

Research Project Prospectus

Polissia Vineyard: a research and educational platform for viticulture adaptation, geoinformation monitoring and the development of local producers

Contents

1. Project title
2. Project relevance
3. Project objective
4. Main project goals
 - 4.1. Zoning and varietal testing of grapes
 - 4.2. Adaptation of cultivation technology
 - 4.3. Training of local producers
 - 4.4. Development of a viticulture culture in Polissia
 - 4.5. Development of satellite and geoinformation monitoring
5. Scientific concept of the project
6. Scientific novelty
7. Project participants and their roles
8. Project beneficiaries
9. Description of the experimental plot
10. Description of the infrastructure of the experimental field and the PNU Farmer Field School
11. Project implementation methodology
12. Project work packages
13. Expected results
14. Scientific, educational and digital products
15. Risks and mitigation measures
16. Prospects for project scaling

1. Project title

Working title: Polissia Vineyard: a research and educational platform for viticulture adaptation, geoinformation monitoring and the development of local producers

Short title: Smart Vineyard Polissia

Full title: Establishment of a research and educational platform for adapting viticulture to the conditions of Polissia through varietal testing, technological adaptation, GIS monitoring and training of local producers

2. Project relevance

Polissia has traditionally not been considered one of Ukraine's classical viticulture regions (Map 1). However, current climate change (Figure 1), the emergence of new resistant grape varieties, growing interest in niche farming and the development of local agri-food brands create new preconditions for a scientific reassessment of the region's potential.



Map 1. Geolocation of the natural and climatic zone of Polissia within Ukraine

Zhytomyr Oblast has considerable land resources, active rural communities, experience in small and medium-sized farming and a growing demand for diversification of agricultural production. Grape cultivation may become a promising direction for small producers, farms, research and educational plots, agritourism and the local processing of grape products.

At the same time, the development of viticulture in Polissia requires scientific justification. It is necessary to assess the suitability of local soil and climatic conditions, conduct varietal testing, identify the risks of frost, excessive moisture, diseases and unstable temperature regimes, and adapt cultivation technologies to the specific features of the region.

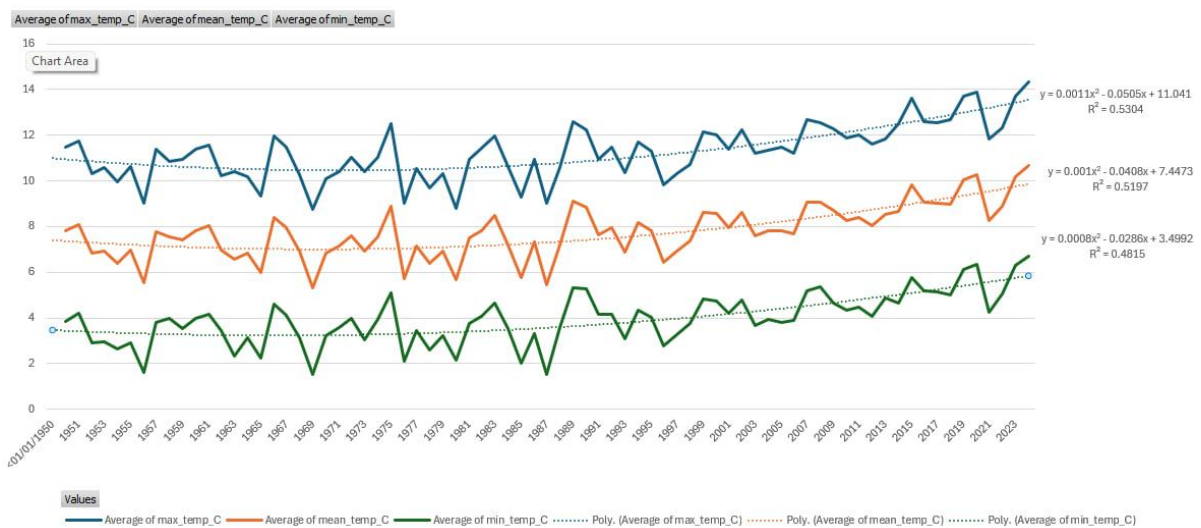


Figure 1. Change in average daily temperature in Zhytomyr Oblast

The combination of classical agronomic research with modern digital technologies is becoming particularly relevant. These technologies include geographic information systems, Earth observation, UAV monitoring, meteorological sensors, digital maps and interactive platforms. This will make it possible not only to establish an

experimental plot, but also to develop a complete research and educational model for scaling viticulture under the conditions of Polissia (Figure 2).

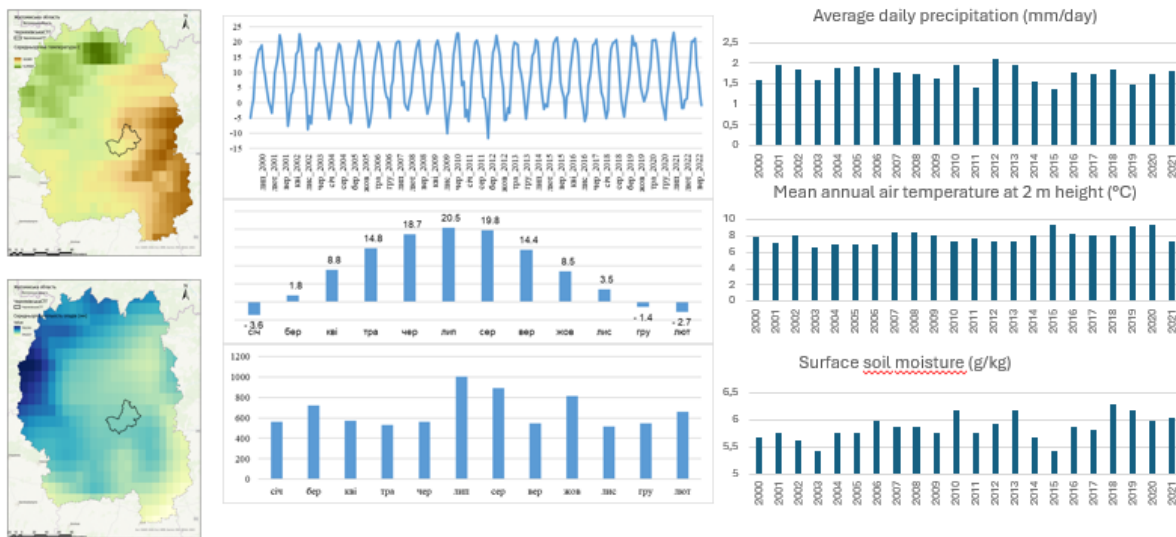


Figure 2. Main climatic indicators of the Polissia area of Zhytomyr Oblast

3. Project objective

The objective of the project is to scientifically justify the feasibility of growing grapes under the conditions of Polissia by establishing an experimental vineyard plot, conducting varietal testing, adapting cultivation technologies, developing a system of geoinformation and satellite monitoring, and preparing local producers for the development of a new area of agricultural production.

4. Main project goals

4.1. Zoning and varietal testing of grapes

To conduct research on promising grape varieties for the conditions of Polissia, taking into account frost resistance, disease resistance, ripening time, yield, berry quality, adaptation to soil and climatic conditions, and potential for fresh consumption and further processing.

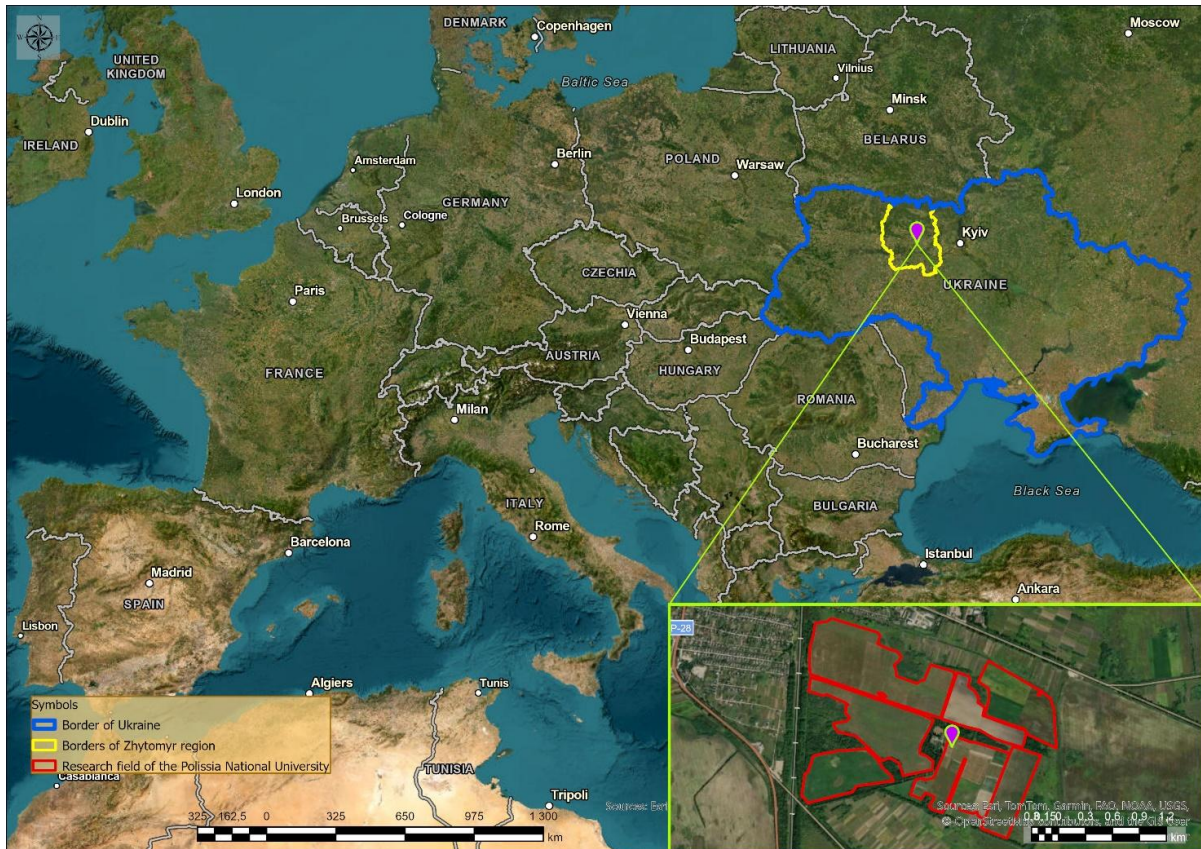
4.2. Adaptation of cultivation technology

To develop and test adaptive technological solutions for growing grapes under the conditions of Polissia, including planting schemes, vine training systems, care systems, frost protection, plant nutrition, moisture conservation, integrated disease control and assessment of the economic feasibility of cultivation.

4.3. Training of local producers

To establish, on the basis of the Farmer Field School of Polissia National University (Map 2), a training and demonstration platform for farmers, small producers, students, postgraduate students, consultants and representatives of territorial communities.

The training should cover vineyard establishment, care for plantations, digital monitoring, risk assessment, production economics and the fundamentals of developing local grape products in compliance with applicable legislation.



Map 2. Geolocation of the Farmer Field School of Polissia National University

4.4. Development of a viticulture culture in Polissia

To foster a new culture of viticulture and grape-product development as an element of farm diversification, local brand development, increased employment in communities, agritourism, the gastronomic identity of the region, and the educational and scientific promotion of agricultural innovations.

4.5. Development of satellite and geoinformation monitoring

To create a digital monitoring system for vineyards based on Sentinel-1, Sentinel-2 and Landsat satellite data, UAV imagery, weather stations, field sensors, a digital varietal map, spectral indices, GIS analysis of soil, climate and relief conditions, and an interactive dashboard showing the state of the experimental plot.

5. Scientific concept of the project

The scientific concept of the project is to create, on the basis of Polissia National University, an interdisciplinary research and educational platform that combines grape varietal testing, adaptation of cultivation technologies to the conditions of Polissia, digital monitoring of plantations and practical training of local producers. The project is intended not only to test the possibility of growing grapes in a non-traditional region for this crop, but also to develop a scientifically justified model for local viticulture that can be scaled to communities of Zhytomyr Oblast and other areas of Polissia.

6. Scientific novelty

The scientific novelty of the project consists of the following elements:

1. The study of viticulture potential in Polissia as a non-traditional region for this crop.
2. The combination of classical varietal testing with geoinformation analysis, Earth observation and digital monitoring.
3. The creation of a digital passport for the experimental vineyard, including data on varieties, soils, relief, microclimate, plant condition and technological operations.

4. The development of adaptive grape cultivation technology for conditions of increased moisture, frost risk and specific Polissia soils.
5. The creation of a training model for farmers that combines field practice, digital technologies and elements of local entrepreneurship.
6. The formation of a foundation for a new direction of regional agricultural development: Polissia viticulture as part of niche farming, agritourism and the local economy.

7. Project participants and their roles

Participant	Role in the project
Polissia National University	Project coordinator, research base, experimental field, agronomic research, GIS monitoring and educational component.
Farmer Field School of PNU	Organisation of training sessions, field days and practical training for farmers and students.
Educational and Scientific Centre for Space and Geoinformation Technologies of PNU	Development of the GIS database, satellite monitoring, digital maps and dashboards.
NGO “GREEN TECH”	Partnership with communities, communication, sustainable development and engagement of producers.
Odesa National Technological University	Project development for a vineyard, and agro-technical support for the project. Expertise in food technologies, raw material quality and opportunities for further grape processing.
	Participation in the development of educational modules, training sessions, and practical classes on the technological fundamentals of grape product processing.
UVWA – Ukrainian Vine and Wine Association	Sectoral expertise, consultations on varieties, technologies, standards and links with producers.
Local farmers and producers	Participation in training, testing of technologies and further scaling of results.
International participants	Potential involvement in expertise, exchange of experience, joint research and international cooperation.

The combination of the scientific and research base of Polissia National University, the practical infrastructure of the Field School of Farming, the digital capacities of the Educational and Scientific Center for Space and Geoinformation Technologies, the technological expertise of Odesa National University of Technology, the sectoral experience of the Ukrainian Vine and Wine Association, the communication potential of the NGO “GREEN TECH”, and the involvement of local producers forms a strong interdisciplinary consortium. Such a consortium makes it possible to cover the full project implementation cycle - from scientific justification, variety testing, and digital monitoring to farmer training, technological assessment of raw materials, development of local processing, and further scaling of the results.

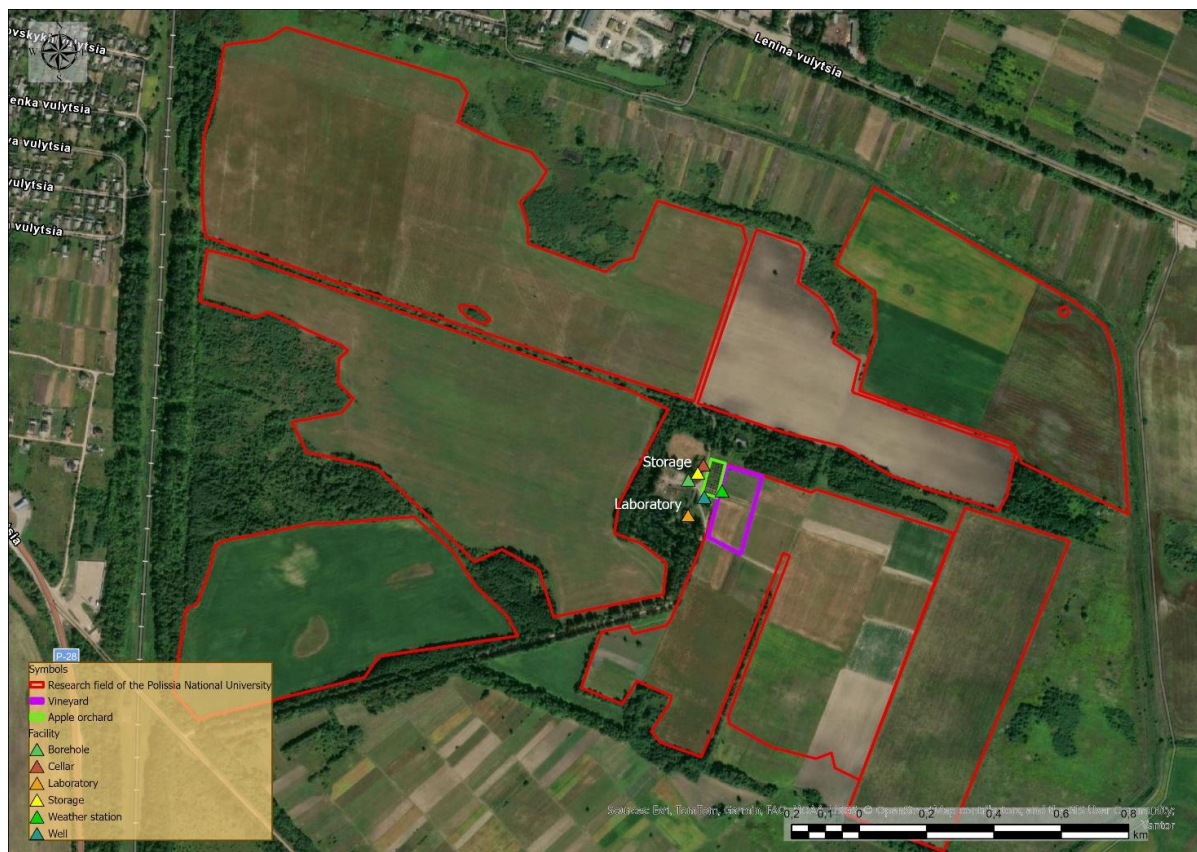
8. Project beneficiaries

The main beneficiaries of the project are:

Beneficiary group	Expected benefit
University researchers	A new research base for agronomic, climatic, soil and geoinformation studies.
Students and postgraduate students	Practical training and topics for coursework, bachelor’s, master’s and dissertation research.
Local farmers	Access to practical recommendations on growing grapes under the conditions of Polissia.
Small producers	Opportunities to diversify production and develop niche agricultural products.
UVWA and sectoral organisations	New data on the potential expansion of viticulture into non-traditional regions.
Territorial communities	New opportunities for the local economy, agritourism and branding.
Educational institutions	Teaching materials, a demonstration plot and digital tools.

9. Description of the experimental plot

The experimental vineyard plot will be established on the experimental field of Polissia National University as part of the research and educational infrastructure of the Farmer Field School (Map 3).



Map 3. Prospective plot for establishing the vineyard

The plot is intended for establishing a collection of promising grape varieties, conducting varietal testing, studying plant adaptation to Polissia conditions, assessing the influence of soil and climatic factors, testing different technological approaches, organising practical classes and field days, and collecting data for GIS and satellite monitoring.

Area: 1 ha. This is an optimal and convenient scale for establishing demonstration plots, conducting precision-farming experiments and developing practical skills without excessive cultivation costs.

Location: the plot is located in the Zhytomyr region. Its proximity to the regional centre ensures convenient logistics for field visits and continuous links with the research and educational base.

Relief: the terrain is flat and typical of the Polissia Lowland. The absence of significant elevation differences is a major advantage: it helps prevent the washout of the fertile soil layer, contributes to even moisture distribution and provides favourable conditions for calibrating spatial monitoring equipment.

Soil type: soddy medium-podzolic soils. These soils have relatively low natural fertility, usually increased acidity and a low humus content. They will require a systematic approach to nutrition, including mineral and organic fertilisation, and, if necessary, liming to optimise pH for specific crops.

Moisture level: the region generally belongs to the zone of sufficient moisture. However, soddy-podzolic soils of light texture may lose moisture quickly during dry periods. Therefore, moisture availability will depend strongly on seasonal precipitation, which makes artificial water supply highly relevant.

Previous land use: cereals and grain legumes. This is a favourable predecessor. Grain legumes, through root nodule bacteria, contribute to atmospheric nitrogen fixation, improving soil structure and enriching the microbiota of soddy-podzolic soils.

Water access: a stable local water supply is available: 10 metres to a well with a discharge of 400 litres per day and 50 metres to a borehole with a discharge of 500 litres per day. The total volume of 900 litres per day is sufficient for household needs during training sessions and for targeted drip irrigation of experimental beds or greenhouse areas.

Risks of spring and autumn frosts: these risks are high and are a climatic norm for Polissia. There is a considerable probability of late spring frosts in May and early autumn frosts in September. This is a critical factor requiring careful selection of planting dates, protection of vines from low temperatures and the development of an operational temperature warning system.

Possibility of UAV and satellite monitoring: the plot is suitable for the application of GIS technologies.

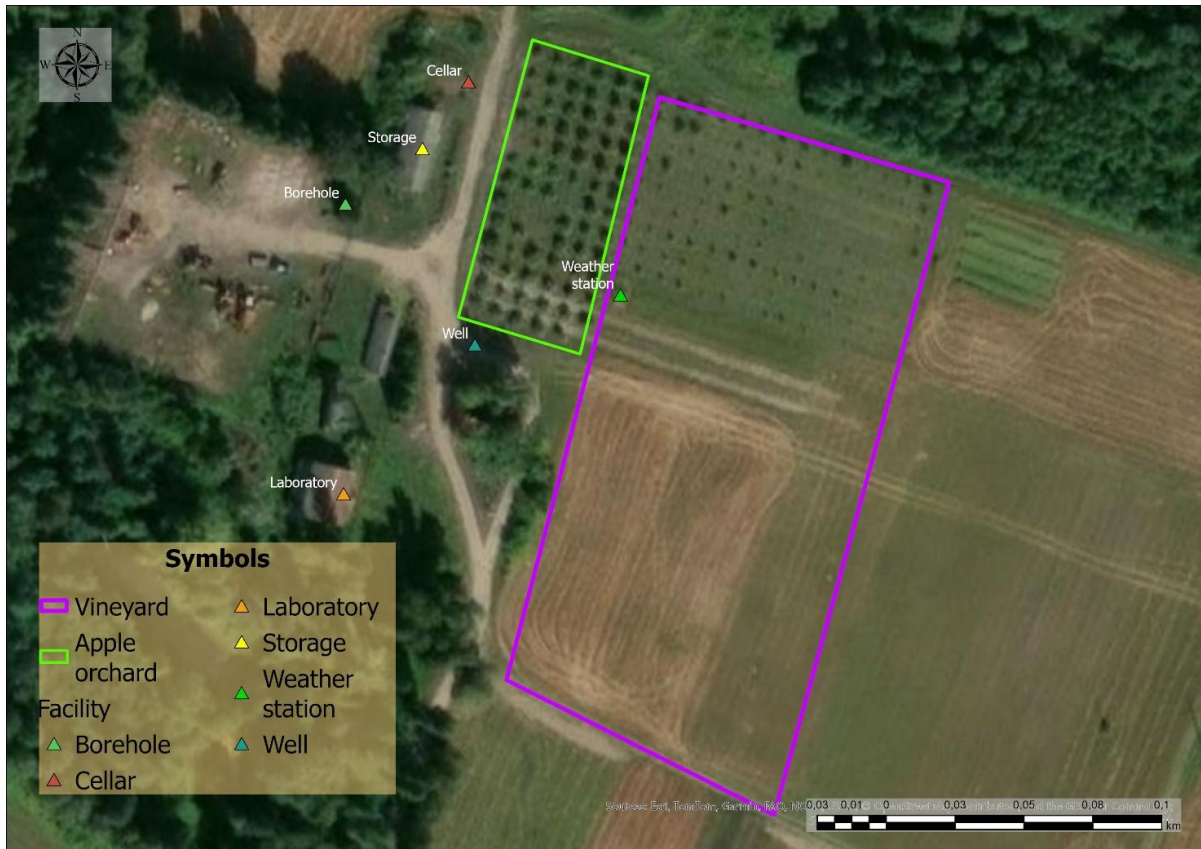
- UAVs: an area of 1 ha can be covered by a drone within minutes, allowing regular creation of high-resolution orthophotos and 3D terrain models.
- Satellites: the plot size of 10,000 square metres is sufficient for satellite-based analysis. For example, Sentinel-2 images with a spatial resolution of 10 x 10 metres per pixel will provide an array of about 100 pixels, which is representative for calculating vegetation indices such as NDVI and for analysing thermal anomalies using platforms such as ArcGIS Pro or Google Earth Engine.

Logistical accessibility for training: the convenient location and access to basic resources, including water, make this plot a suitable field site. It can host practical field classes for students, courses in Earth observation, and testing of equipment and robotics under real field conditions.

In the long term, the experimental plot should become not only a field for experimentation, but also a demonstration site for Polissia viticulture.

10. Description of the infrastructure of the experimental field and the PNU Farmer Field School

The infrastructure of the experimental field of Polissia National University makes it possible to create a complete research and educational platform for studying new agricultural crops, including grapes (Map 4).



Map 4. Vineyard infrastructure as a research object

The infrastructure shown on the map forms an integrated research and educational base for implementing the “Polissia Vineyard” direction within the PNU Farmer Field School. It includes the vineyard production plot, an adjacent apple orchard, a weather station, water sources, storage facilities, a laboratory, a cellar and convenient road access. This combination of facilities makes it possible to organise not only varietal testing and technological experiments, but also a complete training process, digital monitoring, demonstration events and practical training for local producers.

Geoinformation and digital infrastructure: the project’s geoinformation and digital infrastructure is based on the capabilities of the GIS Centre of Polissia National University, which has experience with ArcGIS, Google Earth Engine, Copernicus Data Space, satellite monitoring and UAV imagery. This will make it possible to create digital maps of the vineyard, develop databases of varieties and field observations, monitor the condition of plantations, identify stress zones, analyse agroclimatic risks and present results through interactive dashboards with the possibility of mobile field data collection.

11. Project implementation methodology

The project methodology combines agronomic, soil and climatic, geoinformation, educational and economic approaches.

11.1. Agroclimatic analysis

At the first stage, an assessment of the climatic conditions of the territory will be conducted, including active temperature sums, the length of the growing season, precipitation, risks of spring and autumn frosts, dry periods, temperature extremes and microclimatic features of the experimental field.

11.2. Soil and ecological assessment

An analysis of soil conditions will be conducted, covering soil type, acidity, texture, organic matter content, water regime, drainage and suitability for grape cultivation.

11.3. Varietal testing

Varietal testing will include the selection of promising varieties, establishment of varietal blocks, phenological observations, assessment of plant growth and development, assessment of winter hardiness, disease resistance, yield accounting and evaluation of berry quality.

11.4. Technological adaptation

Within the project, different elements of the technology will be tested, including planting systems, vine training, inter-row management, nutrition, plant protection, moisture conservation and protection against climatic risks.

11.5. Geoinformation and remote sensing monitoring

This block includes the creation of a digital vineyard map, satellite monitoring of plant condition, UAV imagery, calculation of spectral indices, mapping of plot heterogeneity, identification of stress zones, creation of spatial and field data databases, and preparation of a digital vineyard passport.

11.6. Educational and advisory block

This block includes the preparation of teaching materials, organisation of field days, training sessions for farmers, practical classes for students, development of methodological recommendations and advisory support for local producers.

12. Project work packages

WP	Work package title	Main content	Expected result
WP1	Agroclimatic and soil justification	Analysis of climate, soils, relief, water regime and risks	Analytical report on plot suitability
WP2	Planning and establishment of the experimental plot	Selection of varieties, planting scheme, plot preparation and marking	Established experimental vineyard
WP3	Varietal testing	Phenology, growth, resistance, yield and berry quality	Ranking of promising varieties
WP4	Adaptation of cultivation technologies	Care, nutrition, protection, vine training and moisture conservation	Technological recommendations
WP5	GIS and remote sensing monitoring	Sentinel data, UAVs, weather data, digital maps and dashboard	Digital vineyard passport
WP6	Education and knowledge transfer	Training sessions, field days, Farmer Field School and teaching materials	Trained farmers and students
WP7	Communication, branding and scaling	Publications, presentations, communities, associations and local brand	Scaling model for Polissia

13. Expected results

As a result of project implementation, the following outcomes are expected:

- establishment of an experimental vineyard plot on the basis of Polissia National University;
- creation of a collection of promising grape varieties;
- identification of the varieties most suitable for the conditions of Polissia;
- development of adapted technological recommendations;
- creation of a digital vineyard map;
- launch of a satellite, UAV and field monitoring system;
- preparation of educational materials for farmers;
- organisation of field days and training sessions;

- engagement of local producers in a new direction of agricultural activity;
- preparation of scientific publications;
- creation of a foundation for the development of a local brand of Polissia viticulture.

14. Scientific, educational and digital products

Scientific products

- varietal testing database;
- phenological observations;
- agroclimatic characteristics of the plot;
- assessment of varietal suitability;
- scientific articles;
- conference abstracts;
- methodology for GIS monitoring of the vineyard.

Educational products

- training course for the Farmer Field School;
- practical classes for students;
- methodological recommendations for farmers;
- field days;
- demonstration materials;
- general educational video instructions.

Digital products

- digital vineyard passport;
- interactive varietal map;
- field observation database;
- plantation condition dashboard;
- map of agroclimatic risks;
- map of spatial heterogeneity of the plot;
- project StoryMap.

15. Risks and mitigation measures

Risk	Potential impact	Mitigation measures
Spring and autumn frosts	Damage to shoots and yield	Selection of frost-resistant varieties, microclimatic analysis and protective technologies
Excessive moisture	Risk of diseases and reduced growth	Plot selection, drainage, inter-row management and moisture monitoring
Grape diseases	Reduced productivity	Resistant varieties, regular monitoring and integrated protection
Insufficient experience of local producers	Errors during scaling	Training, advisory support and demonstration plots
Unstable climatic conditions	Variability of results	Multi-year monitoring, weather data and adaptive technologies
Low economic efficiency of certain varieties	Limited practical implementation	Economic assessment and selection of the most promising varieties
Regulatory restrictions on further processing	Impossibility of uncontrolled production	Work strictly within the applicable legislation and with specialised partners

16. Prospects for project scaling

If the pilot stage is successfully implemented, the project can be scaled to:

- training farms of other universities;
- farms;
- territorial communities;
- demonstration farm sites;
- regional programmes for the development of niche agricultural production.

A promising direction is the creation of a network of demonstration vineyard plots in different soil and climatic conditions of Ukraine, using a unified methodology for data collection, digital monitoring and evaluation of results.