AGROKAZ

DEVELOPMENT OF BACHELOR PROGRAM IN AGROECOLOGY WITH DUAL EDUCATION IN KAZAKHSTAN

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Partner Country Report

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Project acronym	AGROKAZ
Project full title	Development of bachelor program in agroecology with dual education in Kazakhstan
Project number	101082564
Funding scheme	ERASMUS Lump Sum Grants (ERASMUS-EDU-2022-CBHE-STRAND-2)
Project start date	01/02/2023
Project duration	3 years

TITLE OF DOCUMENT	**Partner Country Report**
Work package	WP2 Preparation for development of dual study program in agroecology
Deliverable	**D2.1 Partner Country Report**
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Due date	31/07/2023
File name	D5 Partner Country Report
Number of pages	60
Dissemination level	SEN

Abstract	The primary purpose of Partner Country Report is to determine differences and similarities of best study programs of dual education and agroecology at one place to create proper curriculum. Also, the report will provide useful data for training and workshops planned in the other WP.

VERSIONING AND CONTRIBUTION HISTORY

Version	Date	Description	Responsible members
1.0	26/07/2023	First draft	KEnEU
1.1	30/07/2023	Final version	KEnEU

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Content

NORMATIVE REFERENCES

The following normative references are used in this report:

- Code of the Republic of Kazakhstan dated 09.07.2003 N 481-11 "Water Code of the Republic of Kazakhstan" - Water legislation of the Republic of Kazakhstan regulates relations in the field of use and protection of the water fund, management of the water fund and water management systems, water supply and water disposal, carrying out of hydro reclamation works and works on safety of water management systems and structures and other water relations.
- Code of the Republic of Kazakhstan dated 08.07.2003 N 477-I "Forest Code of the Republic of Kazakhstan" - The Code regulates public relations concerning ownership, use, disposal of the forest fund, as well as establishes legal bases for protection, conservation, reproduction, enhancement of ecological and resource potential of the forest fund, its rational use. Regulation of forest legal relations is carried out based on the fact that the forest is one of the most important components of the biosphere, having global ecological, social, and economic significance.
- Code of the Republic of Kazakhstan dated 09.01.2007 N 212-1II "Ecological Code of the Republic of Kazakhstan" - The Code regulates relations in the field of protection, restoration, and conservation of the environment, use, and reproduction of natural resources in carrying out economic and other activities related to the use of natural resources and impact on the environment, within the territory of the Republic of Kazakhstan.
- Law of the Republic of Kazakhstan dated 07.07.2006 N 175-Z "On specially protected natural territories".
- Law of the Republic of Kazakhstan dated 09.07.2004 N 593-N "On protection, reproduction, and use of fauna".
- Law of the Republic of Kazakhstan dated 03.07.2002 N 331-N "On plant protection".
- Law of the Republic of Kazakhstan dated 24.06.2010 N 291-IV "On subsoil and subsoil use".
- Law of the Republic of Kazakhstan dated 14.04.1997 N 93-1 "On the use of atomic energy".
- Law of the Republic of Kazakhstan dated 11.02.1999 N 344-1 "On plant quarantine".

DEFINITIONS

The following main concepts and definitions are used in this report:

Academic Degree (Degree) - a degree awarded by educational organizations to students who have mastered the relevant educational programs, based on the results of the final certification.

Academic Hour - the time of a student's contact work with a teacher according to the schedule in all types of academic activities (classroom work) or according to a separately approved schedule within established time frames, in order to achieve certain educational goals.

Academic Period (Term) - a period of theoretical training, established independently by the educational organization in one of three forms: semester, trimester, quarter.

Assessment - a general concept that extends to all methods and actions for assessing outcomes (knowledge, skills and competences) of an individual, which leads to understanding the level of mastery of knowledge, skills and competencies.

Checkpoint control - control of students' educational achievements upon completion of a section (module) of one academic discipline.

Competencies - qualities of a subject of activity that ensure the fulfillment of tasks of professional activity of a certain qualification level.

Course Description - a brief description of the discipline (consisting of 5-8 sentences), which includes the goals, tasks, and content of the discipline.

Descriptors - a description that reflects the entire spectrum of learning outcomes or competencies.

Descriptors used in higher education are level descriptors, which are differentiated into knowledge and understanding (Wissensverbreitung, Wissensvertiefung), application of knowledge and understanding (Wissen anwenden), reasoning (ability to analyze correctly), Ability to learn (Systematische Kompetenz), communication skills (Kommunikative Kompetenz).

Educational programs - a systematically organized set of actions, content, and teaching methods that need to be implemented.

Elective disciplines - academic disciplines included in the elective component within the established credits and introduced by educational organizations, reflecting the individual preparation of the student, taking into account the specifics of socio-economic development and the needs of a specific region, established scientific schools of higher education institutions.

European Credit Transfer System (ECTS) – credits assigned to qualifications and study programs as a whole, as well as their educational components.

Experience - conscious activity, knowledge and skills that can be acquired and effectively used over a certain period of time.

Independent Student Work (ISW) - work on a specific list of topics allocated for independent study, supported by educational and methodological literature and recommendations, controlled in the form of tests, control work, colloquiums, essays, compositions, and reports.

Interim student assessment - a procedure conducted during the examination session in order to evaluate the quality of the student's mastering the content of part or the entire volume of the academic discipline after completing its study.

Knowledge - the result of assimilating information through learning and personal experience, a set of facts, principles, theory, and practice related to the field of study or work, a component of qualification that must be evaluated.

Learning Outcomes - competencies acquired through formal and informal learning and confirmed and recognized upon receipt of a qualification. They are defined as knowledge, skills, and competences.

Module - an educational component of the curriculum, distinguished when designing study programs taking into account national qualification structures, level descriptors, qualification descriptors and with assigned number of credits.

National Qualifications Framework - a systematic and structured description of qualification levels recognized in the labor market.

National Qualifications System - a set of mechanisms supporting the qualifications framework, including the mechanisms of legal and institutional regulation of the demand for workers' qualifications from the labor market and the supply of qualifications from the education and training system.

Postrequisites - disciplines that require knowledge, skills and abilities acquired after completion of the study of a given discipline.

Prerequisites - disciplines containing knowledge, skills, and abilities necessary for mastering the studied discipline.

Profile of a specific study program - a description of the program in terms of its main functions and specific goals and corresponding learning outcomes. Profile - specialization.

Qualification - an official recognition of value in the form of a diploma, certificate, confirming the person's competences that meet the requirements for performing labor functions within a specific type of professional activity (requirements of a professional standard or requirements that have developed as a result of practice), formed in the process of education, training or work activity (on-the-job training), giving the right to work.

Qualification level or level of qualification - established and described within the framework of qualifications, a generalized set of requirements for worker competencies, differentiated by parameters of knowledge, skills, complexity, non-standard labor contexts, responsibility, and independence.

Sectoral Qualifications Framework - a structured description of qualification levels recognized in the industry. Each level is described by a set of uniform parameters (criteria) by descriptors.

Skills - the ability to apply knowledge and demonstrate competence in order to carry out activities and solve tasks (application of logical, intuitive, creative, and practical thinking).

Standard defining the professional standard in a specific area of professional activity requirements for the level of qualification of **competence, content, quality, and working conditions**.

Students' academic achievements - knowledge, skills, abilities, and competences of students acquired by them in the process of learning and reflecting the achieved level of personal development.

Working Curriculum - a document developed and approved by a university based on the standard curriculum of the State Educational Standard for a specialty and individual study plans of students, taking into account the conditions of a specific professional activity, stages of the educational process. It contains a complete list of disciplines grouped into cycles of general educational disciplines, basic disciplines, professional disciplines with an indication of the minimum credits required for students to master, forms of control, as well as additional forms of training and final certification. The structure of the working curriculum is determined by the university independently.

ABBREVIATIONS

BD - Basic Cycle Disciplines

BEP - Basic Education Program

CD - Choice Component Disciplines

CED - Catalog of Elective Disciplines

CSE - Credit System of Education

CTE - Credit Technology of Education

EQF - European Qualification Framework

FSA - Final State Attestation

IQF - Industry Qualification Framework

ISW - Independent Student Work

LC - Labor Code

M - Module

MCD - Mandatory Component Disciplines

MD - Mandatory Cycle Disciplines

NQF - National Qualification Framework

PD - Profiling Cycle Disciplines

SMES - State Mandatory Education Standard

SP - Study Plan

TS - Teaching Staff

UC - University Component

Introduction

The connection between agriculture and climate change is evident. Drought or flooding, it is agriculture that becomes the victim of these consequences of global warming, and it also provokes them. Agriculture is primarily a realm of food security, thus a prerogative of the state. The current solution to these issues is "Agroecology".

What impacts agriculture more than weather, and ultimately, the climate? Since the 1980s, climate change has negatively impacted the yield of crops such as corn and wheat globally. To reduce emissions into the atmosphere means to reduce production. However, the freedom to produce the product necessary for the population remains in the hands of the state. Experts, though, suggest another possibility called "agroecology".

"Agroecology" means applying ecological principles to agriculture, to agricultural lands. "Ecological principles" are when we consider a particular environment, a biological community, and say that there are regulatory mechanisms within it. They bring the community into equilibrium, but equilibrium does not mean that it does not undergo any changes. We're talking more about fluctuations around a balanced state. The approach behind agroecology is the idea of using biological regulation mechanisms for our purposes, i.e., to achieve higher productivity and improve environmental indicators.

Among the mechanisms that govern this, i.e., regulatory mechanisms, we need to choose those that have a positive effect and thus get the ability to control the environment. This leads us to two things: the use of such a critical lever as diversity - functional diversity - and the presence of diversity at various levels of the ecosystem, for example, several genotypes in one field, several different varieties in one field, different cultures in one territory. Different tiers too - for instance, herbaceous plants where wheat is grown, but also trees. Here, we can also add landscape design - all of this is functional diversity.

Next, we need to organize this diversity, maximize it, because by increasing the level of diversity, we also increase what the ecosystem gives us in terms of regulation.

Initiating these processes, at least in theory, three things happen. First, some biological communities are more stable than others. One of the reasons why diseases develop or a large number of insects appear on agricultural lands, for example - is that these communities are quite poor. If the community is rich, an insect species that entered from outside will not be able to develop.

Either it will not find its ecological niche, or its natural predators will simply eat it. To increase the diversity of the agricultural environment, the number of communities there must be increased. As the quantity increases, each of them will weigh less, but in the case of the

appearance of outsiders, for example, an aggressive species like aphids, there will already be species present that are their natural enemies, which will devour them and prevent them from spreading. This concerns the first side, and there are many examples that show that all of this really works.

The second side is as follows: by increasing species diversity, we also increase the diversity of physiological mechanisms, especially - the mechanisms for obtaining nutrients, nitrogen, and phosphorus. So, increasing species diversity - with proper management of this diversity - contributes to the closing of cycles, that is, the cycling of carbon, nitrogen, and phosphorus. The more closed this cycle is - the less these substances are leached from the environment, and accordingly, the negative effect of such leaching is reduced. And the idea we rely on, dealing with agroecology - is building the communities that interest us, managing them properly, controlling natural aggressors - which means fewer pesticides, and controlling cycles - which means less pollution. That is the point of this approach.

One of the main complexities of this system, which can be effective from both an economic and ecological point of view, is social. "Agroecology" as an educational program that will give specialists the opportunity to conduct research in this field - which should be aimed primarily at understanding the various processes we want to use for our own purposes. Then, based on this understanding, we need to develop specific techniques, advice that will allow farmers to deal with this issue.

The third side is working in this way, it will be necessary to actively use agricultural machinery and units, so the application of technology must be adapted to such a practice.

There is a need for a new concept, based on how agriculture is developing, what equipment is being produced for it, how information management is going on, in order to give farmers the opportunity to work according to these principles of preserving ecological safety and increasing yield.

In exploring these issues, there is a need for specialists who will run the agroecological system of farming, including natural plant protection.

Agroecology is the science of agroecosystems. An agroecosystem is understood as an artificial ecosystem in which agricultural activity is applied, or a set of biogenic and abiotic components of a land plot used for the production of agricultural products. Often, an agroecosystem is understood as an interconnected (economically, energetically, and ecologically) system on the scale of one large farm.

The structural elements of an agroecosystem are agrophytocenosis and agrobiocenosis (agrocenosis). Agrophytocenosis is a farming and pasture community that includes cultivated and weed vegetation, both of a single planting and a crop rotation within one area. Agrobiocenosis

(agrocenosis) represents the totality of agrophytocenosis and heterotrophic biota (the aggregate of living organisms living in the soil, on plants, and in a given crop).

Unlike biocenoses, agrocenoses are characterized by a very small number of species, especially in phytocenoses. As is known, the fewer species in a community, the less stable it is. To maintain agrocenoses (plantings of agricultural crops, and breeds of domestic animals), humans have to spend a large amount of additional energy on soil cultivation, fertilizer application, pest control, diseases, and weed plants that in agroecosystems are considered enemies, using heavy agricultural machinery for all this in the fields.

All this not only benefits plants and animals but also inflicts certain harm on the entire environment. Agroecosystems are not isolated ecosystems, they interact both with each other and with the surrounding biocenoses and biogeocenoses. Moreover, the influence is mutual, biocenoses mainly positively affect agrocenoses, and the latter on biocenoses, unfortunately at present, mainly negatively, worsening their living conditions and reducing both their total number and species diversity.

One of the priorities of agroecology is the protection of natural resources and biodiversity, as well as the ability to adapt to climate change and mitigate its effects. It can also increase the resilience of farms, contribute to the production and consumption of healthy and nutritious food, and stimulate the economy and markets.

Ecological thinking is one of the complex types of cognitive activity, as it presupposes such an attitude towards nature, when it is perceived not only as a human habitat but as a unified self-organizing whole - a living world system. Ecological education and upbringing play a special role in the formation of ecological thinking among students. It is designed to develop an ecological worldview, ecological morality, and ecological culture of the individual.

Ecological education implies the formation of everyone's conviction of the objective necessity to preserve the values created by nature and man. The level of ecological culture of the individual is determined by understanding the social significance of ecological problems, their connection with the political, socio-economic tasks of humanity and the individual, therefore, the educational process should ensure the formation of the basics of the ecological worldview and its real implementation.

Due to the increasing anthropogenic pressure on the environment, including in the agricultural sector of Kazakhstan, agricultural production without adherence to environmental standards can lead to irreversible social and technogenic processes.

Therefore, future specialists - agroecologists, in order to ensure balanced dynamic development and reduce or prevent anthropogenic load on the natural environment, should have a complex of knowledge proposed in this educational program:

- formation of basic professional competencies in the field of environmental protection,
- creation of prerequisites for independent search and research activities of students within the framework of conducting an experiment at all its stages,
- the ability to work with scientific and technical information, use domestic and foreign experience in professional activities, systematize and summarize the obtained information.

These steps are crucial in training professionals who can not only perform their duties, but also understand and tackle emerging environmental problems in their field. This holistic and forward-thinking approach to education can provide the next generation with the skills and knowledge necessary to manage and mitigate the effects of agricultural activities on the environment.

1 Analysis of Agricultural Producers' Production Experience in the Field of Agroecology

"Zamandas" farm, located in the Irtysh district in the northwest of Pavlodar region, has the most experience in implementing agroecology methods into production. The area of arable land in the farm amounts to 13,000 hectares. The soils are southern carbonate chernozems. The annual rainfall is 240-260 mm.

The application of agroecological farming methods with the No-Till technology started in 2015. The following reasons prompted them to switch to agroecological methods of farming: lack of moisture, soil degradation, low economic effect from traditional farming, and a large number of accompanying production operations in traditional farming. By 2015, the management of the "Zamandas" farm realized that continuing farming by traditional methods would lead to the final degradation of the soil cover and the loss of economic profitability.

The transition to No-Till technology was associated with a number of significant difficulties. The main problems were: soil compaction, accumulation of crop residues, weed control, and lack of knowledge on the application of this technology.

To combat soil compaction, a bioplough method was used. The method involves the inclusion of dicotyledonous crops with a powerful taproot system in the crop rotation. Taproots are capable of breaking through compacted soil horizons, and subsequently become natural channels for moisture penetration inside the soil profile. When water freezes inside root channels, the channels expand and, consequently, the compacted soil horizon is destroyed. Sunflower, buckwheat, mustard, flax, lentils, wheat, oats, millet, and Sudan grass are used as a bioplough.

When studying the issue of preserving crop residues, it was found that crop rotation with a 50:50 ratio of cereals to dicots does not allow preserving and accumulating crop residues. To accumulate and maintain a certain level of plant residues, it is necessary for the share of grain crops in the crop rotation to be at least 60%. Keeping crop residues in the fields allows for effective snow retention and provides additional moisture supply to the fields. The same purpose is served by the use of cover crops. The application of the cover crops method requires changes to the structure of seeders, which was done at the "Zamandas" farm.

To combat weeds, crop residue retention and a special crop rotation consisting of the following crops are used: Spring Wheat, Winter Wheat, Sunflower, Lentils, Flax, Sudan Grass, Millet, Rapeseed, Spring Barley, Oats. Depending on the growth conditions and early maturity of the main crops, the composition of the crop rotation changes, as does the number of cover crops in it.

The implementation of No-Till methods and an agro-ecological approach in the practice of the "Zamandas" farm has stopped soil degradation and increased production profitability by 20-25% compared to traditional plant growing methods.

The implementation of agroecological methods in the farm's practice continues with the participation of scientists from Toraighyrov University. The "Zamandas" farm in the Irtysh district of Pavlodar region is implementing research results into production on an area of 400 hectares as part of the activity "Improving Degraded Pasture Areas with an Increase in Green Mass Yield up to 1.5 Times (Improvement of Water-Physical Soil Properties) in the Irtysh District of Pavlodar Region" within the framework of the Scientific and Technical Program of the PTF of the Ministry of Agriculture of the Republic of Kazakhstan for 2021-2023 under the R&D project BR10764915 "Development of New Technologies for Pasture Restoration and Rational Use (Use of Pasture Resources)".

On the experimental plots, soil samples were taken to determine the following indicators: bulk mass, reserves of productive moisture, NPK, etc., and observations were made on the growth and development of wheatgrass. Selected samples for nutrient content were sent to agrochemical laboratories.

A recommendation was issued: Uakhitov J.J., Kakezhanova Z.E., Askarov S.U., Almisheva T.U., Sarbasov A.K., Kukusheva A.N. Methodological Guide to Effective Schemes for Improving Degraded Pasture Areas with an Increase in Green Mass Yield up to 1.5 Times in the Conditions of Pavlodar Region: recommendation - Pavlodar: Toraighyrov University, 2023. - 20 p. (ISBN number – 978-601-345-393-4).

A notification of positive results of formal expertise was received for application № 02023/0085.1. Kakezhanova Z.E., Uakhitov J.J., Sarbasov A.K., Kukusheva A.N., Almisheva T. U., Askarov S.U. "Method for Increasing the Productivity of Degraded Pasture Lands".

Recently, there has been a global trend towards the use of technologies for growing agricultural plants that aim to reduce the rates of mineral fertilizers application, enhance the role of biological factors (crop rotations, bio-preparations, growth regulators, green manure crops, composts, and other organic fertilizers), and varieties adapted to such conditions.

Worldwide, the area allocated to organic farming constitutes 1% of the agricultural land area – 71 million hectares. Their annual increase occurs as a result of support and development by states of rural regions, adaptation to climate change on the planet, the necessity to preserve soil fertility. All this is relevant for the Republic of Kazakhstan.

Research by domestic and foreign scientists has found that crop yields decrease when transitioning to environmentally friendly technologies, with this period averaging 4-5 years. In the first year, this decrease ranges from 56 to 64% compared to the control variant, but as soil fertility increases, crop yields under different farming technologies become similar. It is noted that organic

farming technologies ensure a more stable yield, especially under stressful conditions, such as drought.

The low efficiency of organic farming in the initial years of use is explained by a deficit of nutrients, as the nutrients in organic fertilizers become available to plants slowly, another reason could be competition for nutrients with weeds, which is particularly intense in the first years.

Organic production involves crop rotation, so different types of crops - grains, forage, oilseeds, and legumes - are grown and exported, contributing to the rational use and conservation of soil fertility.

On average, the price of products grown using organic technology is 20-50% higher, making the transition to this technology attractive for many producers and offsetting the decrease in crop yields during the transition period.

In the Kostanay region, as of the end of 2022, the number of certified farms growing agricultural crops using organic technology was 9, covering a total area of 16,854 hectares. The main crops grown are wheat, flax, and peas. The produced goods are exported to European countries.

The profitability of organic farming can be increased by using specialized varieties for organic farming, these varieties are capable of using the available soil nutrients more effectively.

The private limited company "Agricultural Experimental Station 'Zarechnoe'" has been involved in the development and adaptation of agronomic elements for organic crop production technology since 2012.

In the experimental stationary of organic farming in 2021, 5 varieties of spring wheat - Lyubava 5 (control), Chelyaba 75, Likamero, Omsk 41, Ayna, and 2 varieties of linseed - Kazar and Kostanay-11 were studied. Based on the results of the 2021 research, standout varieties were selected, and in 2022, 6 varieties of spring wheat (Lyubava 5, Chelyaba 75, Likamero, Uralosibirskaya, Alabuga, and Ayna) and 2 varieties of linseed (Altyn and Kostanay-11) were studied. Soil treatment technologies were minimal.

Based on the results of research conducted in 2021-2022, data on varietal testing of spring wheat and oil flax in organic farming were obtained (Figures 1, 2).

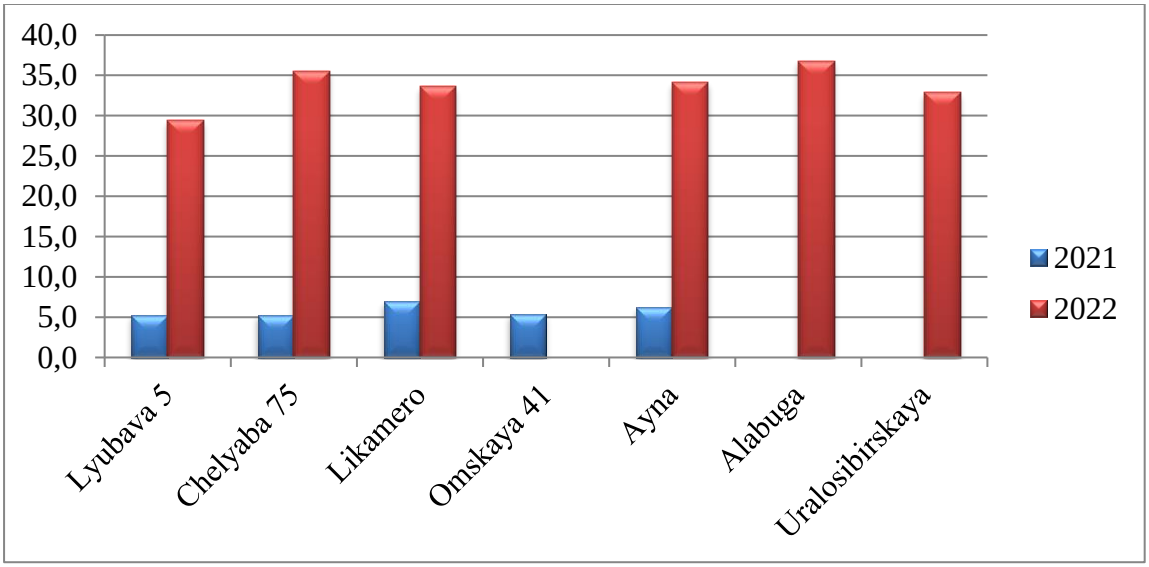


Figure 1 - Yield of spring wheat varieties, 2021-2022.

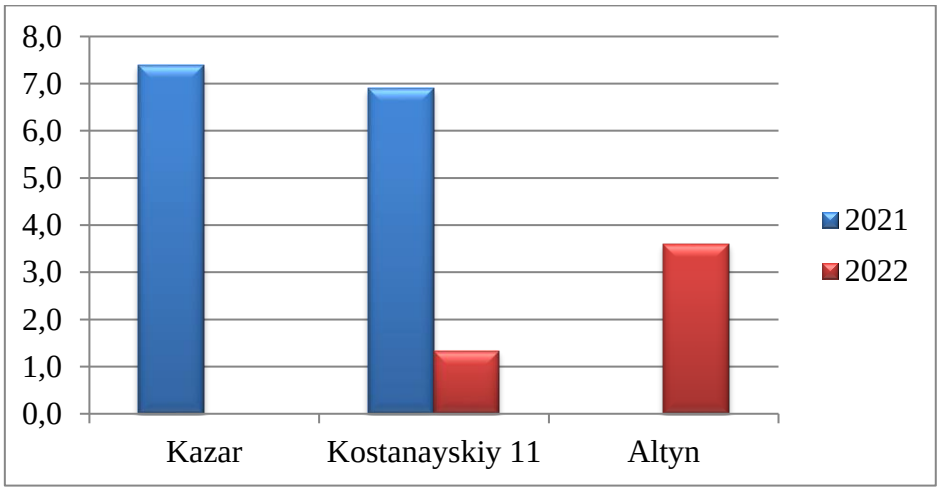


Figure 2 - Yield of oil flax varieties, 2021-2022.

The spring wheat varieties grown in the dry conditions of 2021 showed the following results. The highest yield was observed for the Likamero variety, averaging 6.92 centners/ha. Slightly lower was the yield of the Ayna variety (6.24 centners/ha). In 2022, the maximum yield was noted for the Alabuga variety, averaging 36.8 centners/ha, or 25.2% higher than the control - Lubava 5 variety. Slightly lower yields were observed for the Ayna and Chelyaba 75 varieties (34.16-35.57 centners/ha or 16.2 and 21% higher than the control respectively).

For oil flax in 2021, the Kazar variety proved to be the best, with a yield of 7.4 centners/ha. The yield of the second variety, Kostanaysky 11, was 6.9 centners/ha. In 2022, the Altyn variety stood out with a seed yield of 3.6 centners/ha. The yield of the Kostanaysky-11 variety was 1.33 centners/ha. It should be noted that the Altyn variety of oil flax showed good resistance to thrips damage at the early stages of its development.

We also conducted work to assess the quality of the studied spring wheat varieties (Table 1).

Table 1 – Quality indicators of spring wheat, 2021-2022

Spring Wheat Variety	Protein, %	Gluten, %	Test Weight, g/l	Class
2021				
Lubava 5	19.2	37.1	783	Highest
Chelyaba 75	17.6	32.2	766	Highest
Likamero	17.1	31.1	766	I
Omskaya 41	18.5	34.2	744	II
Ayna	16.8	30.6	746	II
2022				
Lubava 5	17.4	32.6	790	Highest
Chelyaba 75	16.4	30.9	786	I
Likamero	15.1	27.5	767	II
Alabuga	14.2	25.9	757	II
Ayna	14.9	28.0	770	I
Uralosibirskaya	16.4	30.7	763	I

Analyzing the quality of grain from the spring wheat varieties studied in the drought year of 2021, we see that all varieties produced a good quality harvest thanks to the precipitation that fell in July. Although the Likamero variety had the best yield, its wheat grain was classified as Quality Class I. The highest class was observed in spring wheat varieties – Lubava 5 and Chelyaba 75. At the same time, the Lubava 5 variety recorded the highest quality indicators: protein – 19.2%,

gluten content – 37.1%, and test weight – 783 g/l. The grain of the Omskaya 41 and Ayna varieties was classified as Quality Class II, which is also a good indicator for this year.

In the favorable conditions of 2022, the quality indicators of the spring wheat varieties studied were as follows: the protein content in the grain ranged from 14.2% to 17.4%, gluten content was between 25.9% and 32.6%, and the test weight was between 757-790 g/l, indicating that the harvested grain was of good quality. Despite the good yield of the Ayna and Chelyaba 75 varieties, the grain was classified as Quality Class I. The highest class was obtained in the Lubava 5 spring wheat variety. The grain of the Likamero and Alabuga varieties belonged to Quality Class II, which is also a satisfactory indicator for this year.

Based on the results of two years – spring wheat and oil flax varieties tested in the extremely dry conditions of 2021 and the favorable conditions of 2022 – it is too early to draw conclusions. The cultivated varieties require further study. However, it is worth noting that, based on the productivity and seed quality indicators for 2021-2022, the domestic spring wheat varieties – Ayna and Lubava 5 – show promise for cultivation using organic technology. The new domestic oil flax variety Altyn also demonstrated good yields and pest resistance, which is especially important when refraining from using chemical plant protection products in organic farming.

According to the strategic development plan of the Republic of Kazakhstan until 2025, one of the strong points in the development of the agro-industrial complex in the country is the high potential for the production and export of organic products. In connection with this, in various soil and climatic zones of the country, a thorough study of the conditions and opportunities for realizing this potential is necessary.

KRIPPQ (Kazakh Research Institute of Plant Protection and Quarantine named after Zhazken Zhiyembayev) is the only specialized institution in Kazakhstan that is carrying out important strategic, environmental, economic, and social research to find ways to improve the effectiveness of scientific research in the field of plant protection and quarantine.

The history of the Kazakh Research Institute of Plant Protection and Quarantine began on February 21, 1958, when by a resolution of the Council of Ministers of the Kazakh SSR, the institute was created based on the Republican Plant Protection Station.

Today it comprises two branches: the Kostanay and South Kazakhstan branches. The main task of the institute is to develop an integrated system for protecting plants from harmful organisms, to reduce the pesticide load on agrophytocenoses, and to provide scientific support for plant quarantine for the national security (food, environmental, biological) of the Republic of Kazakhstan.

The activities include:

– Development and implementation of an effective system for protecting plants against pests, diseases, and weeds;

- Scientific and technical support for plant quarantine;
- Creation of biological plant protection agents;
- Conducting systematic research in the field of plant protection and quarantine;
- Transfer and adaptation of promising foreign technologies for plant protection and quarantine.

According to the project documentation, the main aforementioned city-forming companies participate in the development and implementation of the "Agroecology" strategic program.

2 Analysis of Educational Programs in the Field of Agroecology in Kazakhstan

Agriculture is a phenomenon that significantly influences the life of each of us. Modern industrial agriculture, despite its undeniable successes in food production, is unsustainable in the long term from an ecological point of view. That's why new approaches, such as agroecology, are emerging, which is referred to as the future of agriculture.

Agroecology represents a very complex concept of an approach to agriculture, food production, which is not limited to just the technical side of food production, but also includes social and ecological aspects and landscape care. The role of consumers is very important for an agroecological approach as participants in shaping the entire food system towards sustainability.

The management of the educational process in Kazakhstan involves a series of stages: constant analysis of labor market needs, analysis of employment and surveying of stakeholders, forming the necessary competencies of graduates based on the requirements of professional standards and employer requests, forming the goals, content and structure of the educational program, choosing approaches to teaching and methods for evaluating the quality of implementation of the educational program, further improvement of the educational program.

Educational programs are updated due to changes in regulatory documents of the Ministry of Science and Higher Education of the Republic of Kazakhstan, labor market requests, and stakeholders. Also, taking into account the demand for specialists in the labor market and ongoing transformations in the country's economy, the university opens new educational programs.

The development of educational programs in the field of agroecology was predetermined by intense socio-economic changes, new priorities in the development of the education system and the country as a whole; fundamental changes in the system of higher and postgraduate education of the Republic of Kazakhstan. Designing and developing educational programs is dictated by new challenges, as well as changing priorities of state policy, stemming from the Message of the President of the Republic of Kazakhstan N. A. Nazarbayev to the people of Kazakhstan dated December 14, 2012 "Strategy 'Kazakhstan-2050' - a new political course of the established state", Decree of the President of the Republic of Kazakhstan dated March 1, 2016 No. 205 "On approval of the State program for the development of education and science of the Republic of Kazakhstan for 2016 - 2019"; Decree of the President of the Republic of Kazakhstan dated August 1, 2014 No. 874 "On approval of the State program for industrial-innovative development of the Republic of Kazakhstan for 2015–2019 and on amending the Decree of the President of the Republic of Kazakhstan dated March 19, 2010 No. 957 "On approval of the List of state programs"; Decree of the President of the Republic of Kazakhstan dated February 1, 2010 No. 922 "On the Strategic Plan for the Development of the Republic of Kazakhstan until 2020", the

State Compulsory Standard of Higher and Postgraduate Education. Order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 No. 2. Registered in the Ministry of Justice of the Republic of Kazakhstan on July 27, 2022 No. 28916.

The design and development of educational services in the Republic of Kazakhstan are based on: - input data – Dublin descriptors, the national qualifications framework, industry qualifications framework, professional standards, compulsory state educational standards (SMHES, SMPES), and other regulatory requirements and labor market demands.

Generally, the process of developing an educational program includes the following stages:

1. Study of Dublin descriptors.
2. Study of NQF, IQF, Professional Standards, SMES.
3. Analysis of labor market demands to identify key content requirements for modules and disciplines.
4. Identification of interdisciplinary correspondences for module and competence formation. Each module assumes uniqueness in the formation of future specialists' competences. The competencies being formed cannot be duplicated in other modules.
5. Involvement of teachers with the aim of proposing module formations in line with the aims and objectives of disciplines, indicating the results of module learning, volume, and duration.
6. Formation of an initial version of the educational program and teachers' proposals.
7. At the Academic Committee meeting, the correctness of module compilation, its effectiveness in preparing future specialists, adherence to the requirements for forming modular educational programs set by the CTE rules, SMES, etc., are analyzed.
8. As a result of the analysis, corrections are made to the initial version of the educational program modules.
9. Compulsory modules include compulsory component disciplines of the MD cycle, are developed by respective specialized departments, and are mandatory for all educational programs.
10. Compulsory modules for the educational program include compulsory disciplines (UC) of BD and PD cycles, can include elective disciplines (CD) considering the specifics of socio-economic development of the region and labor market needs, established scientific schools.
11. Elective modules for a certain educational program consist of one or several training trajectory options or a set of modules (Minor) (the total volume of credits for each option should be the same, different in terms of modules) depending on the individual interests of students.
12. The National Qualifications Framework contains eight levels of qualification, which correspond to the European Qualifications Framework and the levels of education defined by the Law of the Republic of Kazakhstan dated July 27, 2007 "On Education". The eight recommended levels are described in the form of learning outcomes.
13. Learning outcomes are divided into three categories: knowledge, skills, and competencies. They indicate that the qualification presents a full spectrum of educational

outcomes in various combinations, including theoretical knowledge, practical and technical skills, as well as social competence, for which the ability to cooperate with other people is crucial.

14. The NQF defines a unified scale of levels of qualification of general professional competencies for the development of industry qualifications frameworks, professional standards. Thus, the NQF provides intersectoral comparability of qualifications and competencies and is the basis for the system of compliance confirmation and the awarding of qualifications to specialists.

Table 2 – Model comparison of Dublin Descriptors and qualification characteristics of a Bachelor's degree in the Republic of Kazakhstan

Dublin Descriptors	Structure of Higher Education Competencies in Kazakhstan	Competency Type in Kazakhstan	Types of Competencies
Descriptor A			
Demonstrate knowledge and understanding in the studied scientific field, the training of which is usually based on general secondary education.	Student's knowledge and understanding are based on the level required for admission to a university and are expanded during the course of study.	Professional Competencies	General professional (basic) competencies, expanding knowledge
The training program is implemented using the most modern textbooks including individual aspects of knowledge that are at the forefront of science.	Students understand the most important theories, principles, and methods provided by the training program.	Professional Competencies	General professional (basic) competencies; Special competencies, deepening knowledge
Descriptor B			
Can apply their knowledge and understanding from the	Each student must be able to: - Apply their	Professional Competencies	Special competencies Instrumental

perspective of a professional approach to their activities.	knowledge and understanding in their professional activity; - Master the fundamental knowledge in the field of natural and social-humanitarian disciplines.		competencies Special competencies in the research area, instrumental competencies
Descriptor C			
Have the ability to collect and interpret the necessary data (in their field of scientific knowledge) in order to express judgments on social, scientific, and ethical issues.	- Collect, evaluate, and interpret important information on their study program.	General Competencies, Professional Competencies	System Competencies
Descriptor D			
Can communicate and visually present information, ideas, problems, and their solutions to an audience not only of specialists but also of non-specialists.	- Fluent in the state language, language of international communication; - Knowledge of Kazakh and foreign languages in the field of professional communication.	Communicative Competencies	Information and Communication Competencies, Organizational and Managerial Competencies

The National Qualification Framework (NQF) provides a structural description of requirements for personal and professional competencies, skills, and knowledge. Its details are specified within sectoral qualification frameworks and professional standards.

Competency is an integrated concept and expresses a person's ability to independently apply different elements of knowledge and skills in a certain context.

A worker's personal and professional competencies, skills, and knowledge determine the level of quality and results of the activities performed.

Depending on the position within the system of professional activity, workers possess different scopes of authority and responsibility. Workers' activities are carried out under supervision, independently (executive activities), or involve managing the activities of other workers.

Competencies relate to the generalized characteristics of a worker's behavior. Skills and knowledge relate to specific characteristics that specify the key competencies of a worker used in certain life situations, allowing solving various tasks in the professional or social sphere.

The foundation of professional activity is the personal and professional competencies of a worker, determining their adaptation to changing situations in society and the labor market, the update of existing or the formation of new competencies.

Qualifications and competencies are the result of a person mastering a certain educational program and (or) acquiring professional practical experience. To enhance qualifications or change the activity profile (profession), workers have the opportunity to undergo training, additional educational programs in various educational organizations.

The National Qualification Framework includes a description of eight qualification levels based on learning outcomes: the first and second levels correspond to general secondary education, the third and fourth levels - to technical and vocational education (advanced level), the fifth level – to technical and vocational education (middle-level specialist), post-secondary or higher education, the sixth - to higher education, and the seventh and eighth levels - to postgraduate education (bachelor's, master's, and doctoral degrees).

Table 3 - National Qualification Framework, sixth level - Bachelor's degree

Levels	**Knowledge**	**Skills and Abilities**	**Personal and Professional Competencies**	**Path to Achievement**
6	A wide range of theoretical and practical knowledge in the professional field	Independent development and proposition of various options for solving professional tasks	Independent management and control of labor and educational activities within the strategy	Higher education. Bachelor's degree, specialty, residency, and practical experience

Based on the qualification descriptors defined in the National Qualification Framework, an industry qualification framework (IQF) has been developed in the field of agriculture.

The IQF is intended for various user groups (employers, education authorities, citizens, workers) and allows:

1. to describe from a unified perspective the qualification requirements for workers and graduates when developing professional standards and educational standards;
2. to develop assessment materials and procedures for determining the qualifications of workers and graduates at all levels of vocational education;
3. to plan various education trajectories leading to the attainment of a specific qualification level and career advancement.

Table 4 – Structure of the Sectoral Qualification Framework in the field of agriculture, sixth level – Bachelor's degree

Levels	**Knowledge**	**Skills and Abilities**	**Personal and Professional Competencies**
6	Activity requiring the synthesis of special (theoretical and practical) knowledge (including innovative) and practical experience. Analyses, designs, and evaluates decision-making in professional situations of high uncertainty. Determines ways of communication and alignment of viewpoints. Understands the nature, applicability, and financial consequences of	Solving technological or methodological problems related to a specific knowledge area, implying choice and a variety of solution methods. Development, implementation, monitoring, evaluation, and correction of technological process components. Performs complex technical and professional tasks or projects, demonstrating design skills and decision-making in social professional situations of high uncertainty, self-management culture, formatting, presentation of results, use of modern software products and technical means. Skills and abilities to conduct	Managing employees (a group) with responsibility for the result at a specific stage of the technological process or at the level of a unit. Leads employees and monitors the task performance of individual workers and teams. Manages the professional development of individual employees or a team. Coordinating work at the assigned area with the activities of other areas. Plans, within the framework of the area's activity strategy, the implementation of new forms of management, and the management of the area's staff activity. Responsible for providing safety measures. Ability to be creative in professional activities, initiative in

	technological, material, and human resources required to perform labor activities in a specific professional field. Understands the risks characteristic of this type of activity, can control them and minimize them.	research and innovative activities for the development of new knowledge and procedures for the integration of knowledge from various fields, correctly and logically express thoughts in written and oral form, apply theoretical knowledge in practice in a specific field. Applies extensive knowledge, technical and legal principles, and a range of managerial methods and principles in professional activities	management, take responsibility for the development of professional knowledge and the results of professional activities. Conducts business planning and allocates material and human resources necessary for management and organization of professional activities. Makes decisions to improve the professionalism and qualifications of the staff. Masters new methods and approaches focused on the end result.

Overall, qualification frameworks create the basis for systematizing and recognizing learning outcomes, contributing to improving the quality and expanding the accessibility of vocational education, linking and recognizing qualifications in the labor market, as well as implementing a lifelong learning strategy.

For educational institutions, professional standards provide the basis for creating educational programs, course development, and so on.

The professional standard characterizes the qualification necessary for a worker to carry out a certain type of professional activity. The qualification characteristic in the professional standard includes, for each generalized labor function corresponding to a certain level of qualification, a description of labor functions, labor actions, skills and knowledge, as well as possible job titles, education requirements, practical work experience, and special conditions for admission to work.

Figure 3 shows the structure of the description of a worker's qualification characteristics in the professional standard.

For the analysis of generalized labor functions in the field of Agroecology at the bachelor's level, the content of the professional standard that relates to a certain level of qualification is chosen: generalized labor functions and labor functions, as well as qualification requirements for workers, outlined in the professional standard.

In this case, the qualification requirements of professional standards are understood as the "necessary skills" and "necessary knowledge" that are stipulated in the professional standard for each labor function.

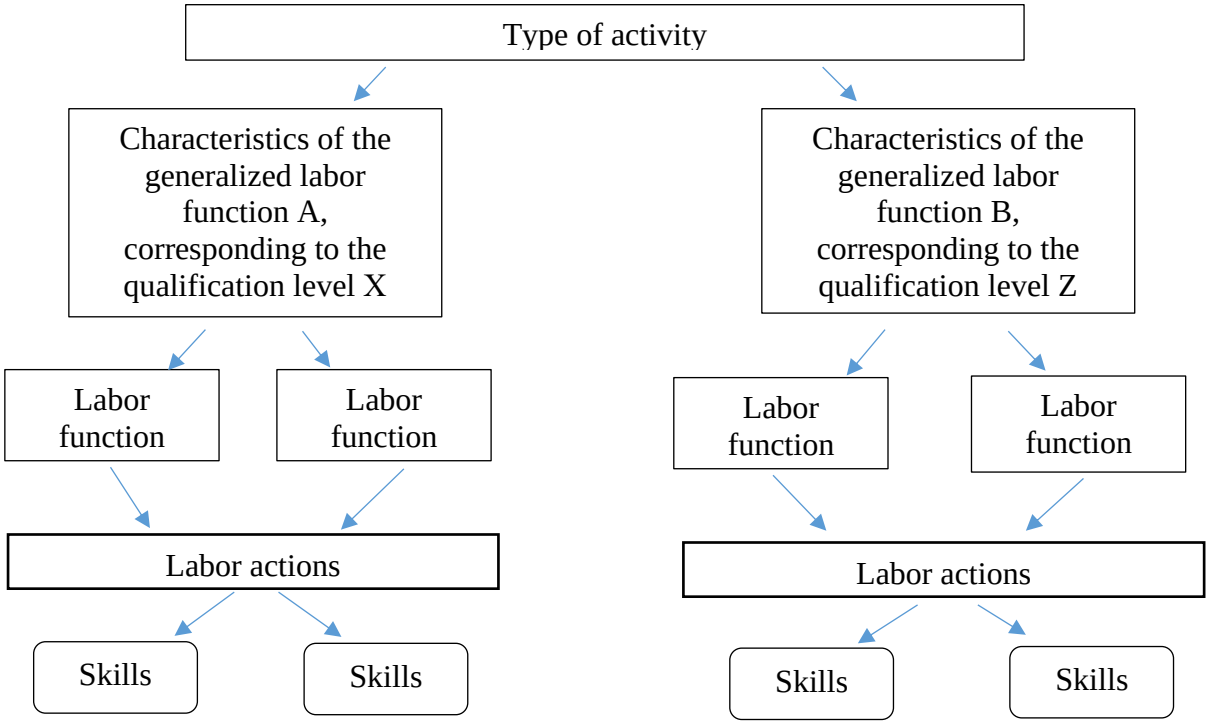


Figure 3 - Structure of qualification characteristic description in a professional standard

Table 5 - Professional Standard: "Nursery Activity", sixth level - Bachelor's degree (excerpt from the standard)

PROFESSION CARD: AGRONOMIST - SOIL SCIENTIST	
Code:	2132-3-001
Group code:	2132-3
Profession:	Agronomist-Soil Scientist
Other possible job titles	Agronomist
Qualification level according to QF:	6

Main activity goal	Organization and management of phytosanitary measures, management of soil-agrochemical preparation of nursery lands, assessment of the state and dynamics of soil fertility.	
Labor functions:	Mandatory labor functions:	1. Management of soil-agrochemical preparation of nursery lands. 2. Assessment and condition and dynamics of soil fertility in the nursery.
	Additional labor functions:	-
Labor function 1: Management of soil-agrochemical preparation of nursery lands, assessment of the state and dynamics of soil fertility	**Task 1: Assessment of agrotechnical and ecological-toxicological state of soils**	**Skills**
		1. Selection of a sample and analysis of soil samples. 2. Performing agrochemical and ecological-toxicological analysis of nursery soils. 3. Planning the fertilizer rotation system in the nursery.
		Knowledge:
		1. Basics of genetic soil science, land management and agrochemistry. 2. Regulatory and legal framework of RK, regulating the use of chemical means in agriculture and environmental protection. 3. Methods of soil, fertilizer, crop production sampling.
	Task 2: Sampling and preparation for laboratory tests	**Skills:**
		1. Conducting phenological observations. 2. Conducting soil-geographical and agro-soil zoning of territories. 3. Creating a soil, ecological, and agrochemical map of the nursery. 4. Sampling and analysis of soil samples.
		Knowledge:
		1. Rules for the use of chemical means to increase soil fertility. 2. Instructions for implementing a system of mechanizing the process of applying chemical and mineral fertilizers to the soil. 3. Standards for environmental monitoring of land condition.

Labor Function 2: Assessment and state and dynamics of soil fertility in the nursery	**Task 1: Assessment of soil fertility**	**Skills:**
		1. Conducting certification and cadastral assessment and sanitary-hygienic expertise. 2. Analyzing the state of land use, data from phytosanitary monitoring. 3. Creating a technological scheme for growing nursery crops.
		Knowledge:
		1. Rules for maintaining internal reporting documentation, use of modern field and laboratory equipment. 2. Computer programs for work in the fields of soil science, reclamation, agrochemistry, ecology, soil-landscape design and soil protection.
	Task 2: Forecasting soil fertility	**Skills:**
		1. Filling out documentation on agrochemical and control-toxicological studies of nursery soil and plants at all stages of development, including crop yield. 2. Processing the results of analysis and forecasting crop yields based on the materials of agrochemical survey of nursery soils.
		Knowledge:
		1. Catalog of cultivated and wild plants with the definition of their physiological state according to atlases. 2. Modern methods in crop cultivation technologies, machinery, machinery operation. 3. Range of pesticides and agrochemicals.
Personal Competence Requirements	Analytical thinking Ability to work in a team Initiative	
Connection with other professions within IQF	5	Medium skilled agronomist
	7	Nursery Manager
Connection with	Typical qualification	Agronomist

Unified Tariff and Qualification Guide or Qualification Guide or other profession directories	characteristics of positions of leaders and specialists of agricultural organizations Order of the Minister of Agriculture of the Republic of Kazakhstan dated August 21, 2019 № 307.		
Connection with the education and qualification system Education Level	Higher education (6 level of International Standard Classification of Education)	Specialty: 5B0801 Agronomy	Qualification: Bachelor of Agriculture in "5B0801 Agronomy" specialty"

The updating of higher education programs is directly linked to external demand - the needs of the labor market, employer organizations, citizens. At the same time, it is necessary to take into account that the content of higher education programs leads to the acquisition of qualifications corresponding to the modern level of science, technology, economy.

The name of the educational program is formulated by the developer, indicating the name of the specialty or direction of training and the orientation of the educational program. If the orientation of the educational program coincides with the name of the training direction, then after the orientation it is indicated "broad profile program".

The task of the working group is to develop agreed approaches to the development of EPs in terms of ensuring compliance with the requirements of relevant professional standards, or other qualification requirements, enshrined in the normative legal acts of the Republic of Kazakhstan. The working group carries out the development of goals, learning outcomes, modules of the educational program.

At present, in Kazakhstan, two universities, Kazakh Agrarian University and Baieshev University, conduct baccalaureate training in the field of "Agroecology". The educational program 6B05221 "Agroecology" of these universities relates to the Field of education - 6B05 Natural sciences, mathematics and statistics, Direction of training - 6B052 Environment, Group of educational programs - B051 Environment.

The structure of educational programs contains modules of mandatory basic and profile disciplines. The ecological component is represented by a number of disciplines: "Ecological laws and documentation in agriculture", "Ecological, hygienic standardization and examination in agriculture", "Organic agriculture", "Environmental protection and rational use of natural

resources, Types of environmental control, Agricultural ecology". Analysis of current curricula points to the direction of focus - "Environmental protection". It turns out that the focus is more of an ecological nature. Also, disciplines and modules fulfill the goal of training ecologists.

The EP we have developed and are proposing falls within the area of education 6B08 - "Agriculture and bioresources", direction of training - Crop production. The bachelor's program "Agroecology" offers practice-oriented training with a special emphasis on the field of agriculture, combined with systematic training in the enterprise, which will be an integral part of the education.

The main distinguishing feature of the existing current EPs in Kazakhstan, and the one we have developed within the AGROKAZ program, is that its implementation will be with elements of dual education.

Dual education will expand the interaction of universities with enterprises at the stages of its implementation, this will create conditions for improving the quality of training of specialists according to the requirements of employers.

In the system of organizing modern vocational education, dual education occupies a special place. The use of dual education is due to the need to combine theoretical and practical training of qualified specialists.

The application of such an educational approach allows graduates to form not only theoretical knowledge, but also to gain basic practical skills, competencies, formed with the direct participation of potential employers.

A dual education system refers to a system where young people's education in a chosen profession takes place in two organizations, that is, two institutions participate in the education process. On the one hand, this is a vocational school, and on the other, a training enterprise. Both institutions are independent partners to each other.

The dual education system in our country provides for a combination of training stages in an educational institution with periods of industrial practice. The learning process is organized as follows: parallel to traditional classes at the university, they work at a specific enterprise or firm, where they gain practical experience (professional training).

In the Republic of Kazakhstan, the development of its own national model of dual education development is being carried out, taking into account foreign experience in organizing a dual education system.

The adoption of the Law "On Education" dated July 27, 2007, in the country, contributed to the formation and development of a demanded national model. This law provides for a correlation of theoretical training in colleges and production at the enterprise in a proportion of 40/60.

By the Order of the Minister of Education and Science of the Republic of Kazakhstan dated January 21, 2016, in execution of the said law, "Rules for organizing dual education" were approved. A significant role in the legal regulation of the organization of dual education is assigned to the norms of the current Labor Code.

According to the formulation of the Labor Code of the Republic of Kazakhstan, dual education is a form of personnel training that combines education in an educational organization with mandatory periods of industrial training and professional practice at an enterprise (in an organization) with the provision of jobs and compensatory payment to students with equal responsibility of the enterprise (organization), educational institution and the student (p. 2 art. 116).

The considered education system implements the following principles:

- the interconnection of theoretical education obtained in a vocational-technical educational institution after secondary education (regardless of the form of ownership and departmental subordination, as well as in educational centers);
- active and direct participation of the enterprise (organization), that is, employers in the process of dual education, expressed primarily in the form of organizing the work of students and paying compensation for their labor;
- consolidation of the tripartite principle, that is, the trilateral responsibility of the educational institution, employer, and student for the preparation of qualified specialists.

Under the enterprise (organization) is understood a legal entity (individual entrepreneur) or an individual participating in dual education (p. 2 p.p.12 of the Rules).

At the same time, based on the principle of social partnership in social and labor relations, the state obliges the employer to assist educational organizations implementing technical and vocational education programs in training, retraining, and improving the qualifications of personnel (p. 7 art. 118 of the Labor Code of the Republic of Kazakhstan).

3 Development of the Bachelor's Educational Program "AGROKAZ"

3.1 Formation of the working group and development of the program goals and objectives

As part of the Project, a regional working group was formed, consisting of representatives from selected universities, to develop the bachelor's educational program "AGROKAZ".

The program is aimed at training specialists with a broad profile, capable of developing rational systems for the reproduction of soil fertility and methods of obtaining high-quality crop products for various natural and economic conditions, implementing and improving agroecological monitoring systems, conducting agroecological expertise, shaping environmental policy in the agro-industrial complex (AIC), and solving tasks of ensuring the sustainable functioning of agroecosystems.

The goal of the work was to develop a new type of study program for regions, in a consortium of universities and employers/companies, in which practical experience in the workplace is an integral part of the academic program, curriculum and syllabus. Stages of education in the university and at the workplace are linked in time and content, and academic credits are assigned for structured work experience. This approach was chosen with the aim of ensuring that the training of future graduates meets the modern requirements of agriculture in a rapidly developing economy. At the same time, the program is developed in compliance with academic standards, which creates conditions for the academic development of future graduates.

This overall regional approach will allow the working team to focus on the program's relevance for participating companies, on student-oriented learning opportunities, and on the potential employability of graduates.

The Bachelor's educational program "AGROKAZ" offers practice-oriented learning with a special emphasis on the field of agriculture, combined with systematic training in the enterprise, which is an integral part of the training.

The "AGROKAZ" educational program will be implemented with elements of dual education, which allows to increase the attractiveness and competitiveness of graduates, expand the university's interaction with enterprises at the stages of implementing the educational program, and create conditions for improving the quality of specialist training according to the requirements of employers.

The program prepares its future graduates for the training of highly qualified personnel in the field of crop production in agriculture. Graduates will possess professional competencies of a specialist in monitoring fertilizer systems and plant protection projects, responsible for the implementation of environmentally friendly crop cultivation technologies and the development of measures to prevent, limit and eliminate air pollution at the level of lower and middle-level specialists, with high potential for career growth.

The program aims to assist and actively collaborate with relevant companies in the agro-industrial sector. The program is relevant for the agriculture and trade industries in food and processing enterprises.

The "AGROKAZ" educational program is developed independently in accordance with the National Qualification Framework, sectoral qualification frameworks, and professional standards based on Dublin Descriptors. The program is focused on learning outcomes.

The form and structure of the university's educational program.

The university's educational program consists of the following sections:

- Passport of the educational program,
- Learning outcomes of the program,
- Curriculum,
- Competency map of the modules,
- Information on disciplines,
- Summary table reflecting the volume of credits mastered in terms of the educational program's modules,
- Information about departments, practice bases, reviews or feedback from employers, excerpts from protocols.

Several stages in the development of an educational program should be distinguished:

Stage 1. Preparation stage

1. Defining employers' requirements for the competencies of graduates of educational programs;
2. Identifying current and future labor market needs;
3. Transforming professional standards into modular educational programs.

Stage 2. Designing the educational program

1. The market need for the given educational program is determined;
2. The list of necessary human, material, informational, and financial resources is defined in terms of modules from the perspective of the ability to organize the educational process, including considering the attraction of partners' resources;

3. Learning outcomes and their achievement criteria are formulated in accordance with a defined competency profile;
4. Using pedagogical design technology, a correspondence between learning outcomes for the module, disciplines (production training, practice), and educational technologies is determined;
5. Methods and means of assessing learning outcomes are designed in terms of disciplines (production training, practice), interim and final certification;
6. An assessment of the attainability of the competency profile based on the modular educational program/project curriculum is carried out.

Stage 3. Development of the educational program

1. The goals of the educational program are formulated;
2. The design of educational program modules is performed by grouping learning outcomes;
3. Transformation of competencies and labor functions from professional standards to competencies and learning outcomes;
4. Determining the list of modules, disciplines in context with competencies and learning outcomes;
5. Determining the workload of modules and disciplines in credits;
6. A project of the educational program/curriculum is formed.

Stage 4. Quality assessment of the development of the educational program

The quality of the educational program development should correspond to the following principles of competency-based learning quality assurance (hereinafter - CBL):

1. Demonstration of the university's potential for implementing CBL and a commitment to its implementation;
2. Development of meaningful, clear, and measurable competencies based on the sectoral qualifications framework and professional standards.
3. Learning outcomes and credits should correspond to the quality assurance system of educational programs.
4. Presence of an effective strategy for assessing the achievement of learning outcomes and ensuring its execution.
5. Presence of a policy aimed at increasing the student's motivation to master competencies.
6. Constructive interaction with external partners.
7. Transparent teaching and learning process.
8. Continuous improvement of educational programs based on monitoring results.

3.2 General Learning Outcomes of the Program

To know about the comprehensive impact of environmental factors on plant organisms; their morphological and anatomical structure; with the basics of plant adaptations in the process of evolution.

Apply methods of rational use of limited resources, principles of conducting monitoring studies, and analysis of physicochemical indicators of atmospheric air and water ecosystems.

Compare the environmental problems of individual industries, the main systemic approaches to solving tasks to reduce environmental risk in the field of hazardous waste management.

Understand the importance and characterize measures to prevent soil resource depletion and pollution, biogeochemical assessment of the state of natural and anthropogenic landscapes, the requirements of regulatory documents, and safety in the field of the environment.

Analyze physiological, biochemical processes in the plant organism, the role of plant communities in ecosystems, regularities of plant growth and development in crop quality formation, compile technological schemes of crop cultivation and protection from pests and diseases, determine types and composition of fertilizers, calculate fertilizer rates for agricultural crops.

Apply modern technologies for storage, processing of agricultural crops, determine raw material quality parameters, possess methods for determining product quality according to the standard, carry out practical control of pollution and assessment of agrolandscapes.

Analyze the ecological situation, conduct ecological monitoring, control of the studied territories for the purpose of rational and legal nature use based on legislative acts, use methods of surveying the ecological state of agrolandscapes, possess modern technologies of environmental protection.

Plan the solution of problems of disturbed ecosystems and rational nature use; diagnosis of the main signs of erosion spread, collection of reliable statistical information, proper use of knowledge in the industrial and scientific field.

3.3 Bachelor's Program Description and Qualification Structure

The educational program is modular. ECTS credit points are assigned to individual modules in accordance with the European Credit Transfer and Accumulation System (ECTS).

When organizing the educational process using credit technology, the volume of each academic discipline consists of a whole number of academic credits. In this case, the discipline is assessed with a volume of no less than 5 academic credits.

General education modules are modules that are necessary for all bachelor's programs, regardless of the direction of study, and which are determined based on regulatory documents. The total number of credits for general education modules is 56 credits. Of these, 51 academic credits are allocated to compulsory component disciplines: History of Kazakhstan, Philosophy, Kazakh (Russian) Language, Foreign Language, Information and Communication Technologies, Physical Culture, Module of Socio-political Knowledge (Political Science, Sociology, Cultural Studies, Psychology).

The cycle of basic disciplines and profiling disciplines includes the study of academic disciplines, types of professional practices, and amounts to no less than 176 academic credits.

The final certification makes up no less than 8 academic credits in the total volume of the higher education program.

Modules are based on certain prerequisites related to the subject and the list of mandatory prerequisites.

The volume of one module is determined and includes two or more academic disciplines or in combination of one or more disciplines with other types of academic work.

Despite the fact that the exact distribution is set depending on the specific module, the purpose of each module is to provide about 30% of the load on contact hours and about 70% on independent work. In addition, the entire study program, and therefore most modules at the university, are characterized by a high degree of practice-oriented preparation, including the analysis of specific situations (case studies), group work and other teaching methods that ensure the achievement of ambitious higher education goals.

Practical modules are based on the theoretical knowledge taught at the university and provide the opportunity to apply this knowledge and critically evaluate its applicability in practice (and vice versa).

Table 6 - Approximate Study Plan of the Educational Program "6B0810...-Agroecology"

1st Semester	cr.	2nd Semester	cr.	3rd Semester	cr.	4th Semester	cr.
Foreign Language *MD/MCD*	5	Foreign Language *MD/MCD*	5	Physical Culture *MD/MCD*	2	Philosophy *MD/MCD*	5
Kazakh (Russian) Language *MD/MCD*	5	Kazakh (Russian) Language *MD/MCD*	5	1) Economics 2) Law and Anti-Corruption Culture 3) Ecology 4) Life Safety 5) Entrepreneurship 6) Methods of Scientific Research *MD/CD*	5	Information and Communication Technologies *MD/MCD*	5
Physical Culture *MD/MCD*	2	Social-Political Knowledge Module (sociology, political science, cultural studies, psychology) *MD/MCD*	8				
Biology and Plant Physiology ***BD/UC***	5						
Inorganic and Organic Chemistry ***BD/UC***	5	History of Kazakhstan (State exam) *MD/MCD*	5	General Entomology ***BD/UC***	6	Physical Culture *MD/MCD*	2
Higher Mathematics ***BD/UC***	5	Physical Culture *MD/MCD*	2	Soil Science ***BD/UC***	6	Farming ***BD/UC***	6
Agricultural Zoology ***BD/UC***	5	Agronomical Meteorology ***BD/UC***	5	Operation of Machinery and Equipment in Crop Production ***BD/UC***	4	Basics of Fruit and Vegetable Growing ***BD/UC***	6
		Educational Practice ***BD/UC***	2	Physics (with basics of biophysics) ***BD/UC***	5	Production Practice ***BD/UC***	8
Total:	**32**	**Total:**	**32**	**Total:**	**28**	**Total:**	**32**
5th Semester	**cr.**	**6th Semester**	**cr.**	**7th Semester**	**cr.**	**8th Semester**	**cr.**

Crop Production ***BD/UC***	5	Protection of Crops from Pests and Diseases ***BD/UC***	5	Nature Conservation, Rational Use, and State Control ***PD/UC***	4	Ecological Mapping and GIS ***PD/UC***	5
Agrochemistry ***BD/UC***	5	Agricultural Economics ***BD/UC***	4	Agroecological Monitoring ***PD/UC***	5	Basics of Ecological Regulation and Expertise ***PD/CD***	5
				Environmental Protection and Rational Use of Natural Resources ***PD/CD***	5		
Biogeocenology ***BD/UC***	5	Basics of Bioindication of Environmental Pollution ***PD/UC***	5			Technical Regulation in Agroecology ***PD/CD***	
				Protection of Aquatic Ecosystems ***PD/CD***			
Principles of Agroecology ***BD/CD***	5	Biogeochemistry and Ecotoxicology ***BD/UC***	5	Agroecological Practices, Systems and Philosophies ***PD/CD***	5	Geographical Information Systems in Ecology ***PD/CD***	5
Agriculture and the Environment ***BD/CD***		Soil Reclamation ***BD/CD***	5	Artificial Systems and Ecological Risks ***PD/CD***		Ecological Modeling of Agroecosystems ***PD/CD***	
Agroecology of Microorganisms ***BD/UC***	5	Soil Fertility Management ***BD/CD***		Production Process Logistics in Agriculture ***PD/UC***	5	Digitization in Agriculture ***PD/UC***	5
Ecological Chemistry ***BD/UC***	5	Production Practice ***PD/UC***	6	Ecological Ethics ***PD/UC***	5	Final Certification	8
				Production Practice ***(PD/UC)***	4		
Total:	**30**	**Total:**	**30**	**Total:**	**33**	**Total:**	**28**

MD - 56, BD - 117, PD - 64, FC - 8
Total - 245 credits

3.4 Discussion of the EP "Agroecology" with Stakeholders

In the course of defining the needs of the market, business sectors and competencies in the national labor market, the main consumers of the EP and interested parties were identified:

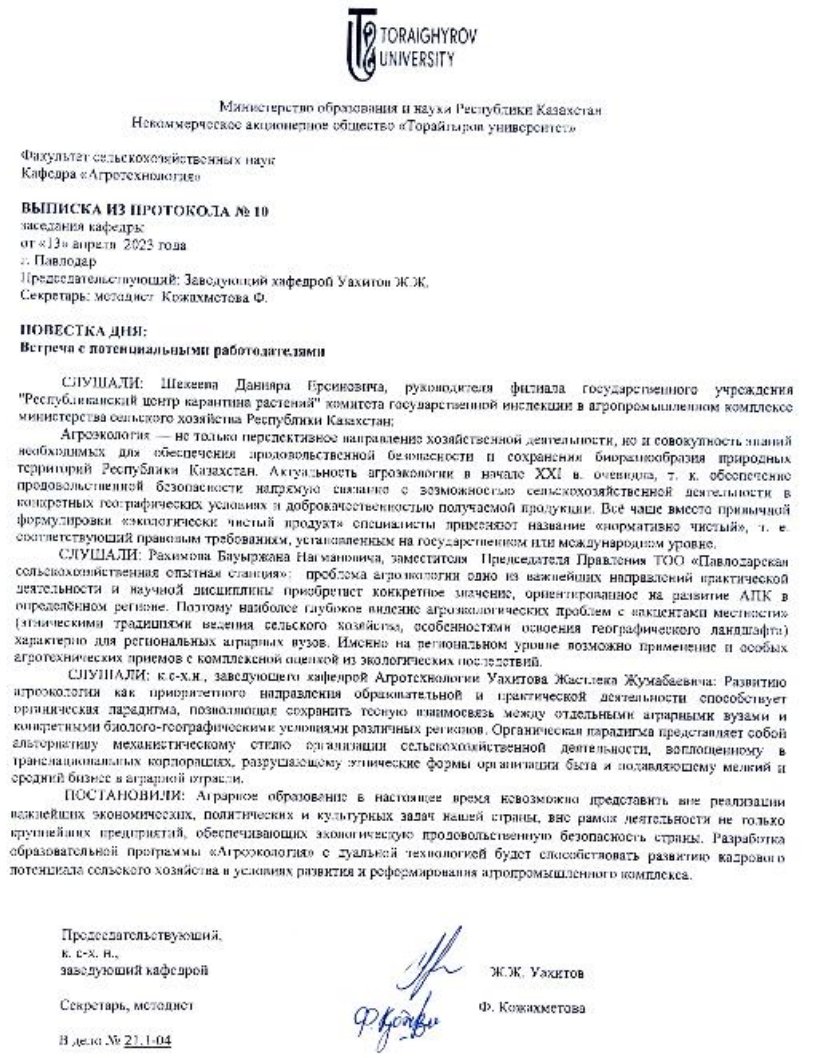
- Applicants - candidates for a bachelor's degree in the direction 6B0810100 - Agronomy, oriented towards professional activity in the field of natural sciences;
- Secondary vocational educational institutions;
- Universities that train specialists in the profile 6B0810100 - Agronomy;
- Industrial and research enterprises in the region and the country.

The main tasks related to consumers have been set:

- Collection and analysis of marketing information about potential consumers of the provided service;
- Attraction of potential consumers;
- Identification and satisfaction of current and future needs and expectations of current and potential consumers.

The department conducts research to study potential consumers of the services provided, their requirements and evaluate the possibility of fulfilling these requirements.

For the meeting of the "Agrotechnology" department of the Toraighyrov University, Danyar Yersinovich Shekeev, the head of the branch of the state institution "Republican Plant Quarantine Center" of the State Inspection Committee in the agro-industrial complex of the Ministry of Agriculture of the Republic of Kazakhstan, and Bauyrzhan Nagmanovich Rahimov, Deputy Chairman of the Board of "Pavlodar Agricultural Experimental Station" LLC were invited. During the meeting, problems and needs of Kazakhstan related to education in the field of agroecology were discussed (Figure 4).



TORAIGHYROV UNIVERSITY

Министерство образования и науки Республики Казахстан
Некоммерческое акционерное общество «Торайгыров университет»

Факультет сельскохозяйственных наук
Кафедра «Агротехнологии»

ВЫПИСКА ИЗ ПРОТОКОЛА № 10
заседания кафедры
от «13» апреля 2023 года
г. Павлодар
Председательствующий: Заведующий кафедрой Уахитов Ж.Ж.
Секретарь: методист Кожахметова Ф.

ПОВЕСТКА ДНЯ:
Встреча с потенциальными работодателями

СЛУШАЛИ: Шекеева Данияра Ерсиновича, руководителя филиала государственного учреждения "Республиканский центр карантина растений" комитета государственной инспекции в агропромышленном комплексе министерства сельского хозяйства Республики Казахстан:

Агроэкология — не только перспективное направление хозяйственной деятельности, но и совокупность знаний необходимых для обеспечения продовольственной безопасности и сохранения биоразнообразия природных территорий Республики Казахстан. Актуальность агроэкологии в начале XXI в. очевидна, т. к. обеспечение продовольственной безопасности напрямую связано с возможностью сельскохозяйственной деятельности в конкретных географических условиях и доброкачественностью получаемой продукции. Всё чаще вместо привычной формулировки «экологически чистый продукт» специалисты применяют название «нормативно чистый», т. е. соответствующий правовым требованиям, установленным на государственном или международном уровне.

СЛУШАЛИ: Рахимова Бауыржана Нагмановича, заместителя Председателя Правления ТОО «Павлодарская сельскохозяйственная опытная станция»: проблема агроэкологии одно из важнейших направлений практической деятельности и научной дисциплины приобретает конкретное значение, ориентированное на развитие АПК в определённом регионе. Поэтому наиболее глубокое видение агроэкологических проблем с акцентами местности» (этническими традициями ведения сельского хозяйства, особенностями освоения географического ландшафта) характерно для региональных аграрных вузов. Именно на региональном уровне возможно применение и особых агротехнических приемов с комплексной оценкой из экологических последствий.

СЛУШАЛИ: к.с-х.н., заведующего кафедрой Агротехнологии Уахитова Жастлека Жумабаевича: Развитию агроэкологии как приоритетного направления образовательной и практической деятельности способствует органическая парадигма, позволяющая сохранить тесную взаимосвязь между отдельными аграрными вузами и конкретными биолого-географическими условиями различных регионов. Органическая парадигма представляет собой альтернативу механистическому стилю организации сельскохозяйственной деятельности, воплощенному в транснациональных корпорациях, разрушающему этнические формы организации быта и подавляющему мелкий и средний бизнес в аграрной отрасли.

ПОСТАНОВИЛИ: Аграрное образование в настоящее время невозможно представить вне реализации важнейших экономических, политических и культурных задач нашей страны, вне рамок деятельности не только крупнейших предприятий, обеспечивающих экологическую продовольственную безопасность страны. Разработка образовательной программы «Агроэкология» с дуальной технологией будет способствовать развитию кадрового потенциала сельского хозяйства в условиях развития и реформирования агропромышленного комплекса.

Председательствующий,
к. с-х. н.,
заведующий кафедрой — Ж.Ж. Уахитов

Секретарь, методист — Ф. Кожахметова

В дело № 21.1-04

Figure 4 - Excerpt from the protocol of the meeting of the "Agrotechnology" Department of ToU

The head of the "Zamandas" farm D. Bakishev participated in the discussion of agricultural enterprises and professional competencies in the field of agroecology. The result of the meeting was a proposal to develop an educational program.

Предложения
по разработке модульной образовательной программы уровня:
бакалавриат
специальности 6В08111 Агроэкология,
реализуемой в НАО Торайгыров университет

Экологическая проблематика современности имеет сложную, многоуровневую структуру и глобальное распространение. Тема устойчивого роста в Казахстане рассматривается преимущественно с точки зрения решения региональных экологических проблем.

Перед Правительством и предпринимателями Казахстана стоит задача перехода от «коричневой экономики» к «зеленой экономике», которая была озвучена в Послании Президента народу Казахстана в новой Стратегии «Казахстан-2050» (Президент Казахстана Нурсултан Назарбаев подвел основные итоги реализации Стратегии «Казахстан-2030» и обратился к народу Казахстана с Посланием «Стратегия «Казахстан-2050»: новый политический курс состоявшегося государства»).

Зелёная экономика – это экономика, которая не влияет на природные активы. Концепция зелёной экономики поддерживает сохранение ресурсов и снижает негативное воздействие на природу.

Концепция «зеленой экономики» Казахстана направлена на повышение эффективности использования ресурсов и продвижение новых технологий для обеспечения устойчивого роста для будущих поколений. Одно из приоритетных направлений Концепция «зеленой экономики» Казахстана предусматривает эффективность использования природных ресурсов и вложение инвестиций в развитие экологической ситуации.

Мы предлагаем включить дисциплины, подготавливающие к выполнению задач профессиональной деятельности:

- проведение почвенных и агрохимических обследований земель, осуществлять анализ, оценку и группировку почв по их качеству и пригодности для сельскохозяйственных культур, составлять почвенные, агроэкологические и агрохимические карты и картограммы;
- составление схемы севооборотов, системы обработки почвы и защиты растений, с обоснованием экологически безопасные технологии возделывания культур;
- применение методов оптимизации водного режима растений на мелиорируемых землях, а также использование химической, водной и агромелиорации;
- разработка проектно-сметной документации в сфере АПК, в т.ч. технологических карт по производству и переработке сельскохозяйственной продукции для агроучета производственных затрат и получения высоких урожаев и качественной продукции растениеводства и плодоовощеводства.

Глава «КХ Замандас» **Д. Бакишев**

Figure 5 - Suggestions for the development of the educational program 6 B 8111 "Agroecology" by the head of the "Zamandas" farm D. Bakishev

The labor market needs and competencies of future bachelors in agroecology were discussed with representatives of the business community at the annual regional agricultural fair in the Akkuly district.

Figure 6 - Meeting of Agricultural Producers and the Head of the "Agroecology" Department of Toraighyrov University, PhD in Agricultural Science Z.J. Uakhitov, and Dean of the Faculty of Natural Sciences T.K. Beksheitov.

The ideas and prospects for the development of the educational program "Agroecology" were discussed at the meeting of the academic committee "Development of Innovative Educational Programs in Engineering, Processing, Natural Science, and Agricultural Areas" of Toraighyrov University. Similar discussions took place in all partner universities.

Figure 7 - Meeting of the Academic Committee of Toraighyrov University.

3.5 Development of learning outcomes (LO)

The objectives of the educational program have been developed, which are necessarily correlated with the level of scientific development and reality so that they are presented as specific results, outcomes that should be achieved within the specified time. Taking into account the content and functional side of goal setting, several strategies for goal planning were identified: national hierarchy of educational goals, goal setting at the level of graduate training, goal setting in the educational field.

The national hierarchy of educational goals is a long-term strategy for transformations in the state education system and the formation of a national model of education, which is reflected in the state general education standard of the Republic of Kazakhstan. The general tactical program for implementing the overall long-term program is called goal setting at the level of graduate training and will be reflected in the qualification characteristics of the graduate. The element-by-element mechanism of transition from the general long-term program and from the general tactical program to the systemic mechanism of educational process planning is considered to be goal setting in the educational field. They will be reflected in the educational and methodical complexes of the educational program. The named goal-setting strategies can be presented in the form of a model consisting of several levels (Table 4).

Table 7 - Level model of goal setting

№	Level model of educational-pedagogical goal setting	Direction of goal setting in the educational sphere
1	Global goal setting	Continuous multilevel education
2	National goal setting	Providing high-quality specialized education. Ensuring the convertibility of higher education documents for equal participation of the Republic of Kazakhstan in the educational space
3	Education goals at the level of graduate preparation	Obtaining full and high-quality professional education, professional competencies in various areas of agriculture and related disciplines
4	Goal setting in the educational field	Mastering knowledge of humanitarian disciplines, ethical legal norms regulating the relationship between people, society, the environment, culture of thinking and the ability to organize their work on a scientific

		basis.
5	Goal setting in the real learning process	Mastering the scientific basis of labor organization, computer technologies used in professional activities; mastering a system of knowledge and skills ensuring health preservation, development, and improvement of physical abilities.

The composition of the objectives of specific educational programs is determined by the direction and level of training: higher professional education programs (bachelor's degree).

Table 8 - Hierarchy of the goals of the educational program 6B08111– Agroecology

GOALS
The main national education goals in accordance with the Concept of Development of the Education System of the Republic of Kazakhstan are to satisfy the interests of society, the state, and the individual in receiving quality higher education, and to provide every person with wide opportunities in choosing the content, form, and terms of learning.
The purpose of undergraduate programs (basic education) is to ensure broad basic professional training, aimed at achieving the fundamental nature of subject knowledge of future specialists. Providing the bachelor's degree holder with a general integrated methodology of professional activity, developing the skills of professional creativity in future specialists, and forming the need for further increase in the level of education.
The purpose of the educational program is to prepare agrarians capable of carrying out agroecological activity, ensuring food security in the field of the agrarian sector on the basis of rational use of bioresources.
The goal of the general education disciplines cycle is to prepare a specialist of a new formation who possesses broad fundamental knowledge, is initiative, adaptive to the changing requirements of the labor market and technologies, and is able to work in a team. Providing conditions for acquiring a high overall intellectual level of development.
The goal of the basic disciplines cycle is to form a set of fundamental knowledge in general education and practice-oriented knowledge in the professional field; to prepare a specialist who has the necessary knowledge in the field of agroecology. Creating conditions for the development of creative potential, initiative, and innovation.

The goal of the cycle of profile disciplines is to complete the fundamental training of bachelors in the specialty and to increase professional competence. Preparing a specialist for creative active professional and social activity, high-quality performance of practical tasks in conditions of uncertainty and risk. Increasing the competitiveness and mobility of graduates in the market of certified specialists of the region and the Republic of Kazakhstan.
The goals for the disciplines are reflected in the syllabi.

3.6 Graduate's Professional Activity Area

To achieve the project goal, a characteristic of the professional activity of the Educational program 6B081100-Agroecology has been developed. The area of professional activity of graduates who have mastered the bachelor's program includes:

- soil, agrochemical, agroecological research and development, aimed at the rational use and preservation of agrolandscapes in the production of agricultural products;
- control over the state of the environment and compliance with environmental regulations of production and land use;
- agroecological assessment of agricultural lands and justification of methods of their rational use;
- development of environmentally safe technologies for the production of crop products and the reproduction of soil fertility; agroecological models, soil-environmental regulation.

The objects of the graduate's professional activity:

agrolandscapes and agroecosystems, soils, soil regimes and processes of their functioning, agricultural lands, agricultural crops, fertilizers and ameliorants, technologies for the production of agricultural products and the reproduction of soil fertility, agroecological models.

Types of graduate's professional activity:

- the main type of professional activity is production-technological;
- additional types of professional activity - organizational-management, research.

Tasks of the graduate's professional activity:

Production and technological activity:

- conducting soil, agrochemical, and agroecological surveys of lands; organizing and conducting analyses of soil and plant samples;
- compiling soil, agroecological and agrochemical maps and cartograms;
- agroecological assessment of plants, soils, fertilizers, plant protection products, and ameliorants;
- grouping lands by their suitability for agricultural crops and optimizing anti-erosion organization of the territory of agricultural land use;
- developing fertilizer systems and technological projects for soil fertility reproduction, taking into account the ecological safety of the agrolandscape and measures to protect soils from erosion and deflation;
- conducting chemical, water improvement and agroforestry improvement of lands;

- implementation of environmentally safe agricultural crop cultivation technologies and control over product quality;
- conducting plant and soil diagnostics, taking measures for agroecological optimization of plant mineral nutrition;
- conducting ecological expertise of agricultural land use objects;
- soil-environmental regulation;

Organizational and managerial activity:

- organization of the work of production units, agrochemical service centers (participation in the preparation of operational and long-term plans, schedules, instructions, estimates, requests for consumables, devices, equipment), preparation of reports in approved forms and methods;
- organization of the work of performers in field and laboratory conditions;
- conducting marketing research in the market of agrochemicals and agricultural products;
- making managerial decisions in the production of crop products under various economic and weather conditions;

Research activity:

- analysis of materials on the soil, agrochemical, and ecological state of agrolandscapes;
- justification of ways to preserve and improve soil fertility and anti-erosion resistance of lands;
- participation in conducting soil, agrochemical, and agroecological research;
- summarization and statistical processing of the results of experiments, formulating conclusions;
- development of methods and ways of soil fertility reproduction.

Planned learning outcomes

As a result of mastering the bachelor's program, the graduate should have formed general cultural, general professional, and professional competences.

The graduate who has mastered the bachelor's program should possess the following **general cultural competences**:

Ability to use the basics of philosophical knowledge to form a worldview;

Ability to analyze the main stages and patterns of historical development of society to form a civic position;

Ability to use the basics of economic knowledge in various fields of life;

Ability to use the basics of legal knowledge in various fields of life;

Ability to communicate in oral and written forms in Russian, Kazakh and foreign languages for solving problems of interpersonal and intercultural interaction;

Ability to work in a team, tolerate social, ethnic, religious, and cultural differences;

Ability to self-organize and self-educate;

Ability to use methods and means of physical culture to ensure full social and professional activity;

Ability to use first aid techniques, methods of protection in emergency situations.

The graduate who has mastered the bachelor's program should possess the following **general professional competences**:

Ability to solve standard tasks of professional activity based on information and bibliographic culture, using information and communication technologies, taking into account the main requirements of information security;

Ability to use the main laws of natural science disciplines in professional activities, to apply methods of mathematical analysis;

Ability to perform landscape analysis of territories;

Ability to recognize the main types of soils, assess their fertility level, justify the directions of soil use in agriculture;

Readiness to conduct physical, physicochemical, chemical, and microbiological analysis of soils, plants, fertilizers, and ameliorants.

The graduate who has mastered the bachelor's program should possess the following **professional competences**:

Readiness to participate in conducting soil, agrochemical, and agroecological surveys of lands;

Ability to compile soil, agroecological, and agrochemical maps and diagrams;

Ability to optimize the water regime of plants on reclaimed lands;

Ability to conduct an assessment and grouping of lands according to their suitability for agricultural crops;

Ability to substantiate the rational application of technological methods of soil fertility reproduction;

Readiness to compile crop rotation schemes, systems of soil treatment and plant protection, justify environmentally safe cultivation technologies;

Ability to conduct an analysis and assessment of the quality of agricultural products;

Ability to conduct plant and soil diagnostics, to take measures to optimize mineral nutrition of plants;

Ability to conduct environmental audits of agricultural objects;

Ability to organize the work of performers, find and make management decisions in the field of labor organization and standardization in various economic and operating conditions;

Ability to determine the economic efficiency of using fertilizers, chemical means of reclamation and technological methods of cultivating agricultural crops;

Ability to conduct marketing research in the markets of agrochemicals and agricultural products;

Readiness for cooperation with colleagues and work in teams of various forms of ownership;

Ability to conduct soil, agrochemical, and agroecological research;

Ability to summarize and statistically process the results of experiments, formulate conclusions.

4 Planned Seminar Topics for the Target Audience

The bachelor's degree program in agroecology combines elements of traditional agricultural management with a focus on its sustainability. This is a practically oriented bachelor's degree program in which the student acquires solid foundations of agriculture intersecting with issues of ecological agriculture, agricultural landscape management, and related activities. To uncover problems in the field of agroecology, it is proposed to hold discussions and round tables with students and teachers, the results of which will be the publication of scientific articles, conducting monitoring on these issues, conducting excursions to farms of agricultural producers, identifying problem areas in the direction of agroecology in regional agriculture.

Seminar Theme 1: Interbiogeocenotic relationships. Protection, regulation, and optimization of agroecosystems. Contact relationships of organisms of the agroecosystem, the influence of phytophages, weed vegetation, transbiotic and transabiotic relationships in agroecosystems. Changes in agricultural landscapes under the influence of anthropogeocenoses, farm biogeocenoses, technogenic land disturbances, agrobiogeocenoses, meadow-pasture biogeocenoses, forest biogeocenoses. The complexity of interbiogeocenotic relationships and interactions.

Seminar Theme 2: Ecological-agricultural measures for the production of high-quality crop products. Agricultural products of plant origin as a result of the functioning of the biogeochemical food chain. The concept of environmentally friendly agricultural products. Sanitary and hygienic assessment of food raw materials and vegetable food products. The reduction in the quality of products due to violations of the conditions of nutrition and life activity of agricultural plants. Measures to improve the quality of agricultural products.

Seminar Theme 3: Agroecological significance of soil phase components. Soil fatigue. Soil fertility: definition, significance. Dependence of crop yields on soil fertility. Soil cultivation and its ecological significance. Weakening landscape stability. Air dusting, water turbidity. Erosion, compaction, bogging.

Seminar Theme 4: Land reclamation, its significance for ecology. Environmental consequences of drainage, irrigation, reclamation, and other types of reclamation.

Seminar Theme 5: Weeds: characteristics, origin, classification. Weeds: place in the agroecosystem, forms of adaptation to the conditions of agrobogeocenoses. Basic methods of weed control. Cultivated plants: place in the agroecosystem, dependence on the influence of ecological factors. Classification of cultivated agricultural plants.

Seminar Theme 6: Agrochemicals (poisons, herbicides, stimulants). The inevitability of use, ecological consequences, increased demand for qualifications and technological discipline.

Seminar Theme 7: Mineral fertilizers as an ecology factor. Production and use of mineral fertilizers in the world and in Kazakhstan.

Seminar Theme 8: Agricultural animals: their place in the agroecosystem, dependence on the influence of ecological factors, relationship with the components of agrobiogeocenosis.

Seminar Theme 9: Ecological stabilization - a common task in agroecology. Ecological factors in agroecosystems (syn-agroecology). State, importance, features of action, possibilities of management, and tasks of stabilization. Experience from different countries. The state of the problem in different countries. Achievements and failures.

Seminar Theme10: Interrelations and interdependencies of agrarian and social problems with ecological ones. Influence of cultivation technology on product quality. Ecologically clean production. The problem of food and fodder protein, essential amino acids, and other examples.

Conclusion

The Kazakhstani higher education system is developing along a strategic path outlined by the country's President in the "Kazakhstan-2050" Strategy: "a new political course of an established state"; in the Laws "On Education" and "On Science" with respect to agricultural specialties. They have provided a clear legislative basis for advancing the higher education system to a new quality level.

In Kazakhstan, to successfully implement agro-ecological education and ensure successful positioning of specialists in the labor market, educational programs are updated annually.

One of the priorities of agroecology is the protection of natural resources and biodiversity, as well as the ability to adapt to climate change and mitigate its consequences. It can also enhance the resilience of farming enterprises, promote the production and consumption of healthy and nutritious food, and stimulate the economy and markets.

Today, it is important to form the right mindset in the younger generation. Ecological thinking represents one of the complex types of cognitive activity, as it assumes an attitude towards nature in which it is perceived not only as the environment in which humans live, but also as a unified, self-organizing, whole-living system of the world.

Ecological education and upbringing play a special role in shaping ecological thinking among students. They are aimed at developing an ecological worldview, ecological morality, and an ecological culture of personality.

Ecological education involves forming a conviction in everyone about the objective necessity to preserve the values created by nature and man. The level of a person's ecological culture is determined by understanding the social significance of ecological problems, their connection with political, socio-economic tasks of humanity and an individual person, hence, the educational process should ensure the formation of the basics of an ecological worldview and its actual implementation.

In the face of increasing anthropogenic pressure on the environment, including in the field of the agrarian sector of Kazakhstan, the production of agricultural products without observing ecological norms can lead to irreversible social and technogenic processes. Therefore, future specialists - agroecologists, in order to ensure balanced dynamic development and reduce or prevent anthropogenic impact on the natural environment, should possess a set of knowledge offered in this educational program:

– forming the basic professional competencies of future specialists in the field of environmental protection,

– creating prerequisites for independent research activities of students within the framework of conducting an experiment at all its stages,

– the ability to work with scientific and technical information, use domestic and foreign experience in professional activity, systematize and summarize the obtained information.

In conclusion of the work on work packages 2 and 3 within the implemented project "Development of bachelor program in agroecology with dual education in Kazakhstan (AGROKAZ)", the goals have been fully achieved.

A voluminous work has been carried out to collect and analyze materials to determine the relevance and implementation of the program in the project's participating universities, as well as by social partners of the project.

The competence model of a graduate of the Educational Program "Agroecology" has been defined.

Goals and objectives have been set. Learning outcomes have been developed.

Within the framework of the Project, a regional working group was formed, consisting of representatives of selected universities, to develop the bachelor's educational program "AGROKAZ".

The aim of the work was to develop a new type of educational program for the regions, in a consortium of universities and employers/companies, where practical experience in the workplace is an integral part of the academic program, curriculum and syllabus. Stages of education in the university and at the workplace are linked in time and content, and academic credits are assigned for structured work experience. This approach was chosen to ensure that the preparation of future graduates meets modern requirements of agriculture in the context of a rapidly developing economy. At the same time, the program was developed in compliance with academic standards, creating conditions for the academic development of the future graduate.

Such a general regional approach will allow the working team to focus on the relevance of the program for participating companies, on student-oriented learning opportunities, and on potential graduate employment opportunities.

The bachelor's educational program "AGROKAZ" offers practice-oriented training with a special emphasis on the field of agriculture, combined with systematic training in a company, which is an integral part of education.

The educational program "AGROKAZ", based on the experience of international universities, will be implemented with elements of dual education, which allows to increase the attractiveness and competitiveness of graduates, expand the interaction of the university with enterprises at the stages of implementing the educational program, and create conditions for improving the quality of specialists' preparation according to the requirements of employers.

The program prepares its future graduates for the preparation of highly qualified personnel in the field of plant growing in agriculture, graduates will possess professional competencies of a specialist, project monitoring of fertilizer systems and plant protection, responsible for the implementation of environmentally friendly technologies for cultivating agricultural crops and developing measures to prevent, limit and eliminate air pollution at the level of lower and middle level specialists, with high potential for career growth.

The program is aimed at facilitating and actively cooperating with relevant companies in the agro-industry sector. The program is relevant for the agriculture and trade industry in food and processing industries.

Thus, the graduate of the Educational Program "Agroecology":

A Bachelor's graduate has a wide range of theoretical and practical knowledge in the professional field, is able to independently develop and propose various options for solving professional tasks using theoretical and practical knowledge, possesses competencies of independent management and control over labor and educational processes within the framework of the organization's strategy, policy, and goals, discussing the problem, arguing conclusions, and competent operation of information.

Professional activity areas. The professional activity of a bachelor is the production, managerial, research, and educational sphere, assessing the environmental situation of the environment, controlling the quality of the natural environment and human health, developing measures to prevent, reduce, and eliminate the degradation of agricultural production objects (soil, water, air, plant) and carrying out practical measures to restore the ecological balance in the agricultural sector.

Objects of professional activity. The objects of professional activity of graduates are: soil, water, air, plants, animals, and agricultural products, agro-industrial complexes, energy facilities, educational institutions, research institutes, and centers.

Subjects of professional activity. The subjects of professional activity are: natural and agricultural ecosystems and their components; the biosphere and its components; environmental monitoring and marketing; analysis, inspection, and control of the environmental status; compilation of econometric models; managerial and expert functions in the field of environmental protection; environmental education and upbringing; compliance with environmental requirements in the field of agriculture and when designing new enterprises, settlements, planning, and implementation of environmental protection measures in various spheres of the economy, conducting an environmental impact assessment (EIA) and environmental audit.

Areas of professional activity. Bachelors can perform the following types of professional activities: organizational and managerial; production and technological; service and operational; experimental and research; educational; project.

Formed learning outcomes of the program:

LO 1 - Know the concepts of the complex impact of environmental factors on plant organisms; their morphological and anatomical structure; with the basics of plant adaptations in the process of evolution.

LO 2 - Apply methods of rational use of limited resources, principles of conducting monitoring research, and analysis of physicochemical indicators of atmospheric air and aquatic ecosystems.

LO 3 - Compare environmental problems of individual industries, basic systemic approaches to solving tasks to reduce environmental risk in the field of hazardous waste management.

LO 4 - Understand the significance and characterize measures to prevent depletion and pollution of soil resources, biogeochemical assessment of the state of natural and anthropogenic landscapes, requirements of regulatory legal acts and safety in the field of the environment.

LO 5 - Analyze physiological, biochemical processes in the plant organism, the role of plant communities in ecosystems, patterns of plant growth and development in crop quality formation, make up technological schemes for cultivating crops and protecting them from pests and diseases, determine types, composition of fertilizers, calculate fertilizer rates for agricultural crops.

LO 6 - Apply modern technologies for storage, processing of agricultural crops, determine the quality parameters of raw materials, master methods of determining product quality according to the standard, carry out practical control of pollution and evaluation of agricultural landscapes.

LO 7 - Analyze the environmental situation, conducts environmental monitoring, control of researched territories for rational and legal nature management based on legislative acts, uses methods of surveying the environmental condition of agricultural landscapes, masters modern technologies for environmental protection.

LO 8 - Plan to solve problems of disturbed ecosystems and rational nature management; diagnose the main signs of erosion spreading, collect reliable statistical information, correct use of knowledge in the production and scientific sphere.

The educational program is modular. ECTS credit points are assigned to individual modules in accordance with the European Credit Transfer and Accumulation System.

When organizing the educational process using credit learning technology, the volume of each subject is a whole number of academic credits. At the same time, the discipline is evaluated with a volume of at least 5 academic credits.

General education modules are modules that are necessary for all bachelor's programs, regardless of the direction of study, and are determined based on regulatory documents. The total

number of credits for general education modules is 56 credits. Of these, 51 academic credits are allocated for compulsory component disciplines: History of Kazakhstan, Philosophy, Kazakh (Russian) language, Foreign language, Information and communication technologies, Physical culture, Module of socio-political knowledge (political science, sociology, cultural studies, psychology).

The cycle of basic disciplines and profiling disciplines includes the study of academic disciplines, types of professional practices, and makes up at least 176 academic credits.

The final attestation is not less than 8 academic credits in the total volume of the higher education program.

Modules are based on certain prerequisites related to the subject and a list of mandatory prerequisites.

The volume of one module is determined includes two or more academic disciplines or in combination of one or more disciplines with other types of academic work.

Despite the fact that the exact distribution is set depending on the specific module, the purpose of each module is to provide about 30% of the load on contact hours and about 70% - on independent work. In addition, the entire curriculum and therefore most of the modules at the university are characterized by a high degree of practice-oriented training, including analysis of specific situations (case studies), group work, and other teaching methods that ensure the achievement of ambitious higher education goals.

Practical modules are based on the theoretical knowledge taught at the university and provide the opportunity to apply this knowledge and critically assess their applicability in practice (and vice versa).

Overall, the set goals and tasks for work packages by the working team have been fulfilled.

List of Used Sources

1 State policy stemming from the Address of the President of the Republic of Kazakhstan N. A. Nazarbayev to the people of Kazakhstan dated December 14, 2012 "Strategy" Kazakhstan-2050 "new political course of the established state".

2 Decree of the President of the Republic of Kazakhstan dated March 1, 2016 No. 205 "On approval of the State program for the development of education and science of the Republic of Kazakhstan for 2016 - 2019".

3 Decree of the President of the Republic of Kazakhstan dated August 1, 2014 No. 874 "On approval of the State program of industrial-innovative development of the Republic of Kazakhstan for 2015–2019 and on making an addition.

4 Decree of the President of the Republic of Kazakhstan dated March 19, 2010 No. 957 "On approval of the List of state programs".

5 Decree of the President of the Republic of Kazakhstan dated February 1, 2010 No. 922 "On the Strategic Plan for the Development of the Republic of Kazakhstan until 2020".

6 State compulsory standard of higher and postgraduate education Order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 No. 2. Registered in the Ministry of Justice of the Republic of Kazakhstan on July 27, 2022 No. 28916.

7 Typical qualification characteristics of positions of managers and specialists of agricultural organizations.

8 Order of the Minister of Agriculture of the Republic of Kazakhstan dated August 21, 2019 No. 307.

9 Reports of partner universities.

10 Protocols of local committees, meetings of departments of partner universities.