   Introduces methods for collecting sensor data and visualising it through cloud platforms and dashboards.

7. **IoT Data Interpretation for Agronomic Decisions**

   Demonstrates how IoT data is interpreted to support decisions on irrigation, fertilisation, and crop management.

8. **Smart Irrigation and Resource-efficient Input Management**

   Explores how IoT-enabled solutions for optimising water and input use to improve efficiency and sustainability.

9. **Integration with Farm Management Information Systems**

   Explains how IoT systems are integrated with FMIS to support coordinated farm planning and operations.

10. **Sustainability, Climate-Smart Agriculture, and IoT**

    Analyses the contribution of IoT technologies to climate-smart agriculture and environmental sustainability goals.

11. **Case studies from Georgia, Ukraine, and Comparable Regions**

    Reviews real-world examples illustrating the application of IoT solutions in diverse agricultural contexts.

12. **Practical Project: Design of a low-cost smart farming IoT system**

    Engages students in designing a cost-effective IoT solution tailored to a specific agricultural problem.

3.2.5.4 Teaching & Learning Methods

- Interactive lectures (conceptual grounding)
- Hands-on IoT laboratory sessions (sensor installation and data collection)
- Software-based data visualisation exercises and demonstrations
- Case-study analysis based on local/regional farming contexts

- Problem-based group project (IoT solution design)

3.2.5.5 Assessment Methods

- Written exam: 30%
- Lab/practical report: 30%
- Group project (IoT solution for a real farming scenario): 30%
- Continuous assessment/participation: 10%

3.2.5.6 Workload Distribution (ECTS Breakdown)

6 ECTS × 25 hours = 180 hours

- **Lectures:** 30 hours
- **Labs/practical sessions:** 30 hours
- **Independent study:** 60 hours
- **Assignments and project work:** 30 hours

3.2.5.7 Required Resources

Software

- Open-source IoT platforms (ThingsBoard, Node-RED)
- Spreadsheet/basic analytics tools
- Python (basic data handling and visualisation)
- FMIS demo platforms (where available)

Equipment

- Low-cost IoT sensor kits (soil moisture, temperature, humidity)
- Arduino/ESP-based microcontrollers
- LoRa/Wifi gateways
- Internet-connected lab environment

3.2.5.8 Bibliography

Required reading:

1. Friha, O., Bouabdellah, N., & Frikha, M. (2021). *Internet of Things for the Future of Smart Agriculture.* IEEE/CAA Journal of Automatica Sinica, 8(4), 734–744. https://doi.org/10.1109/JAS.2021.1003925

2. Tao, W., He, S., Wang, X., & Fan, C. (2021). *Review of the Internet of Things communication technologies for smart agriculture.* Computers and Electronics in Agriculture, 190, 106407. https://doi.org/10.1016/j.compag.2021.106407
3. Muangprathub, J., Boonnam, R., Kajornkasirat, S., Chaiyasoonthorn, W., & Amornsiriphong, T. (2019). *IoT and agriculture data analysis for smart farm.* Computers and Electronics in Agriculture, 156, 467–474. https://doi.org/10.1016/j.compag.2018.12.032
4. Wolfert, S., Ge, L., Verdouw, C., & Bogaardt, M.-J. (2017). *Big Data in Smart Farming – A review.* Agricultural Systems, 153, 69–80. https://doi.org/10.1016/j.agsy.2017.01.023

Recommended reading:

1. LoRa Alliance. (2018). *LoRaWAN™ 1.0.3 Specification.* https://lora-alliance.org/wp-content/uploads/2020/11/lorawan1.0.3.pdf
2. OASIS. (2019). *MQTT Version 5.0 (OASIS Standard).* https://docs.oasis-open.org/mqtt/mqtt/v5.0/mqtt-v5.0.html
3. Verma, A., & Singh, R. K. (2022). *LoRaWAN-based smart irrigation system: design and field deployment results.* International Journal of Distributed Sensor Networks, 18, 155014772210834. https://doi.org/10.1177/15501477221083410
4. ThingsBoard. (n.d.). *ThingsBoard Community Edition Documentation.* Retrieved from https://thingsboard.io/docs/
5. Node-RED Foundation. (n.d.). *Node-RED Cookbook – MQTT and IoT patterns.* Retrieved from https://cookbook.nodered.org/
6. Qin, J., Ding, Y., & Xu, S. (2020). *IoT-based Crop Growth Monitoring and Analytics System with Edge Computing.* Sensors, 20(22), 6590. https://doi.org/10.3390/s20226590

3.2.6 Module 6: Sustainable Agriculture & Climate-Smart Farming

Module Code:
Credits (ECTS): 6
Semester: 1
Status: Mandatory

3.2.6.1 Module Description

This module explores the integration of precision technologies into sustainable farming systems. It focuses on the "triple win" of Climate-Smart Agriculture (CSA): sustainably increasing productivity, enhancing resilience to climate change, and reducing greenhouse gas emissions. Students will learn to use digital tools for carbon sequestration monitoring, biodiversity conservation, and resource-efficient crop production.

3.2.6.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 10. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Describe IoT architectures, sensors, and communication technologies used in precision agriculture, with emphasis on practical deployment constraints.
	K2. Explain how IoT-generated data supports agronomic decision-making, sustainability, and resource efficiency.
	K3. Describe the key soil, climatic, and biological parameters that determine land suitability for specific crop production with regard to yield quantity and quality.
Skills	**S1.** Analyze complex, multidisciplinary agronomic problems by integrating specialized conceptual knowledge and recent scientific advancements to evaluate potential solutions.
	S2. Evaluate and synthesize information from scientific literature and technical sources to support research planning and evidence-based decision-making in agronomy.
Competencies (Autonomy & responsibility)	**C1.** Develop and manage a comprehensive project plan for an applied agronomic research or production initiative, justifying its economic and environmental relevance while considering available resources and multidisciplinary constraints (technical, social, legal).
	C2. Propose and justify solutions to identified agronomic problems by planning and executing a structured research process, from methodology design to data analysis and conclusion formulation.

3.2.6.3 Syllabus / Indicative Content

1. **Foundations of Sustainability**

   UN SDGs and the European Green Deal in agriculture.

2. **Climate-Smart Agriculture (CSA) Pillars**

   Productivity, Adaptation, Mitigation.

3. **Carbon Farming**

   Soil organic matter management and carbon sequestration mapping.

4. **Water Management in Precision Agriculture**

   Drought monitoring and smart irrigation systems.

5. **Biodiversity and Precision Agriculture**

   Using GIS to manage buffer zones and field margins.

6. **Regenerative Practices**

   No-till, cover crops, and integration with VRT technologies.

7. **Greenhouse Gas Accounting**

   Tools for monitoring methane and nitrous oxide emissions.

8. **Future Trends: Circular agriculture and bio-based inputs in digital farming**

3.2.6.4 Teaching & Learning Methods

- Lectures with case studies from leading EU "Green" farms.
- GIS Labs: Mapping soil organic carbon using satellite indices (e.g., BSI).
- Problem-based learning: Designing a climate-adaptation plan for a specific farm.
- Field visits to organic or regenerative demo-sites.

3.2.6.5 Assessment Methods

- Written exam: 40%
- Lab report: 20%
- Practical assessment: 20%
- Group project: 20%

3.2.6.6 Workload Distribution (ECTS Breakdown)

6 ECTS × 20 hours = 120 hours

- **Lectures:** 14 hours
- **Labs/practical sessions:** 16 hours
- **Fieldwork:** 6 hours
- **Independent study:** 84 hours

3.2.6.7 Required Resources

Software

- QGIS/ArcGIS Pro

Equipment

- Autonomous professional weather station "AW007" with the module "UC20GC-128-STD", GPS/GNSS Rover HiTarget V30, LAN-M Pro Penetrometer, UAV: DJI Mavic-3Multispectral

3.2.6.8 Bibliography

Required reading:

1. Lal, Rattan. (2010). Managing Soils and Ecosystems for Mitigating Anthropogenic Carbon Emissions and Advancing Global Food Security. *BioScience*. 60. 708-721. 10.1525/bio.2010.60.9.8.
2. Bradford, M. A., Wieder, W. R., Bonan, G. B., Fierer, N., Raymond, P. A., & Crowther, T. W. (2016). Managing uncertainty in soil carbon feedbacks to climate change. *Nature Climate Change*, 6, 751–758.
3. Adegbeye, M., Reddy, P., Obaisi, A., Elghandour, M., Oyebamiji, K., Salem, A., Morakinyo-Fasipe, O., Cipriano-Salazar, M., & Camacho-Diaz, L. (2020). Sustainable agriculture options for production, greenhouse gasses and pollution alleviation, and nutrient recycling in emerging and transitional nations - An overview. *Journal of Cleaner Production*, 242, 118319. https://doi.org/10.1016/j.jclepro.2019.118319
4. Kabato, W., Getnet, G., Sinore, T., Németh, A., & Molnár, Z. (2025). Towards Climate-Smart Agriculture: Strategies for Sustainable Agricultural Production, Food Security, and Greenhouse Gas Reduction. *Agronomy*. https://doi.org/10.3390/agronomy15030565
5. Zeweld, W., Van Huylenbroeck, G., Tesfay, G., Azadi, H., & Speelman, S. (2020). Sustainable agricultural practices, environmental risk mitigation and livelihood improvements: Empirical evidence from Northern Ethiopia. *Land Use Policy*, 95, 103799. https://doi.org/10.1016/j.landusepol.2019.01.002
6. Mizik, T. (2021). Climate-Smart Agriculture on Small-Scale Farms: A Systematic Literature Review. *Agronomy*, 11, 1096. https://doi.org/10.3390/agronomy11061096
7. Çakmakçı, R., Salık, M., & Çakmakçı, S. (2023). Assessment and Principles of Environmentally Sustainable Food and Agriculture Systems. *Agriculture*. https://doi.org/10.3390/agriculture13051073
8. Rehman, A., Farooq, M., Lee, D., & Siddique, K. (2022). Sustainable agricultural practices for food security and ecosystem services. *Environmental Science and Pollution Research*, 29, 84076 - 84095. https://doi.org/10.1007/s11356-022-23635-z
9. Musa, S., & Lim, S. (2025). Revitalising agriculture through climate change mitigation: a systematic literature review on smart technologies and sustainable practices. *International Journal of Climate Change Strategies and Management*. https://doi.org/10.1108/ijccsm-05-2024-0071
10. Wanglin Ma, & Rahut, D. (2024). Climate-smart agriculture: adoption, impacts, and implications for sustainable development. *Mitigation and Adaptation Strategies for Global Change*, 29. https://doi.org/10.1007/s11027-024-10139-z
11. Zheng, H., W., & He, Q. (2024). Climate-smart agricultural practices for enhanced farm productivity, income, resilience, and greenhouse gas mitigation: a comprehensive review. *Mitigation and Adaptation Strategies for Global Change*, 29. https://doi.org/10.1007/s11027-024-10124-6

12. Bhartiya, S., Chakradhar, P., Lalmuanzuala, B., Serto, E., Devi, N., Jha, S., Kavipriya, J., & Dhananivetha, M. (2024). Climate-smart agriculture: Strategies for resilient farming systems. *International Journal of Research in Agronomy*. https://doi.org/10.33545/2618060x.2024.v7.i12sj.2360
13. Bhatnagar, S., Chaudhary, R., Sharma, S., Janjhua, Y., Thakur, P., Sharma, P., & Keprate, A. (2024). Exploring the Dynamics of Climate-Smart Agricultural Practices for Sustainable Resilience in a Changing Climate. *Environmental and Sustainability Indicators*. https://doi.org/10.1016/j.indic.2024.100535

Recommended reading:

1. FAO (2021) Climate-Smart Agriculture Sourcebook.

3.2.7 Module 7: Data Analytics in Agriculture

Module Code:
Credits (ECTS): 6
Semester: 2
Status: Optional

3.2.7.1 Module Description

This module equips students with practical data analytics skills for precision agriculture, addressing critical gaps identified in Georgian and Ukrainian higher education related to data handling, interpretation, and evidence-based decision-making. Students learn how to collect, clean, analyse, visualise, and interpret agricultural data from sensors, farm machinery, weather stations, and remote sensing sources. Emphasis is placed on applied analytics using accessible tools, supporting sustainable, climate-smart, and economically viable farm management decisions.

3.2.7.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 11. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Explain key concepts of agricultural data analytics, including data types, sources, and quality considerations in precision agriculture.
	K2. Describe how analytical results support agronomic decisions, sustainability goals, and resource efficiency.
Skills	**S1.** Process and analyse agricultural datasets using statistical and analytical methods.
	S2. Visualise and interpret data outputs to support farm-level decision-making (e.g., irrigation, fertilisation, yield forecasting).
Competencies (Autonomy & responsibility)	**C1.** Select appropriate data analytics approaches for specific agricultural problems and datasets.
	C2. Apply analytical insights responsibly to improve farm productivity and environmental performance.

3.2.7.3 Syllabus / Indicative Content

1. **Introduction to Data-driven Agriculture**

   Introduces the role of data analytics in improving decision-making, efficiency, and sustainability in agriculture.

2. **Types and Sources of Agricultural Data (IoT, machinery, weather, UAV, satellite)**

   Explains the main data sources used in precision agriculture and their relevance to farm management.

3. **Data quality, cleaning, and preprocessing**

   Covers techniques for ensuring data accuracy, completeness, and usabilty before analysis.

4. **Descriptive statistics for agricultural data**

   Introduces basic statistical methods for summarising and understanding agricultural datasets.

5. **Data visualisation techniques for farm decisions**

   Demonstrates how charts, maps, and dashboards are used to communicate analytical results to farmers and managers.

6. **Spatial and temporal data in agriculture (introductory level)**

   Explains how location-based and time-series data are analysed to capture variability in agricultural systems.

7. **Analytics for irrigation and nutrient management**

   Applies data analysis methods to optimise water use and nutrient application in crop production.

8. **Yield analysis and basic forecasting concepts**

   Introduces analytical approaches for evaluating yield data and supporting basic yield predictions.

9. **Integrating analytics into farm management information systems (FMIS)**

   Explains how analytical outputs are integrated into FMIS to support operational and strategic decisions.

10. **Sustainability indicators and environmental data analysis**

    Examines the use of data analytics to assess environmental performance and sustainability outcomes.

11. **Case studies from Georgian and Ukrainian Agriculture**

Analyses real-world examples demonstrating the practical use of data analytics in regional farming contexts.

12. **Applied project: Data analysis for a precision agriculture scenario**

    Engages students in applying analytical tools to solve a real agricultural data problem.

3.2.7.4 Teaching & Learning Methods

- Interactive lectures (conceptual grounding)
- Software-based practical exercises
- Guided data analysis workshops
- Case-study analysis
- Problem-based learning
- Individual or group analytical project

3.2.7.5 Assessment Methods

- Written exam (theoretical concepts): 30%
- Practical data analysis assignment: 30%
- Project (data-driven solution to an agricultural problem): 30%
- Continuous assessment/participation: 10%

3.2.7.6 Workload Distribution (ECTS Breakdown)

5 ECTS × 25 hours = 125 hours

- **Lectures:** 25 hours
- **Labs/practical sessions:** 25 hours
- **Independent study:** 50 hours
- **Assignments and project work:** 25 hours

3.2.7.7 Required Resources

Software

- Spreadsheet tools (Excel/LibreOffice Calc)
- Python (introductory level) or equivalent open-source analytics tools
- Data visualisation tools (e.g., basic GIS viewers, dashboards)

Equipment

- Computer lab with internet access
- Sample agricultural datasets (sensor, weather, yield, UAV-derived)

3.2.7.8 Bibliography

Required reading

1. Gebbers, R., & Adamchuk, V. I. (2010). *Precision agriculture and food security.* Science, 327(5967), 828–831. https://doi.org/10.1126/science.1183899
2. Kamilaris, A., Kartakoullis, A., & Prenafeta-Boldú, F. X. (2017). *A review on the practice of big data analysis in agriculture.* Computers and Electronics in Agriculture, 143, 23–37. https://doi.org/10.1016/j.compag.2017.09.037
3. Reichstein, M., Camps-Valls, G., Stevens, B., Jung, M., Denzler, J., Carvalhais, N., & Prabhat. (2019). *Deep learning and process understanding for data-driven Earth system science.* Nature, 566(7743), 195–204. https://doi.org/10.1038/s41586-019-0912-1
4. Jiménez, A. R., Aranda, C., & Garrido-Iserte, R. (2020). *A survey on agricultural data analytics: Methods, tools, and techniques.* Computers and Electronics in Agriculture, 167, 105037. https://doi.org/10.1016/j.compag.2019.105037

Recommended reading:

1. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. J. (2016). *Data Mining: Practical Machine Learning Tools and Techniques* (4th ed.). Morgan Kaufmann. *(Standard text for data mining methods and practical analytics workflows.)*
2. Python Software Foundation. (n.d.). *Python Language Reference* (Python 3.x) – https://docs.python.org/3/
   (Foundation for agricultural analytics using open-source data science tools such as pandas, NumPy, matplotlib.)
3. Jupyter Project. (n.d.). *Jupyter Notebook Documentation.* Retrieved from https://jupyter.org/documentation
   (Interactive computational notebooks for teaching and labs in data analytics.)
4. QGIS Development Team. (n.d.). *QGIS Geographic Information System.* Open Source Geospatial Foundation Project. https://qgis.org/resources/hub/ *(Open-source spatial analysis platform used for agricultural spatial data.)*
5. Sharma, P., Narravula, S., & Reddy, V. G. (2020). *Analytics-driven crop yield prediction using machine learning and UAV data.* Computers and Electronics in Agriculture, 175, 105577. https://doi.org/10.1016/j.compag.2020.105577
6. European Commission (2022). *EU Agricultural Data Integration and Interoperability Guidelines. (Policy/technical reference on data standards and integration in agriculture – official EU documents.)*

3.2.8 Module 8: Agricultural Economics & Agribusiness Management

Module Code:
Credits (ECTS): 6
Semester: 2
Status: Optional

3.2.8.1 Module Description

This module provides advanced knowledge in agricultural economics and agribusiness management, focusing on the economic evaluation of crop and livestock production systems and farm-level business decision-making. Students gain analytical tools to assess costs, revenues, investments, and production efficiency, and to evaluate agricultural enterprises in the context of market conditions, resource constraints, and broader economic and social developments. The module contributes to the MSc programme by strengthening students' capacity for economic analysis, strategic planning, and evidence-based management in agriculture.

3.2.8.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 12. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Explain core concepts of production economics and business management as applied to agricultural enterprises.
	K2. Describe cost structures, revenue mechanisms, and factor remuneration in crop and livestock production systems.
Skills	**S1.** Analyse costs, revenues, and economic performance of agricultural enterprises using established economic methods.
	S2. Apply production-economic principles to evaluate farm development options, changes in production intensity, and investment decisions.
Competencies	**C1.** Independently assess the economic viability of agricultural production processes under varying market and policy conditions.
	C2. Critically interpret economic results and reflect on their implications in a broader economic, social, and sustainability context.

3.2.8.3 Syllabus / Indicative Content

1. **Introduction to agricultural production economics and agribusiness management**
2. **Financial assessment methods for farm enterprises**
3. **Cost and revenue analysis in crop production systems**
4. **Economic evaluation of livestock production enterprises**
5. **Capital requirements and working capital management in agriculture**
6. **Cost-covering prices and profitability in short-run and long-run scenarios**
7. **Factor remuneration: land, labour, and capital**
8. **Production theory: optimal intensity and minimum-cost combinations**
9. **Investment analysis and evaluation in agricultural production**

10. **Labour management and work process costs**
11. **Influence of location and site conditions on farm enterprise structure**
12. **Case studies and applied examples from crop and livestock farming**

3.2.8.4 Teaching & Learning Methods

- **Lectures introducing theoretical concepts and economic frameworks**
- **Seminar-based tuition with guided problem-solving**
- **Case study analysis of real farm enterprises**
- **Applied exercises using farm data and economic indicators**
- **Group discussions and supervised student research work**

3.2.8.5 Assessment Methods

- Written exam (100%)

3.2.8.6 Workload Distribution (ECTS Breakdown)

6 ECTS × 25 hours = 150 hours

- **Lectures:** 45 hours
- **Seminars/practical sessions:** 30 hours
- **Assignments/group work:** 30 hours
- **Independent study:** 45 hours

3.2.8.7 Required Resources

- Spreadsheet and financial analysis tools (e.g. Excel)
- Access to farm enterprise data and case study materials

3.2.8.8 Bibliography

The module builds upon established MSc-level teaching materials from Hochschule Weihenstephan-Triesdorf (Germany). Within ReGrow, these materials will be updated, contextualized and jointly refined with partner institutions to ensure relevance to the Ukrainian and Georgian agricultural systems.

3.2.9 Module 9: Soil Health & Digital Soil Technologies

Module Code:
Credits (ECTS): 6
Semester: 2
Status: Optional

3.2.9.1 Module Description

This module provides an integrated understanding of soil health as a fundamental component of sustainable agriculture, enhanced through modern digital tools and smart technologies. It addresses physical, chemical and biological aspects of soil systems alongside digital soil diagnostics, GIS, remote sensing, IoT-based monitoring, and data-driven decision support systems. The module equips students with practical and analytical competencies to assess, monitor and improve soil health under diverse environmental and agricultural conditions.

3.2.9.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 13. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Explain the principles and indicators of soil health, including physical, chemical, and biological properties, and their relevance to sustainable agricultural systems.
	K2. Describe the concepts and applications of digital soil technologies, including GIS, remote sensing, UAVs, and IoT-based soil monitoring systems.
Skills	**S1.** Apply GIS, remote sensing, and sensor data to assess and monitor soil health and fertility in divers agro-ecological contexts.
	S2. Interpret laboratory and field-based soil data to evaluate soil quality, nutrient status, and potential degradation processes.
Competencies (Autonomy & responsibility)	**C1.** Design integrated soil health management strategies that combine traditional soil science knowledge with digital technologies to support decision-making in sustainable agriculture.
	C2. Critically evaluate soil management practices and make autonomous, evidence-based recommendations for maintaining and improving soil health under varying environmental and agronomic conditions.

3.2.9.3 Syllabus / Indicative Content

1. Principles of Soil Health
2. Soil Science
3. Soil Microbiology
4. Soil Degradation and Conservation
5. Digital Soil Mapping and GIS Applications
6. Remote Sensing and UAV for Soil Assessment
7. Soil Sensors, IoT, and Field Diagnostics
8. Data Analysis and Visualization
9. Smart Agriculture and Precision Farming
10. Integrated Pest and Disease Management
11. Climate Change and Soils
12. Case Studies and Project Work

3.2.9.4 Assessment Methods

- Written exam: 30%
- Lab report / practical report: 25%
- Practical assessment / fieldwork: 20%
- Group project / assignments: 25%

3.2.9.5 Workload Distribution (ECTS Breakdown)

4 ECTS × 30 hours = 120 hours

- **Lectures:** 40 hours
- **Labs/practical sessions:** 24 hours
- **Fieldwork:** 16 hours
- **Independent study:** 30 hours
- **Assignments and project work:** 10 hours

3.2.9.6 Required Resources

Software

- QGIS, ArcGIS – for GIS-based soil mapping and spatial analysis
- Pix4D, DroneDeploy – for UAV/drone imagery processing
- Python, R – for data analysis, visualization, and modeling
- FMIS (Farm Management Information System) platform – for smart agriculture applications

Equipment

- Soil probes and sensors – for moisture, temperature, nutrient monitoring
- Drones / UAVs – for aerial surveys and remote sensing
- GPS / GNSS devices – for precise field mapping
- IoT devices / sensor networks – for real-time soil and environmental monitoring

3.2.9.7 Bibliography

Required Reading

1. Brady, N.C., & Weil, R.R. (2017). *The Nature and Properties of Soils* (15th Edition). Pearson.
2. Hillel, D. (2004). *Introduction to Environmental Soil Physics*. Elsevier.
3. Smith, P., et al. (2016). *Soil Carbon and Climate Change: Science for Policy and Practice*. Cambridge University Press.
4. USDA NRCS (2018). *Soil Survey Manual*. United States Department of Agriculture.

Recommended Reading

1. Sparovek, G., & Schnug, E. (2015). *Digital Soil Mapping and Soil Informatics*. Springer.
2. Lal, R. (2020). *Soil Health and Climate Change*. CRC Press.
3. White, R.E. (2013). *Principles and Practice of Soil Science: The Soil as a Natural Resource* (4th Edition). Blackwell Publishing.
4. Zhang, C., & Kovacs, J.M. (2012). *The application of small unmanned aerial systems for precision agriculture: a review*. Precision Agriculture, 13, 693–712.
5. FAO. (2020). *Guidelines for Soil Description*. Food and Agriculture Organization of the United Nations.
6. Jones, D.L., & Willett, V.B. (2006). *Experimental Evaluation of Soil Microbiology Techniques*. Soil Biology & Biochemistry, 38, 317–322.
7. Online platforms:
    - QGIS Documentation: https://docs.qgis.org
    - ArcGIS Resources: https://www.esri.com/en-us/arcgis/resources
    - Pix4D Tutorials: https://www.pix4d.com/tutorials
    - R Project: https://www.r-project.org

3.2.10 Module 10: Modelling and design of technological processes, machinery, and equipment for agricultural production

Module Code:
Credits (ECTS): 6
Semester: 2
Status: Optional

3.2.10.1 Module Description

This module focuses on studying modern methods of modeling and analyzing the functioning of technological processes of machines and equipment in accordance with adaptive agricultural production. The main attention is paid to the systems engineering approach, digital twins, computer-aided engineering analysis (CAE), and optimization of flexible technological processes for the conditions of adaptive agriculture.

3.2.10.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 14. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Explain the principles of modelling and design of technological processes, machinery, and equipment used in agricultural production, including their functional structure and operating conditions.

	K2. Describe mathematical, physical, and computer-based modelling methods applied to the analysis and optimisation of agricultural machines and technological processes.
	K3. Explain the application of CAD/CAE/CFD tools for virtual prototyping, performance evaluation, and improvement of agricultural machinery and equipment with regard to efficiency, reliability, and sustainability.
Skills	**S1.** Apply modelling and simulation tools to analyse technological processes and operating regimes of agricultural machinery and equipment.
	S2. Develop and modify digital models of agricultural machines and technological systems using CAD/CAE environments.
	S3. Perform engineering calculations and CFD-based simulations to evaluate structural, kinematic, and flow-related characteristics of agricultural equipment.
	S4. Interpret simulation results and optimise design and technological parameters of machinery and equipment to improve performance, energy efficiency, and operational reliability.
Competencies (Autonomy & responsibility)	**C1.** Independently design, validate, and manage modelling and design solutions for technological processes, machinery, and equipment in agricultural production, taking responsibility for engineering decisions and their technical justification.
	C2. Critically evaluate design alternatives and modelling results with respect to technical performance, energy efficiency, sustainability, and safety, and effectively communicate engineering solutions and conclusions to both technical and non-technical stakeholders.

3.2.10.3 Syllabus / Indicative Content

1. Modern approaches to modeling agrotechnological processes. System modeling, digital twins, multiphysics modeling, uncertainty and sensitivity analysis.
2. Modeling technological processes in agriculture Modeling the interaction "working body - cultivated environment" for soil cultivation, sowing processes, fertilizer application, plant protection, harvesting grain material and its post-harvest processing.
3. Implementation of the results of modeling technological processes in the designs of agricultural machines and equipment using CAD/CAE. Reliability, safety of life, sustainable development and life cycle analysis.
4. Computer engineering analysis and simulation. Advanced CAD modeling, FEM, CFD, DEM and multi-link dynamics of machines.
5. Optimization and digital technologies of smart agriculture Engineering optimization, adaptive flexible agriculture, IoT, data-driven management, industry cases. Practical and laboratory work.

3.2.10.4 Teaching & Learning Methods

- Lectures and laboratory work with specialised software (SolidWorks, Salome + OpenFOAM) focused on modelling and design of technological processes, machinery, and equipment for agricultural production.

- Practical exercises using real or demonstration engineering datasets for analysis, modelling, and optimisation of agricultural machines and technological systems
- Problem-based learning and case studies addressing real engineering challenges in agricultural production and machinery design.

3.2.10.5 Assessment Methods

- Written exam: 30%
- Individual scientific and design project: 40%
- Practical assessment: 30%

3.2.10.6 Workload Distribution (ECTS Breakdown)

4 ECTS × 30 hours = 120 hours

- **Lectures:** 16 hours
- **Labs/practical sessions:** 16 hours
- **Independent study:** 88 hours

3.2.10.7 Required Resources

Software

- SolidWorks, Salome, OpenFOAM

Equipment

- HORSCH precision (adaptive) farming training stands

3.2.10.8 Bibliography

Required reading:

1. **Pozhydaiev, S.P.** *Models and Modeling in Engineering: А учебное издание* / S.P. Pozhydaiev. Kyiv: National University of Life and Environmental Sciences of Ukraine (NUBiP), 2012. 271 p.
2. **de Silva, C. W.** Modeling of Dynamic Systems with Engineering Applications. 2nd ed. Boca Raton: CRC Press, 2018. 792 p.
3. **Petrescu, C. P., Valeriu, V. D.** (Eds.). Modeling and Simulation in Engineering. Basel: MDPI, 2022. 350 p.
4. **Gianni, D., D'Ambrogio, A., Tolk, A**. Modeling and Simulation-Based Systems Engineering Handbook. Boca Raton: CRC Press, 2014. 558 p.
5. **Vacondio, R., Rogers, B. D., Stansby, P. K.** Modeling in Engineering Using Innovative Numerical Methods for Solids and Fluids. Cham: Springer, 2020. 317 p.

Recommended reading:

1. **Zaika, P.M.** *Theory of Agricultural Machines. Vol. 2, Part 2, Book 2: Grain Harvesting Machines*. Kharkiv: Oko Publishing, 2005. 404 p.
2. **Vergunova, I.M.** *Fundamentals of Mathematical Modeling for Analysis and Forecasting of Agronomic Processes*. Kyiv: Nora-Print, 2000. 146 p.
3. **Vladuț, N., Ungureanu, N.** Beyond Agriculture 4.0: Design and Development of Modern Agricultural Machines and Production Systems. *Agriculture*, 14(7), 991. https://doi.org/10.3390/agriculture14070991.
4. **Chang, C., Ucgul, M.** Innovative Design and Application of Modern Agricultural Machinery Systems in Cropping Systems. *Agriculture*, 15(22), 2371. https://doi.org/10.3390/agriculture15222371
5. **Jiang, L., Husnain, N., Wang, Q.** Overview of Agricultural Machinery Automation Technology for Sustainable Agriculture. *Agronomy*, 15(6), 1471. https://doi.org/10.3390/agronomy15061471
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7. **Vovk, M., Zubro, T., Omarov, E., Kolomiiets, B., Hnydiuk, V.** Modelling the Efficiency of Technological Management of Agricultural Enterprises in Economic Security. *Agricultural and Resource Economics: International Scientific E-Journal*, 11(1), 262-287. https://doi.org/10.51599/are.2025.11.01.10
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3.2.11 Module 11: Advanced Plant Physiology

Module Code:
Credits (ECTS): 6
Semester: 2
Status: Optional

3.2.11.1 Module Description

This module provides advanced knowledge of plant physiological processes governing crop growth, stress tolerance, and yield formation, with a strong emphasis on applications in precision and digital agriculture. It links classical and stress physiology with modern phenotyping techniques, remote sensing indicators, and data-driven decision-making. The module contributes to the MSc programme by strengthening agronomic, technical, and digital competences required for climate-smart, sustainable, and economically efficient crop production systems.

3.2.11.2 Learning Outcomes (LOs)

Upon successful completion of this module, students will be able to:

Table 15. Types and Key Competences acquired

Type	Key competences
Knowledge	**K1.** Explain advanced physiological mechanisms of plant growth, development, and yield formation under optimal and stress conditions.
	K2. Describe the physiological basis of crop responses to abiotic stresses and their relevance for precision agriculture and sustainability.

Skills	**S1.** Apply plant phenotyping and remote sensing indicators to assess crop status, stress responses, and yield potential.
	S2. Analyse and interpret physiological, sensor, and geospatial data to support precision fertilisation, irrigation, and crop management decisions.
Competencies (Autonomy & responsibility)	**C1.** Integrate physiological knowledge with digital agriculture tools (remote sensing, sensors, FMIS) for evidence-based agronomic decision-making.
	C2. Demonstrate autonomy in evaluating the agronomic, environmental, and economic implications of physiology-based crop management strategies.

3.2.11.3 Syllabus / Indicative Content

1. Advanced plant growth processes: cell expansion, source–sink relations, hormonal regulation
2. Physiological basis of biomass accumulation and yield formation
3. Crop responses to drought, heat, cold, salinity, and nutrient stress
4. Plant water relations, photosynthesis, and transpiration efficiency
5. Principles and methods of plant phenotyping
6. High-throughput and field-based phenotyping platforms
7. Remote sensing indicators linked to plant physiology (NDVI, thermal indices, fluorescence)
8. Linking physiological traits with UAV, satellite, and proximal sensing data
9. Precision irrigation and fertilisation based on physiological indicators
10. Environmental sustainability and climate-smart crop management
11. Case studies integrating physiology, remote sensing, and precision agriculture tools

3.2.11.4 Teaching & Learning Methods

- Lectures
- Laboratory and practical sessions
- Data analysis and interpretation workshops
- Case studies and problem-based learning
- Independent study and literature review

3.2.11.5 Assessment Methods

- Written exam: 30%
- Practical assessment: 70%

3.2.11.6 Workload Distribution (ECTS Breakdown)

5 ECTS × 30 hours = 150 hours

- **Lectures:** 16 hours
- **Labs/practical sessions:** 16 hours
- **Independent study:** 104 hours

3.2.11.7 Required Resources

Software

- QGIS / ArcGIS
- FMIS platform (educational or demo version)
- Basic data analysis tools

Equipment

- Plant sampling and physiological measurement tools
- UAV- or sensor-derived datasets (demonstration datasets)
- Proximal and remote sensing data sources

3.2.11.8 Bibliography

Required reading:

1. Taiz, L., Møller, I. M., Murphy, A., & Zeiger, E. (2022). *Plant physiology and development* (7th ed.). Oxford University Press. Plant Physiology and Development, 7e Instructor Resources - Oxford Learning Link
2. Virginia Cooperative Extension. (2020). *Agronomy handbook* (Publication 424-100). Virginia Tech. https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/424/424-100/spes-299.pdf.
3. Anderson, A., & Fidel, R. (2025). *Introduction to soil science* (2nd ed.). Open Textbook Library. https://open.umn.edu/opentextbooks/textbooks/1206
4. Daya, J. L., Jasmine, S., & Köse, U. (Eds.). (2025). Digital farming and smart agriculture for a sustainable future. Routledge. https://doi.org/10.4324/9781003434624
5. Food and Agriculture Organization of the United Nations, & Joint Research Centre (European Commission). (2021). *Handbook on remote sensing for agricultural statistics*. FAO. https://openknowledge.fao.org
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- **Recommended reading:**
-

1. Anand, S., Yadav, S., Lal, P., Mishra, P., & Rani, U. (Eds.). (2026). *Sustainable agriculture development and management through geospatial technologies*. Springer. https://link.springer.com/book/9789819563739
2. European Commission. (2020). *Precision agriculture handbook for beginners*. Erasmus+ Programme. https://ec.europa.eu/programmes/erasmus-plus
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3.3 Professional/VET Course Outline

In parallel with the MSc curriculum development, the Professional/VET course outline has been designed to address the specific training needs of the agricultural workforce, as identified in WP3. This course provides a comprehensive curriculum tailored to both foundational knowledge and advanced techniques in Precision Agriculture. The developed course is aimed at enhancing the skills of agricultural professionals and workers, preparing them to implement cutting-edge technologies and sustainable practices in the field.

The Professional/VET course outline included the following key components: a) course title; b) course description (aim and objectives); c) units and learning outcomes; d) EQF Level; e) delivery mode; f) duration and length; g) types of training materials; h) assessment methods; i) required equipment; j) completion criteria.

3.3.1 Unit 1: Introduction to Precision Agriculture and Smart Farming Practices

EQF Level: 5
Target group: Local farmers, agricultural technicians, farm managers, agricultural advisors, and VET learners interested in modern and sustainable farming practices.
Total duration: 40 hours

3.3.1.1 Course Aim and Delivery Mode

The aim of the course is to provide participants with practical knowledge and hands-on skills in precision agriculture and smart farming technologies, enabling them to improve farm productivity, resource efficiency, and sustainability through data-driven decision-making. Different modes are used to the course delivery:

- On-site lectures
- Field-based practical training
- Demonstration activities on farms
- Limited online support materials

3.3.1.2 Learning Outcomes

Upon completion of the course, participants will be able to:

LO1:
Explain the core principles of precision agriculture and smart farming and their relevance for sustainable agricultural practices.

LO2:
Use basic digital tools, sensors, and data collection methods to monitor soil, crops, and environmental conditions.

LO3:

Apply precision agriculture techniques in real farm settings to improve soil management, water efficiency, and crop performance.

3.3.1.3 Course Structure (Units)

Table 16. Structure of Unit 1

Unit No.	Unit Title	Learning Outcomes	Duration	Assessment
Unit 1	**Introduction to Precision Agriculture Concepts**	Introduction to Precision Agriculture Concepts	6 hours	Understand principles, benefits, and challenges of precision agriculture
Unit 2	**Smart Farming Technologies & IoT Systems**	Smart Farming Technologies & IoT Systems	8 hours	Identify and use basic sensors and smart farming tools
Unit 3	**Remote Sensing & Drone-Based Monitoring**	Remote Sensing & Drone-Based Monitoring	8 hours	Interpret basic remote sensing data for crop monitoring
Unit 4	**Soil Health, Water Management & Efficient Field Practices**	Apply data-driven approaches to soil and water management	8 hours	Field task evaluation
Unit 5	**Practical Application & On-Farm Demonstrations**	Implement learned techniques in real farm conditions	10 hours	Practical demonstration

3.3.1.4 Assessment Methods

- Practical demonstrations
- Short quizzes
- Field task evaluation
- Small applied project or case study

3.3.1.5 Required Equipment and Infrastructure

- Sensors, drones, handheld devices
- Software platforms
- Farm/field access

3.3.1.6 Certification/Completion Criteria

- Attendance
- Passing assessments
- Demonstration of competencies

3.3.2 Unit 2: Smart Farming Technologies and IoT Systems

EQF Level: 5

Target group: Farmers, technicians, agricultural workers, agricultural machinery sales consultants
Total duration: 45 hours

3.3.2.1 Course Aim and Delivery Mode

The aim of the course is to provide learners with practical competencies in Smart Farming, precision agriculture, and IoT-based systems using modern educational stands (HORSCH). The delivery mode is blended with lectures in classroom, and laboratory stands HORSCH.

3.3.2.2 Learning Outcomes

Upon completion of the course, participants will be able to:

LO1:
Configure and operate Smart Farming and IoT training stands.

LO2:
Analyze field data for variable-rate application.

LO3:
Apply precision seeding, fertilization, and spraying.

LO4:
Integrate IoT data into farm management systems.

LO5:
Perform diagnostics and calibration of smart machinery.

3.3.2.3 Course Structure (Units)

Table 17. Structure of Unit 2

Unit No.	Unit Title	Learning Outcomes	Duration	Assessment
Unit 1	**Fundamentals of Smart & Precision Farming**	Students understand the principles, objectives, benefits, and challenges of smart and precision farming, as well as the role of digital technologies in modern agriculture	6 hours	Quiz, oral discussion
Unit 2	**IoT Systems & Sensors in Agriculture**	Students are able to explain IoT architectures, identify key agricultural sensors, and describe their application in soil, crop, and climate monitoring	8 hours	Written test, case study analysis
Unit 3	**Smart Machinery & ISOBUS Technologies**	Students can describe smart agricultural machinery, understand ISOBUS standards, and explain machine-to-	10 hours	Test, practical assignment

		machine communication and interoperability		
Unit 4	**Variable Rate Application & Digital Field Mapping**	Students are able to apply variable rate technology principles and analyze digital field maps for optimized resource management	9 hours	Practical work, data analysis report
Unit 5	**Practical Training & On-Farm Demonstrations**	Students acquire hands-on experience with precision farming equipment and digital tools through field demonstrations and practical exercises	12 hours	Practical exam, field report

3.3.2.4 Assessment Methods

- Practical demonstrations
- Quizzes
- Task evaluation
- Short project

3.3.2.5 Required Equipment and Infrastructure

- Sensors, data processing devices
- Precision farming training stands (HORSCH)

3.3.2.6 Certification/Completion Criteria

- 80% attendance and successful completion of assessments

3.3.3 Unit 3: Remote Sensing and Drone-Based Monitoring

EQF Level: 6
Target group: Farmers, farm managers, agronomists, technicians, agricultural advisors
Total duration: 50 hours

3.3.3.1 Course Aim and Delivery Mode

The aim of the course is to provide participants with practical skills in using satellite and UAV data for crop monitoring, stress detection, and decision support in precision agriculture systems. The delivery mode is blended with lectures in classroom, online, and UAV field practice.

3.3.3.2 Learning Outcomes

Upon completion of the course, participants will be able to:

LO1:

Plan and perform UAV flights for agricultural monitoring tasks

LO2:
Process multispectral imagery and derive vegetation indices (NDVI, NDRE, etc.).

LO3:
Interpret remote sensing data to support variable-rate application and crop management decisions.

3.3.3.3 Course Structure (Units)

Table 18. Structure of Unit 3

Unit No.	Unit Title	Learning Outcomes	Duration	Assessment
Unit 1	**Remote Sensing & Drone-Based Monitoring**	Plan and perform safe UAV monitoring missions in compliance with basic national and European flight regulations. Process and analyze multispectral (NDVI, NDRE, etc.) and thermal imagery to detect and assess plant stress and spatial variability Interpret remote sensing data and translate it into actionable maps and recommendations to support variable-rate application and crop management decisions	50 hours	Practical task

3.3.3.4 Assessment Methods

- Practical UAV mission
- Data processing assignment
- Short quiz
- Field report

3.3.3.5 Required Equipment and Infrastructure

- Sensors, drones, handheld devices: Multirotor UAV with RGB and multispectral camera (DJI Mavic-3Multispectral), agrodron MC-A22, GPS/GNSS Rover HiTarget V30 (for GCP).
- Software platforms: ArcGIS (license), QGIS (open source)
- Farm/field access: Access to training fields and experimental plots (University research field and fields of partners (LLC "Korostyshivzeminvest")

3.3.3.6 Certification/Completion Criteria

- Minimum 75% attendance
- Successful completion of practical UAV task

- Submission of final field monitoring report

3.3.4 Unit 4: Soil Health, Water Management and Efficient Field Practices

EQF Level: 5
Target group: Farmers and farm managers, agricultural workers and field operators, agricultural technicians, agricultural advisors and extension staff
Total duration: 10 hours

3.3.4.1 Course Aim and Delivery Mode

The aim of the course is to provide participants with practical understanding of soil health and water management and to support the adoption of efficient field practices using simple observations and basic precision agriculture tools. The delivery mode is onsite and field-based training, with short classroom inputs.

3.3.4.2 Learning Outcomes

Upon completion of the course, participants will be able to:

LO1:
Recognize basic soil health conditions and water-related issues in the field.

LO2:
Interpret simple soil moisture and field data to support day-to-day field decisions.

LO3:
Apply efficient field practices that contribute to improved soil condition and water use efficiency.

3.3.4.3 Course Structure (Units)

Table 19. Structure of Unit 4

Unit No.	Unit Title	Learning Outcomes	Duration	Assessment
Unit 1	**Basic Soil Health Concepts and Indicators**	Recognize basic soil health indicators through field observation and simple measurements	2 hours	Quiz, oral discussion
Unit 2	**Soil Moisture and Water Availability**	Read basic soil moisture measurements and understand their relevance for irrigation	2 hours	Written test, case study analysis
Unit 3	**Soil and Water Variability in the Field**	Observe differences in soil and water conditions within a field using simple tools and maps	2 hours	Test, practical assignment
Unit 4	**Efficient Field Practices**	Follow basic field practices that support soil condition and efficient water use	2 hours	Field task evaluation

Unit 5	**On-Farm Demonstration and Review**	Explain basic soil and water management actions during a guided field demonstration	2 hours	Practical exam, field report

3.3.4.4 Assessment Methods

- Practical demonstration during field exercises
- Field task evaluation based on instructor observation
- Short practical tasks (e.g. reading soil moisture, explaining a field action)
- Short knowledge check or quiz (oral or written)

3.3.4.5 Required Equipment and Infrastructure

- Training field or demonstration farm
- Soil probes and basic soil assessment tools
- Handheld soil moisture meters or simple sensors
- GPS/GNSS devices or field maps for variability observation

3.3.4.6 Certification/Completion Criteria

- Minimum 80% attendance of unit sessions
- Successful participation in field exercises and practical tasks
- Demonstration of basic understanding of soil health and water management practices

3.3.5 Unit 5: Practical Application and On-farm Demonstration

EQF Level: 6
Target group: Farmers, agrobusiness professionals, agricultural consultants and extension agents, beneficiaries of rural development projects
Total duration: 45 hours

3.3.5.1 Course Aim and Delivery Mode

The aim of the course is to enhance practical agricultural skills and applied knowledge through on-farm training and demonstrations, enabling participants to effectively implement modern and sustainable farming practices. The delivery mode is blended, including lectures in the classroom and field demonstrations with farm practical training.

3.3.5.2 Learning Outcomes

Upon completion of the course, participants will be able to:

LO1:
Apply practical farming techniques in real farm conditions.

LO2:
Use farm tools and equipment safety and efficiently.

LO3:
Implement sustainable farming practices at farm level.

LO4:
Solve common on farm challenges using applied skills.

LO5:
Participate effectively in peer to -peer and in-farm learning activities.

3.3.5.3 Course Structure (Units)

Table 20. Structure of Unit 5

Unit No.	Unit Title	Learning Outcomes	Duration	Assessment
Unit 1	**Fundamentals of Smart & Precision Farming**	Students understand the principles, objectives, benefits, and challenges of smart and precision farming, as well as the role of digital technologies in modern agriculture	6 hours	Quiz, oral discussion
Unit 2	**IoT Systems & Sensors in Agriculture**	Students are able to explain IoT architectures, identify key agricultural sensors, and describe their application in soil, crop, and climate monitoring	8 hours	Written test, case study analysis
Unit 3	**Smart Machinery & ISOBUS Technologies**	Students can describe smart agricultural machinery, understand ISOBUS standards, and explain machine-to-machine communication and interoperability	10 hours	Test, practical assignment
Unit 4	**Variable Rate Application & Digital Field Mapping**	Students are able to apply variable rate technology principles and analyze digital field maps for optimized resource management	9 hours	Practical work, data analysis report
Unit 5	**Practical Training & On-Farm Demonstrations**	Apply practical farming techniques, farm equipment, and basic digital tools in real farm conditions, gaining hands-on experience	12 hours	Practical exam, field report

		with precision farming equipment through field demonstrations and practical exercises.		

3.3.5.4 Assessment Methods

- Practical demonstrations
- Quizzes
- Task evaluation
- Short project

3.3.5.5 Required Equipment and Infrastructure

- Farm infrastructure and sites suitable for on-farm training and demonstration;
- Equipment, digital tools

3.3.5.6 Certification/Completion Criteria

- 80% attendance and successful completion of assessments

4. Risk Mitigation and Curriculum Adaptability Framework

4.1 Purpose, Scope and Positioning within D4.2

The ReGrow MSc Programme Course Framework (D4.2) has been developed as a jointly agreed academic reference framework, intended to support national accreditation and implementation of the programme across diverse higher education systems, with pilot delivery foreseen in Ukraine and Georgia.
Given the diversity of national higher education legislation, accreditation standards, and mandatory Programme Learning Outcomes, the consortium has adopted a structured and transparent risk mitigation approach to ensure that the ReGrow MSc remains:

- fully accreditable at national Higher Education Institution (HEI) level,
- academically coherent and comparable across partner countries, and
- firmly anchored in its digital, innovation-driven, and sustainability-oriented profile.
- This chapter consolidates the key curriculum-related risks identified during the development of D4.2 and presents the mitigation measures embedded in the curriculum framework and governance architecture.

It should be read in conjunction with:

- **Section 2.9.4**, which outlines national accreditation requirements, with particular reference to Ukrainian higher education standards;
- **Section 3.1.6**, which defines the joint governance and quality assurance framework of the ReGrow MSc; and
- **Section 3.1.7**, which operationalises national compliance adaptation through a formal disclaimer and implementation framework.

4.2 Identified Curriculum-Related Risks and Embedded Mitigation Measures

The development of a joint curriculum framework intended for national accreditation and implementation across heterogeneous higher education systems inevitably entails structural, regulatory, and academic risks. In the context of the ReGrow MSc, these risks primarily arise from differences in national education standards, mandatory programme learning outcomes, and institutional accreditation requirements, as well as from the need to preserve a coherent academic identity while enabling controlled national adaptation.

To address these challenges in a systematic and transparent manner, the consortium has identified the key curriculum-related risks relevant to the scope of D4.2 and has embedded corresponding mitigation measures directly within the design of the ReGrow MSc Programme Course Framework. These risks and mitigation measures are summarised in Table 21, together with the governance mechanisms responsible for their oversight.

Table 21. Curriculum Design and Accreditation-Related Risks and Mitigation Measures

Risk ID	Risk Description	Potential Impact on Programme Design	Mitigation Measures Embedded in D4.2	Governance & Oversight Mechanisms
R1	Misalignment with mandatory national education standards (e.g. compulsory competences, Programme Learning Outcomes, and legally required subject areas for specific national specialties)	Risk of non-compliance with national accreditation frameworks if mandatory components are not explicitly addressed	D4.2 is explicitly positioned as a common academic framework, allowing national HEIs to introduce additional mandatory modules or integrate required content into existing modules, as detailed in Section 2.9.4 and operationalised through Section 3.1.7	Steering Committee; WP Leaders Group (WP4–WP6); Quality Assurance Board (QAB)
R2	Overly rigid interpretation of the "joint MSc" concept as a single, identical curriculum across all partner countries	Structural incompatibility with national legislation governing programme composition and content	The ReGrow MSc is defined as a jointly designed framework, rather than a uniform curriculum, explicitly permitting national adaptation within clearly defined academic boundaries (Sections 3.1.6 and 3.1.7)	Steering Committee; Joint Academic Committee (JAC)
R3	Inflexible ECTS allocation across programme components (e.g. thesis, internship, taught modules)	Limited capacity to integrate nationally required modules within the legally permitted total ECTS volume	The framework allows internal redistribution of ECTS credits between programme components at national level, provided that overall programme learning outcomes, EQF Level 7 alignment, and academic coherence are preserved (Section 3.1.7)	WP Leaders Group; JAC; QAB
R4	Fragmentation of programme identity due to national adaptations	Risk of weakening the recognisability, comparability, and academic integrity of the ReGrow MSc	Core thematic areas, programme-level learning outcomes, and the digital and innovation-oriented profile of the ReGrow MSc are fixed at framework level, ensuring that national adaptations remain academically equivalent (Section 3.1.6)	JAC; QAB
R5	Ambiguity between curriculum framework design	Confusion regarding responsibilities and scope between design	Clear separation of roles: D4.2 defines the academic framework and guiding principles, while national	WP Leaders Group; Steering Committee

	(WP4) and national accreditation implementation (WP6)	and implementation phases	accreditation and final curriculum configurations are addressed under WP6, as reflected across Sections 2.9.4, 3.1.6 and 3.1.7	

As illustrated in Table 21, the identified risks are primarily associated with the interaction between a jointly agreed academic framework and nationally binding regulatory environments. The mitigation measures adopted do not seek to eliminate national differentiation; rather, they establish clear academic boundaries within which adaptation can occur. By fixing programme-level learning outcomes, core thematic areas and EQF Level 7 alignment at framework level—while allowing flexibility in module composition and ECTS allocation at national level—the ReGrow MSc ensures both accreditation feasibility and academic comparability across partner institutions.

Importantly, these mitigation measures are not treated as static design choices but are supported by an integrated governance structure, ensuring that curriculum adaptations remain transparent, academically justified, and aligned with the strategic objectives of the ReGrow project.

4.3 Governance and Monitoring of Risk Mitigation

The monitoring and management of curriculum-related risks are fully integrated into the existing governance and quality assurance mechanisms of the ReGrow project, as defined in Section 3.1.6, ensuring effective oversight without the introduction of additional administrative structures.

Specifically:

- The **Steering Committee** provides strategic oversight, ensuring that curriculum adaptations introduced at national level remain aligned with the overall objectives of the ReGrow project, Erasmus+ CBHE principles and long-term programme sustainability.

- The **Work Package Leaders Group**, with particular coordination between **WP4** (Curriculum Development) and **WP6** (Accreditation and Implementation), ensures operational alignment between the common curriculum framework and national accreditation requirements, facilitating informed and timely decision-making.

- The **Joint Academic Committee (JAC)** provides academic oversight, monitoring the coherence of programme-level learning outcomes, the integrity of core thematic areas, and the academic equivalence of nationally adapted curricula, in line with the jointly agreed ReGrow MSc profile.

- The **Quality Assurance Board (QAB)** oversees the academic quality and consistency of the ReGrow MSc framework and related outputs, verifying alignment with EQF Level 7 descriptors, Bologna Process principles, and agreed quality standards across partner institutions.

Through the coordinated functioning of these bodies, curriculum adaptations required for national compliance are reviewed, documented and validated, ensuring that flexibility is applied in a controlled, transparent, and academically robust manner.

4.4 Concluding Remarks

By embedding structured flexibility within a clearly articulated academic framework, the ReGrow MSc Programme Course Framework proactively addresses the challenges arising from national regulatory diversity while safeguarding the programme's academic integrity, digital orientation and innovation-driven character.

This risk mitigation approach ensures that the ReGrow MSc remains accreditable, coherent and sustainable, supporting successful national implementation and long-term integration within participating higher education systems, fully aligned with the objectives of the ReGrow project and the Erasmus+ CBHE action.

5. Conclusion

This Deliverable presents the comprehensive academic and institutional framework for the ReGrow MSc in Precision Agriculture and Digital Farming, developed collaboratively by project partners across the European Union and the Eastern Neighbourhood (Greece, Germany, Georgia, and Ukraine). It consolidates the institutional capacities of participating Higher Education Institutions, the harmonised structure of the 90 ECTS MSc programme, detailed course unit specifications, and the complementary Professional/VET course design. Together, these components establish a coherent, academically robust, and implementation-ready curriculum aligned with contemporary developments in digital and sustainable agriculture.

The programme responds directly to the skills gaps identified during earlier project phases and reflects European best practices in precision agriculture, geospatial technologies, automation, smart farming systems, and climate-resilient agricultural practices. By integrating advanced technological knowledge with applied learning, internship experience, and independent research, the MSc equips graduates with the competencies required to operate effectively in modern, data-driven agricultural environments. The structured involvement of academic institutions and industry stakeholders ensures that the curriculum remains relevant to labour market needs while maintaining strong academic standards.

Long-term sustainability is embedded in the programme's design. The MSc is fully aligned with the Bologna Process, EQF Level 7 descriptors, and the national accreditation frameworks of the participating countries, facilitating institutional adoption and formal accreditation. The strengthened laboratory infrastructure, digital resources, and enhanced academic expertise developed through the project will remain operational beyond the funding period. Established governance and quality assurance mechanisms will support continuous curriculum review and academic harmonisation, while sustained cooperation with industry partners will ensure ongoing internship placements, applied research collaboration, and professional engagement. The complementary Professional/VET course further expands the programme's impact by supporting workforce upskilling and regional agricultural development. Collectively, these measures ensure that the ReGrow MSc will remain operational, academically sound, and strategically relevant beyond the lifetime of the Erasmus+ project.

ANNEX I: Modules Description for Specialties 208 Agroengineering and 201 Agronomy

Table 22. Detailed description of the additional Ukrainian Modules

Specialty	Module	Competence	Description
208 Agroengineering	Foreign Language	General Competence	Ability to communicate in a foreign language
		Program Learning Outcome	Possess a complex of necessary humanitarian, natural sciences, and professional knowledge sufficient to achieve other learning outcomes defined by the educational program
	Methodology of Scientific Research and Intellectual Property	Professional Competence	Ability to carry out applied research to create new and improve existing technological systems for agricultural purposes, and to find optimal methods for their operation. Ability to apply methods of similarity theory and dimensional analysis, mathematical statistics, queuing theory, and systems analysis to solve complex tasks and problems in agricultural production
		Program Learning Outcome	Create physical, mathematical, and computer models to solve research, design, organizational, management, and technological problems
	Management in Agricultural Production	Professional Competence	Ability to solve complex management tasks and problems in the field of agricultural production
		Professional Competence	Ability to use management and planning methods for material and related information and financial flows to increase the competitiveness of enterprises
		Professional Competence	Ability to comprehensively implement organizational, managerial, and technical measures to create safe working conditions in the agro-industrial complex
		Program Learning Outcome	Make informed management decisions to ensure the profitability of the enterprise
	Occupational Safety and Ecology	Professional Competence	Ability to ensure environmental safety in agricultural production
		Program Learning Outcome	Develop energy-saving, environmentally safe technologies for the production, primary processing, and storage of agricultural products
		Program Learning Outcome	Develop occupational safety measures in the field of agricultural production in accordance with current legislation
	Ukrainian Legislation and Law	Professional Competence	Ability to use the regulatory and legislative framework for the legal protection of intellectual property objects that are being developed and are in economic circulation
		Program Learning Outcome	Ensure the protection of intellectual property

	Modeling and Optimization of Production Systems	Professional Competence	Ability to use modern methods of modeling technological processes and systems to create models of mechanized technological processes in agricultural production
		Professional Competence	Ability to solve optimization problems and make effective decisions regarding the use of machinery and equipment in crop production, animal husbandry, storage, primary processing, and transportation of agricultural products
		Professional Competence	Ability to forecast and ensure the technical readiness of agricultural machinery
		Program Learning Outcome	Plan applied research, justify the choice of methodology and specific research methods
		Program Learning Outcome	Create physical, mathematical, and computer models to solve research, design, organizational, management, and technological problems
		Program Learning Outcome	Make effective decisions regarding the composition and operation of machinery complexes
	Design and Calculation of Technological Systems	Professional Competence	Ability to design, manufacture, and operate technologies and technical means for the production, primary processing, storage, and transportation of agricultural products
		Program Learning Outcome	Design competitive technologies and equipment for agricultural production in accordance with consumer requirements and legislation
		Program Learning Outcome	Create and optimize innovative technical and technological systems in crop production, animal husbandry, product storage, and technical service
201 Agronomy	Professional Foreign Language[8]	Program Learning Outcome	Search for necessary information and evaluate it in scientific and technical literature, analyze, process, and assess this information
		Program Learning Outcome	Communicate freely in the state and foreign languages to discuss the results of professional activities, research, and innovation projects in the field of agricultural sciences and food
	Methodology and Organization of Scientific Research[9]	Program Learning Outcome	Use scientific research methodology, special methods and tools of experimental research, and modern data processing methods to solve complex problems in agronomy
		Program Learning Outcome	Plan and execute scientific and applied research in the field of agronomy, analyze results, and substantiate conclusions
	Modern Technologies in Crop Production	Program Learning Outcome	Choose the optimal management strategy in agronomy, including under conditions of vague goals and uncertainty

[8] *Similar to the Standard for specialty 208 "Agroengineering".*
[9] *Similar to the Standard for specialty 208 "Agroengineering".*

	Integrated Plant Protection in the Precision Agriculture System	Program Learning Outcome	Evaluate and analyze the modern range of mineral fertilizers, chemical plant protection products, and biotechnology products to develop scientifically based systems for their application
		Program Learning Outcome	Collect, process, and analyze spatial, cartographic, and field data; interpret monitoring results for agronomic planning