






# The main approaches to the formation of professional competencies based on a convergent approach in education and sustainable development of territories

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Abstract: There is a definition the possibilities of using the means of technical discipline in the formation of sustainable development of territories subjected to anthropogenic pollution. In this article the ways of teaching bachelors to draw up projects for the reclamation of disturbed territories are described. The authors offer training in the development of projects from the point of view of their ecological state and the use of convergent education. The most important tasks of sustainable development in land reclamation are demonstrated. It should ensure the restoration of land to a condition suitable for their use in accordance with the intended purpose and permitted use. This makes it possible to teach future specialists to develop projects that ensure compliance of land quality with environmental quality standards. As well as the requirements of the legislation of the Russian Federation in the field of ensuring the sanitary and epidemiological welfare of the population. This make possible not to endanger the common future generation. Underline that the universal nature of the ideas of sustainable development. It served as the basis for the implementation of competencies in the emerging education for sustainable development. It will ensure the further harmonious development of society, the economy and the environment.

## 1 INTRODUCTION


The goal of education for sustainable development in Russia is to prepare in-demand graduates capable of self-determination, self-education, self-development and cooperation in the professional field.


All this determines the need for modern organization of education and progressive aspects of the training of university graduates. As well as their inclusion in the model of education, taking into account the principles and goals of the modern model of sustainable development. Modern graduates of higher educational institutions should be competent, strive for creative work and mobile. They should also


be able to find and implement new effective forms of organizing their activities. As well as creating conditions for the functioning of objects of future activity. Graduates should easily fit into the realities of modern society.


Within the framework of improving education for sustainable development, it is necessary to promote the formation of a comprehensively educated, socially active personality. She must understand the new phenomena and processes of social life. And it must have a system of views, ideological and moral, cultural and ethical principles, norms of behavior. All this ensures readiness for socially responsible activities and continuing education in a rapidly


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changing world (Ilyin I.V., Ursul A.D., Ursul T.A., Andreev A.I.).

Only appropriate and high-quality education will help people to assimilate environmental and ethical norms, values and attitudes of professional skills and a new way of life. All this is required to ensure sustainable development (Kovaleva T. N., Kundas S. P., Ankuda S. N. Bulygina T.G.).

During the technological revolution, all major branches of science are developing very quickly and rapidly. To a large extent, such directions are amenable to development, which are closely related to natural and industrial human activity. For decades, scientists from various branches of science have been paying special and close attention to the issues of protecting the biosphere from pollution. As well as restoration of disturbed or polluted land resources.

People are increasingly paying attention in the XXI century to the current catastrophic environmental situation. It includes issues related to the elimination of negative consequences of human activity. Most often, this is the accumulation of landfills of industrial and household waste, improper operation, and the design of landfills and the identification of abandoned, unattended landfills. All this leads to serious contamination of soils, groundwater and the atmosphere (Shefer O., Kraineva S., Lebedeva T., 2021).

Land reclamation is necessary for the effective application of technological solutions for the elimination of objects of accumulated environmental damage. And also to restore the original characteristics of the territory on which this object was located. We define land reclamation as a complex of various engineering, reclamation, agrotechnical and other measures. They are aimed at restoring the productivity and economic value of land, as well as improving environmental conditions.

Land reclamation is a young technology that is rapidly gaining momentum due to the convergence of different sciences (physics, chemistry, geography, geology, soil science, geobotany, agrochemistry, forestry, economics, urban planning, etc.) and information technologies. V.D. Gorlov described the most complete classification of types of restoration of disturbed lands depending on the types development and directions of land use (Gorlov V. D.) (Fig. 1).

Biological type	Construction type	Combined
<ul style="list-style-type: none"> <li>• Agricultural</li> <li>• Forestry</li> <li>• Water management</li> <li>• Fisheries management</li> </ul>	<ul style="list-style-type: none"> <li>• Industrial and civil construction</li> <li>• Hydraulic engineering construction</li> <li>• Recreational construction</li> </ul>	<ul style="list-style-type: none"> <li>• Rural-forest reclamation</li> <li>• Agricultural and water management</li> <li>• Forestry</li> <li>• Agriculture and forestry water management there</li> <li>• Construction and forestry reclamation management</li> <li>• Sanitary and hygienic</li> </ul>

Figure 1: Types and directions of land reclamation.

We have analyzed the typology and directions of land reclamation. The analysis shows that the development of projects will be associated with the construction of facilities providing reclamation, and includes a sanitary and hygienic aspect. This aspect takes into account the peculiarities of the group of combined areas of reclamation work. V.D. Gorlov emphasizes the importance of projects based on the biological type of reclamation. He also notes the importance of the completeness of withdrawals and secondary of fertile soil. Such work requires personnel with relevant competencies formed by means of convergence. So that they would be able to develop and implement projects for the reclamation of disturbed lands.

## 2 MATERIALS AND METHODS

Land reclamation is carried out on the basis of a land reclamation project. It is the main guiding document. It provides for all necessary measures to restore technogenically disturbed lands on certain plots of land, taking into account the chosen direction of reclamation (Fig. 2).

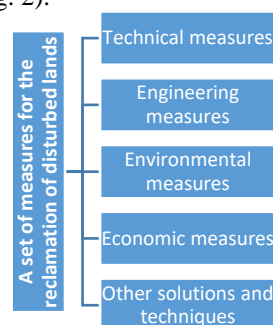


Figure 2: Types of land reclamation measures.

An analysis of the types of land reclamation measures shows that reclamation projects provide technological, technical and construction solutions

for land protection. These measures significantly reduce the area of violations, but do not exclude the possibility of the appearance of disturbed areas during the construction process. Which need to be restored taking into account the economic justification and calculation of the estimated cost of work (Bryzhko, V.G.).

The projects being developed contain the necessary measures for the artificial restoration and formation of vegetation cover. They are carried out taking into account the manifestation of technogenic processes:

- technogenesis of the subsoil (with a complex of negative processes and phenomena in the geological environment);

- technogenesis of landscapes (with a complex of negative processes and phenomena in soil and soil, biota, bottom sediments, natural waters).

In such technogenesis projects, it is taken into account that each site has its own characteristics and operating conditions. A set of measures for the restoration of recultivated lands should be carried out taking into account local soil and climatic conditions. And also according to the degree of damage, disturbance and pollution, landscape and geochemical characteristics of the disturbed lands, a specific site or part of the site. The lands and the territories attached to them should represent, after completion of all the stages provided for in the project, an optimally organized and ecologically balanced sustainable landscape (Fig. 3).



Figure 3: Comparison of lands before and after reclamation.

N.G. Martynova and V.A. Budarova proposed the content of reclamation projects, which, in their opinion, should consistently include preparatory, technological and biological stages.

The preparatory stage of reclamation includes general provisions on the reclamation of disturbed lands, the choice of reclamation directions.

The technical stage of reclamation consists of a number of works:

- justification of the period of reclamation works;

- terms and procedure of delivery and acceptance of completed works;

- design solutions for the reclamation of disturbed lands;

- calculation of the need for materials for the biological stage of reclamation;

- technological maps of the production of reclamation works;

- estimated cost of environmental protection measures to restore the soil cover.

The biological stage of reclamation is the final stage and represents environmental protection during the production of reclamation works (Martynova N.G., Budarova V.A.).

The implementation of land reclamation projects should be based on convergence requirements. And also rely on the use of modern digital technologies. In this regard, we believe that the list of proposed stages of reclamation should be expanded by introducing a stage of computer modeling of processes. This stage should take into account the use of the possibilities of not only biology, as indicated by N.G. Martynova and V.A. Budarova, but also physics and chemistry.

### 3 RESEARCH RESULTS

The preparatory stage of the design is not sufficiently described in studies of land reclamation problems, and there is no regulatory documentation at all. The characteristics of this stage are discussed in classes with bachelors in the field of preparation 21.03.02 "Land management and cadastre". This is discussed at the time of issuing assignments for the course work on the discipline "Land management design". Assignments are given in the form of developing course projects on topics to choose from: "Recultivation of landfills of solid household waste in the Chelyabinsk region", "Recultivation of disturbed lands in the Chelyabinsk region", "Recultivation of lands disturbed during open-pit mining in the Chelyabinsk region". At the consultation hold during the development of the reclamation project, the requirements for the reclamation of disturbed lands are also discussed. Depending on the directions of their further use in the design of land reclamation, an individual route is drawn up for the development of each stage by the student. We gave them a brief description, taking into account the competencies formed at these stages in students.

The preparatory stage includes the investment justification of measures for the implementation of reclamation and the development of documentation. The development of project documentation is carried

out on the basis of the task for the design of the reclamation complex.

The investment justification is a variant study of design solutions in order to choose the optimal one. It should have the best combination of commercial, social and environmental efficiency. It is at this stage that developers use the capabilities of numerical simulation performed using the HEC-RAS modeling system version 5.0.5. [Brunner G.W.]. The project is carried out using the modeling system HEC-RAS version 5.0.5 according to the 2D modeling scheme, the detailed physical and mathematical basis of which is described in great detail in the manuals for the HEC-RAS program and scientific papers (Alonso R., Santillana M., Dawson C.; Candy A.; Casulli V., Shefer, O.R., Bepal, I.I., Kraineva, S.V.).

When developing the preparatory stage of the project, bachelors in the field of preparation 21.03.02 "Land management and cadastres" form such components of the competence of OPK-3 (the ability to use knowledge of modern technologies of design cadastral and other works related to land management and cadastres) as:

- knowledge of the methodology for the development of pre-project land management documents and land management projects;

- ability to analyze and apply land management documentation for certain purposes. Also, the analysis of the initial data for the design, taking into account the solution of legal, technical, economic and organizational issues that arise throughout the entire period of design and development of projects;

- mastery of modeling skills to determine the degree of influence of reclamation factors on the efficiency of economic activity.

The technical stage includes the layout, organization of slopes. Also, the removal and application of a high-quality, fertile soil layer. And the totality of the hydraulic engineering complex and reclamation facilities, the burial of toxic rocks, including the work that creates the necessary conditions for the use of restored land in the future. Also, the selection of materials with physical and chemical properties corresponding to the purposes of reclamation, the preparation of estimates of environmental protection measures. And after that, further use of reclaimed land for its intended purpose. At this stage, designers use computer programs Mapinfo Professional 9.0 and Microsoft Office Access DBMS, Module "2TP (reclamation)" 1.1.

During the development of the technical stage of the project, bachelors in the field of preparation 21.03.02 "Land Management and cadastres" form such components of the competence of PC-3 (the

ability to use knowledge of the regulatory framework and methods of developing design solutions in land management and cadastres) how:

- knowledge of the methodology for the development of individual sections (parts) of the project (scheme) of land management. Knowledge of the latest scientific and technical achievements of advanced domestic and foreign experience in land management design using automation and computerization;

- ability to calculate prospective indicators of tasks for the development of land management projects (schemes) and other design solutions. Linking the design decisions made with design decisions on other sections (parts) of the land management project (scheme);

- proficiency in the development of measures for the design of land use and the arrangement of the territory of collective gardens. Also, the organization of the territory of agricultural enterprises on an ecological and landscape basis, the peculiarities of land management in a polluted area.

The biological stage is a set of measures aimed at improving the effectiveness of agrotechnical and phytomeliorative measures. Designed to improve the agrophysical, agrochemical, biochemical and other properties of the soil. Designed to restore their fertility by resuming the process of soil formation. Increasing the self-cleaning ability of the soil and reproduction of biocenoses (Uskova T.V.; Wu Y., Wang J., Gou A.).

Basically, the biological stage is carried out in two stages. The first is the cultivation of preliminary crops that are able to adapt to existing conditions and have high regenerative abilities. At the second stage, the requirements for land reclamation in the areas of their use and ensuring further sustainable development of the restored territory should be taken into account (Lebedeva T. N., Shefer O.R., Belousov A.O.).

When developing the biological stage of the project, bachelors in the field of preparation 21.03.02 "Land management and cadastres" are formed:

- such components of the competence of the OPK-3:

- \* knowledge of the methodology of development, land redistribution, improvement of the system, land use and land ownership, organization of land, environmental protection measures, elements and components of the scheme, implementation of schemes;

- \* the ability to organize the rational use of land resources and determine measures to reduce the anthropogenic impact on the territory;

\* knowledge of the skills of performing land management work in accordance with the ideas of the biological stage of land reclamation design;

– such components of the PC-3 competence:

\* knowledge of land legislation on the organization of rational use and protection of land resources;

\* the ability to participate in monitoring compliance with the environmental safety of the land management process for carrying out activities aimed at restoring soil fertility (biological stage);

\* proficiency in the development of measures for the design of land use and the arrangement of the territory of collective gardens, the organization of the territory of agricultural enterprises on an ecological and landscape basis, the peculiarities of land management in polluted areas (Kolesova E. V.; Kraineva S.V., Shefer O.R.).

When developing all stages of the project, bachelors consider various areas of reclamation of the disturbed land. And they choose the most optimal option for restoring land resources. Also, the effective use of soil cover, taking into account the further sustainable development of the territory, depending on the results of computer modeling. Thus, a bachelor in the field of preparation 21.03.02 "Land management and cadastres" should form not only the components of the competence of OPK-3 and PC-3, but also information and communication competencies, taking into account the technical capabilities of the university (Shefer O.R., Kraineva, S.V., Lebedeva T. N., 2022).

The development of projects for the reclamation of disturbed lands and restoration of soil cover is one of the urgent ways to improve the environment. As well as restoration of the ecological condition of the territory. And has for bachelors in the field of preparation 21.03.02 "Land management and cadastre" professional experience and a motivational incentive to improve competencies and opportunities for education for sustainable development. This is reflected in the dynamics of changes in the formation of motivation and competencies of OPK-3 and PC-3 (Table 1). The effectiveness of changes in the level of motivation of students was assessed using the A.V. Karpov's methodology "Determining the level of motivation for success" (Karpov A.V.), the level of change in the competencies of OPK-3 and PC-3, taking into account:

1) the structure of competence (with the content of invariant bases – instrumental, motivational, value-semantic, individual psychological, cognitive);

2) completeness of representation of all stages of the project as a completed design cycle.

Table 1: Dynamics of the level of formation of motivation, competencies of OPK-3 and PC-3.

Level	% of bachelors who are at the level of forming			
	motivations of project activity		OPK-3/PC-3	
	Before starting work on the project	After project protection	Before starting work on the project	After project protection
high	12,4	27,4	9,0 / 13,8	29,4 / 29,1
average	27,3	33,3	35,0 / 39,2	42,6 / 49,5
low	60,3	39,3	56,0 / 47,0	28,0 / 21,4

This dynamics is due to the application within the framework of the discipline "Land management design" of the main approaches to the formation of competencies for the design of land reclamation:

– undergraduates, under the guidance of a teacher, form structural, process, resource, convergent project models in practical classes during a heuristic conversation. Projects are formed taking into account the principles of sustainable development education. Which is based on interdisciplinary knowledge based on an integrated approach to the development of society, the economy and the environment;

– individual consultations are arranged by the teacher to work on the project through project management technology;

– when preparing the project defense, the risk management system of the developed project is discussed with bachelors;

– when evaluating the resulting product, a conceptual separation is carried out. And, if necessary, organizational separation of regular and innovative bachelor's activities when working on a project.

## 4 CONCLUSION

The above-mentioned basic approaches to the formation of competencies for the design of land reclamation, allow us to consider the convergent approach for the development of reclamation projects as promising, since:

firstly, the activity of bachelors in the design of land reclamation involves the structuring and formalization of activities for the formation and

development of the competencies of OPK-3 and PK-3, which means a thorough study of the stages of design by bachelors;

secondly, the elaboration of each stage of the project in the conditions of convergence of sciences and information technologies is implemented in the form of the development and implementation of a system of intra-organizational structures. This is quite difficult, and attempts to build a project-oriented system for the formation and development of competencies in the absence of the necessary knowledge, skills, and abilities can lead to unviable results. Overcoming this negativity is associated with the self-education of bachelors;

thirdly, it promotes the development of education for sustainable development. Since it affects the content side of education, taking into account specific specifics, global problems and local priorities. And it is interdisciplinary, because no discipline includes a number of pedagogical techniques that contribute to active learning and the development of thinking skills (Balandina, I., Lebedeva T., Milyutina A., Moskvitina T., Shefer O., Shiganova, G., Yuzdova, L.).

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