Жылысбаева Гүлхан Нұрділләқызы – техника ғылымдарының кандидаты, доцент, Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті, Қазақстан Республикасы, 160400 Кентау қ., Ш.Уәлиханов көш. 130, тел.: 87051612049, e-mail: gulkhan.zhylysbayeva@ayu.edu.kz.*

Нурматова Зилола Азаматқызы – магистрант, Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті, Қазақстан Республикасы, 161200 Түркістан қ., Ақ Орда көш. 38, тел.: 87071715747, e-mail: zilola.nurmatova@ayu.edu.kz.

Жылысбаева Аққоңыр Нұрділләқызы – химия ғылымдарының кандидаты, доцент, Өзбекәлі Жәнібеков атындағы Оңтүстік Қазақстан педагогикалық университеті, Қазақстан Республикасы, 160000 Шымкент қ., А.Байтұрсынов көш. 13, тел.: 87014419535, e-mail: zhylysbayeva.akkonyr@ okmpu.kz.

Сарбаева Гулнара Тұрсынбайқызы – техника ғылымдарының кандидаты, доцент, Қожа Ахмет Ясауи атындағы Халықаралық қазақ-түрік университеті, Қазақстан Республикасы, 160400 Кентау қ., Т.Рысқұлов көш. 104, тел.: 870786738047, e-mail: gulnar.sarbayeva@ayu.edu.kz.

Жылысбаева Гульхан Нурдуллаевна – кандидат технических наук, доцент, Международный казахско-турецкий университет имени Ходжи Ахмета Ясави, Республика Казахстан, 160400, г. Кентау, ул. Ш.Уалиханова 130, тел.: 87051612049, e-mail: gulkhan.zhylysbayeva@ayu.edu.kz.*

Нурматова Зилола Азаматовна – магистрант, Международный казахско-турецкий университет имени Ходжи Ахмета Ясави, Республика Казахстан, 161200, г. Туркестан, ул. Ак Орда 38, тел.: 87071715747, e-mail: zilola.nurmatova@ayu.edu.kz.

Жылысбаева Акконыр Нурдуллаевна – кандидат химических наук, доцент, Южно-Казахстанский педагогический университет имени Өзбекәлі Жәнібеков, Республика Казахстан, 160000, г. Шымкент, ул. А. Байтурсынова 13, тел.: 87014419535, e-mail: zhylysbayeva.akkonyr@ okmpu.kz.

Сарбаева Гульнара Турсынбаевна – кандидат технических наук, доцент, Международный казахско-турецкий университет имени Ходжи Ахмета Ясави, Республика Казахстан, 160400, г. Кентау, ул. Т.Рыскулова 104, тел.: 870786738047, e-mail: gulnar.sarbayeva@ayu.edu.kz.

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METHODOLOGY FOR STUDYING TRANSBOUNDARY RIVERS OF KAZAKHSTAN AND CENTRAL ASIA AS AN OBJECT OF GEOCONFLICTOLOGICAL RESEARCH

Issabayev A.T. – PhD student, Department of natural sciences, I.Zhansugurov Zhetysu University, Taldykorgan, Republic of Kazakhstan.*

Jan A. Wendt – PhD, Professor, University of Gdańsk, Gdańsk, Republic of Poland.

Tokpanov Y.A. – Candidate of Geographical Sciences, Associate Professor, Department of natural sciences, I. Zhansugurov Zhetysu University, Taldykorgan, Republic of Kazakhstan.

Kerimbay B.S. – PhD, Senior Lecturer, Department of Natural Sciences, I.Zhansugurov Zhetysu University, Taldykorgan, Republic of Kazakhstan.

This article discusses a methodology for the study of geoconflicts as an object of geoconflictology using the example of transboundary rivers in Kazakhstan and Central Asia. The aim of the study is to develop and test a methodology for studying transboundary rivers in Kazakhstan and Central Asia within the educational process as an object of geoconflictological analysis, aimed at fostering students' professional competencies in identifying, analyzing, and modeling geoecological conflicts related to the use of water resources in transboundary regions. The research objectives include analysis of international agreements and legal norms regulating the use of transboundary water resources; development of practical tasks for students focused on identifying the causes and consequences of geoconflicts; implementation of a pedagogical experiment aimed at forming students' skills in analyzing, synthesizing, and evaluating information using innovative teaching methods. The study presents the results of the pedagogical experiment and identifies the key factors influencing the development of students' professional competencies in geoconflictology. The research highlights the importance of integrating theoretical knowledge with practical application in geoecology, as well as the need for further development of methodologies and technologies aimed at analysis and resolution of transboundary geoecological conflicts. The paper also underscores the significance of using international legal regulations and predictive models in the formation of sustainable water resources management systems in Central Asia.

Key words: *geoconflictology, geoecological conflict, professional competence, transboundary rivers, innovative teaching methods.*

ҚАЗАҚСТАН МЕН ОРТАЛЫҚ АЗИЯНЫҢ ТРАНСШЕКАРАЛЫҚ ӨЗЕНДЕРІН ГЕОКОНФЛИКТОЛОГИЯНЫ ЗЕРТТЕУ ОБЪЕКТІСІ РЕТІНДЕ ЗЕРТТЕУ ӘДІСТЕМЕСІ

Исабаев А.Т. – PhD докторанты, І.Жансүгіров атындағы Жетісу университеті, Талдықорған қ., Қазақстан Республикасы.*

Jan A. Wendt – PhD, профессор, Гданьск университеті, Гданьск қ., Польша Республикасы.

Токпанов Е.А. – география ғылымдарының кандидаты, жаратылыстану пәндері кафедрасының қауымдастырылған профессоры (доцент), І.Жансүгіров атындағы Жетісу университеті, Талдықорған қ., Қазақстан Республикасы.

Керімбай Б.С. – PhD, жаратылыстану пәндері кафедрасының аға оқытушысы, І.Жансүгіров атындағы Жетісу университеті, Талдықорған қ., Қазақстан Республикасы.

Мақалада Қазақстан мен Орталық Азияның трансшекаралық өзендерінің мысалында қақтығыстарды геоконфликтология объектісі ретінде зерттеу әдістемесі қарастырылады. Зерттеудің мақсаты трансшекаралық өңірлерде су ресурстарын пайдаланумен байланысты геоэкологиялық қақтығыстарды анықтау, талдау және модельдеу бойынша студенттердің кәсіби құзыреттерін қалыптастыру үшін геоконфликтологиялық талдау объектісі ретінде білім беру процесінде Қазақстан мен Орталық Азияның трансшекаралық өзендерін зерттеу әдістемесін әзірлеу және сынақтан өткізу болып табылады. Міндеттері: трансшекаралық су ресурстарын пайдалануды реттейтін халықаралық келісімдер мен құқықтық нормаларды талдау; геоконфликттердің себептері мен салдарын зерделеуге бағытталған студенттер үшін практикалық тапсырмаларды әзірлеу; оқытудың инновациялық әдістемелері арқылы студенттердің ақпаратты талдау, жалпылау және бағалау дағдыларын қалыптастыруға бағытталған педагогикалық эксперимент жүргізу. Жұмыста педагогикалық эксперименттің нәтижелері, сондай-ақ геоконфликология саласындағы студенттердің кәсіби құзыреттілігін дамытуға әсер ететін негізгі факторларды анықтау ұсынылған. Зерттеулер теориялық білімді Геоэкология саласында практикалық қолданумен интеграциялаудың маңыздылығын, сондай-ақ трансшекаралық геоэкологиялық қақтығыстарды талдауға және шешуге бағытталған әдістер мен технологияларды одан әрі дамыту қажеттілігін атап көрсетеді. Сонымен қатар, бұл жұмыс Орталық Азияда су ресурстарын басқарудың тұрақты жүйелерін қалыптастыру үшін халықаралық құқықтық нормалар мен болжамды модельдерді пайдаланудың маңыздылығын атап көрсетеді.

Түйінді сөздер: *геоконфликтология, геоэкологиялық жанжал, кәсіби құзыреттілік, трансшекаралық өзендер, оқытудың инновациялық әдістері.*

МЕТОДИКА ИЗУЧЕНИЯ ТРАНСГРАНИЧНЫХ РЕК КАЗАХСТАНА И ЦЕНТРАЛЬНОЙ АЗИИ КАК ОБЪЕКТА ИССЛЕДОВАНИЯ ГЕОКОНФЛИКТОЛОГИИ

Исабаев А.Т. – PhD докторант, кафедра естественных дисциплин, Жетысуский университет им. И. Жансугурова, г. Талдыкорган, Республика Казахстан.*

Jan A. Wendt – PhD, профессор, Гданьский университет, г. Гданьск, Республика Польша.

Токпанов Е.А. – кандидат географических наук, ассоциированный профессор кафедры естественных дисциплин, Жетысуский университет им. И. Жансугурова, г. Талдыкорган, Республика Казахстан.

Керімбай Б.С. – PhD, старший преподаватель кафедры естественных дисциплин, Жетысуский университет им. И. Жансугурова, г. Талдыкорган, Республика Казахстан.

В статье рассматривается методика изучения геоконфликтов как объекта геоконфликтологии на примере трансграничных рек Казахстана и Центральной Азии. Целью исследования является разработка и апробация методики изучения трансграничных рек Казахстана и Центральной Азии в образовательном процессе как объекта геоконфликтологического анализа для формирования у студентов профессиональных компетенций по выявлению, анализу и моделированию геоэкологических конфликтов, связанных с использованием водных ресурсов в трансграничных регионах. Задачи: анализ международных соглашений и правовых норм, регулирующих использование трансграничных водных ресурсов; разработка практических заданий для студентов, направленных на изучение причин и последствий геоконфликтов; проведение педагогического эксперимента, ориентированного на формирование у студентов навыков анализа, обобщения и оценки информации через инновационные методики обучения. В работе представлены результаты педагогического эксперимента, а также выявлены основные факторы, влияющие на развитие профессиональных компетенций студентов в области геоконфликтологии. Исследование подчеркивает важность интеграции теоретических знаний с практическим применением в области геоэкологии, а также необходимость дальнейшей разработки методик и технологий, ориентированных на анализ и разрешение трансграничных геоэкологических конфликтов. Работа также подчеркивает

важность использования международных правовых норм и прогнозных моделей для формирования устойчивых систем управления водными ресурсами в Центральной Азии.

Ключевые слова: *геоконфликтология, геоэкологический конфликт, профессиональная компетенция, трансграничные реки, инновационные методы обучения.*

Introduction. In the modern world, there is a steady trend towards an increase in the number of geo-conflicts caused by the scarcity and uneven distribution of natural resources, especially in transboundary regions. Over the past decades, issues of joint management of natural resources, in particular water, have acquired particular importance both in academic and practical terms. One of the key aspects is the study of transboundary water conflicts affecting the interests of many states and complicated by contradictions in ecology, economics and politics [1, p. 317].

The studies of C.Vorosmarty et al. emphasize the importance of the ecosystem approach to ensuring water security and achieving sustainable development goals, focusing on the integration of scientific knowledge and practical measures for sustainable water management in the context of global climate change and population growth [1, p. 325]. At the same time, the work of I.Makhmudov et al. explores the socio-economic and regulatory aspects of water management in Central Asia, highlighting the need for water-saving technologies and coordination between states to address water scarcity and improve water use efficiency [2, p. 2951].

The Central Asian region, including Kazakhstan, is one of the hotbeds of global water-related tensions, with the Syr Darya, Irtysh, Ili, Chu and Talas rivers crossing national borders and becoming the subject of competition between countries with limited water resources [3, p. 42]. Ye.Dmitrieva's study provides a detailed analysis of the problems and solutions in water management in Central Asia, focusing on the shortcomings of existing interstate regulatory mechanisms and the importance of an integrated approach to conflict resolution [3, p. 45]. Similarly, L.De Stefano et al. assess transboundary river basins for potential hydropolitical tensions, offering analytical tools for conflict prediction and prevention, which is important for the formation of management strategies [4, p. 35].

Geoconflictology as an interdisciplinary scientific discipline emerged at the intersection of geography, political science, ecology and international law, focusing on the study of spatial-resource conflicts caused by the contradictory use of natural resources [5, p. 86]. However, despite the development of the theoretical base, a critical analysis of existing methods of teaching geoconflictology and the formation of professional competencies in this area remains underrepresented in the literature.

The works of S.Mäkinen and A.Martini devoted to the pedagogical aspects of teaching geopolitics demonstrate the potential of active and practice-oriented teaching methods, including case studies and modeling, for developing students' critical thinking skills and analyzing complex political and natural processes [5; 6]. Nevertheless, the use of such methods specifically in the field of geoconflictology, especially with a focus on transboundary water resources, has been little covered, and research aimed at systematically testing pedagogical technologies and assessing their effectiveness is extremely limited.

In the context of transboundary water resources of the Republic of Kazakhstan, legislative and interstate agreements regulating the joint use and protection of water bodies play a significant role. Resolutions of the Government of the Republic of Kazakhstan, agreements with the Russian Federation, the Kyrgyz Republic and Uzbekistan, as well as regulations on the use of water management structures on the Chu and Talas rivers create a legal basis for coordinating actions and minimizing conflicts [7-10]. However, scientific publications lack a deep analysis of the impact of these agreements on the methods of training specialists, which emphasizes the need to integrate the legal context into curricula on geoconflictology.

Thus, despite the extensive theoretical material and legal framework, existing studies do not provide a complete picture of a systematic approach to teaching geoconflictology in educational institutions aimed at developing students' practical competencies in analyzing and managing transboundary water conflicts. Particular attention should be paid to the integration of digital technologies, such as GIS, statistical modeling and simulation of conflict scenarios, which can improve the quality of education and prepare students to solve real problems.

The objective of this study is to develop and test a methodology for teaching geoconflictology using the example of transboundary rivers in Kazakhstan and Central Asia, aimed at developing students' professional competencies in identifying, analyzing and modeling geoecological conflicts, as well as developing management decisions taking into account legal, environmental and socio-cultural factors.

To achieve this goal, the following tasks are solved within the framework of the study:

- conduct a critical analysis of the theoretical foundations of geoconflictology and existing methods of teaching it, identify gaps and promising areas of development.
- study regulatory legal acts and international agreements governing transboundary water management in Central Asia, with an emphasis on Kazakhstan.
- develop a set of practice-oriented educational materials and methodological approaches, including case studies, the use of GIS and modeling of conflict scenarios.

- test the proposed methodology in the educational process and assess its impact on the formation of key professional competencies in students.

- formulate recommendations for the integration of modern digital technologies and interdisciplinary approaches in the teaching of geoconflictology.

This study seeks to fill the identified gaps and contribute to improving the quality of training specialists who are able to effectively analyze and manage transboundary water conflicts.

Materials and Methods. The methodology of the study conducted during the 2024-2025 academic year within the Geography program at the I.Zhansugurov Zhetysu University (Taldykorgan) was based on the integration of theoretical and applied approaches to the study of geoecological conflicts associated with the use of transboundary water resources in Central Asia. The normative and analytical foundation of the research comprised the provisions of the 1992 UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes, as well as the UNECE Water Convention.

The primary research methods employed included a pedagogical experiment, systematic literature analysis, expert evaluation, surveys, and observation. The pedagogical experiment, which constituted the central methodological component of the study, was conducted within the framework of the courses “Fundamentals of Political Geography and Geopolitics” and “Geoconflictology.” It encompassed both diagnostic (preliminary) and formative stages and aimed to assess the effectiveness of implementing an innovative teaching methodology focused on the study of transboundary geoecological conflicts.

The study involved 51 students from the third and fourth years of the Faculty of Geography, who were divided into a control group (25 students) and an experimental group (26 students). To ensure objective assessment of the initial knowledge level, an entrance test was administered. The educational process included lectures on international and bilateral agreements concluded by Kazakhstan with neighboring countries, as well as practical sessions aimed at analyzing the hydrological regime of major regional rivers, modeling conflict scenarios, assessing anthropogenic impacts, and developing strategies for sustainable water resource management using digital mapping, statistical models, and climate data.

The assessment of students’ analytical and managerial competencies was conducted using a specialized test consisting of 40 tasks covering key topics such as transboundary water resource management, international legal frameworks, sources of conflicts, and conflict resolution strategies.

Systematic literature analysis served to establish the theoretical and methodological basis of the study. This involved reviewing academic publications, international legal documents (including the 1992 UNECE Convention), bilateral agreements on water resource allocation, and educational research in the field of geoconflictology, thereby ensuring the relevance and validity of the research.

Expert evaluation was applied for the objective assessment of students’ project works and presentations. The evaluation was conducted by a panel of experts, including faculty members experienced in geopolitics and water security. Student works were assessed according to pre-established criteria, guaranteeing objectivity of the results.

Surveys were utilized to investigate students’ perceptions of the course content, their motivation, and self-assessment of analytical and problem-solving skills before and after the course. Survey results complemented the quantitative data obtained through testing.

Observation was conducted throughout the pedagogical experiment to monitor student engagement, participation in group work, and application of theoretical knowledge in practice. Instructors recorded behavioral indicators reflecting the development of critical thinking skills.

The comprehensive application of these methods ensured robust data triangulation and enabled both quantitative and qualitative evaluation of the pedagogical effectiveness of the implemented innovative teaching methodology.

Results and discussion. The results of the experimental work indicate a high level of pedagogical effectiveness in implementing innovative teaching methods for the study of transboundary rivers within the courses “*Fundamentals of Political Geography and Geopolitics”* and “*Geoconflictology”*. The analysis of the obtained quantitative and qualitative data demonstrates that the targeted integration of components such as international legal documents, digital models of water usage, case analyses of real geoecological conflicts, and interdisciplinary tasks into the educational process significantly enhances students’ abilities in information analysis, synthesis, and evaluation.

The results confirm that thematically oriented approaches to teaching geoconflicts related to transboundary rivers contribute to the development of deep professional and interdisciplinary competencies of students.

A comparative analysis of the pre-test and post-test results revealed that the level of analytical, synthesizing, and evaluative skills in the experimental group increased by an average of 23.5%, while in the control group where traditional methods were maintained without methodological adjustments, the increase was only 9.3% (Table 1).

Table 1 – Results of the entrance and final testing in the control and experimental groups

Group	Number of students	Average score of the entrance test (%)	Average final test result (%)	Gain, (%)
Control	25	62,4	71,7	+9,3
Experimental	26	61,8	85,3	+23,5

A comparative analysis of the data presented in the table demonstrates a significant increase in the competency levels of students who were taught using the innovative methodology. This clearly confirms the relevance of integrating practice-oriented tasks and international legal case studies into the training process of future specialists in geography and geoecology.

The application of an integrative methodology based on the principles of the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992), intergovernmental agreements between Central Asian countries, and predictive models of hydrological regime changes is a significant factor in enhancing students' ability to analyze and prevent transboundary geoecological conflicts (Figure 1).

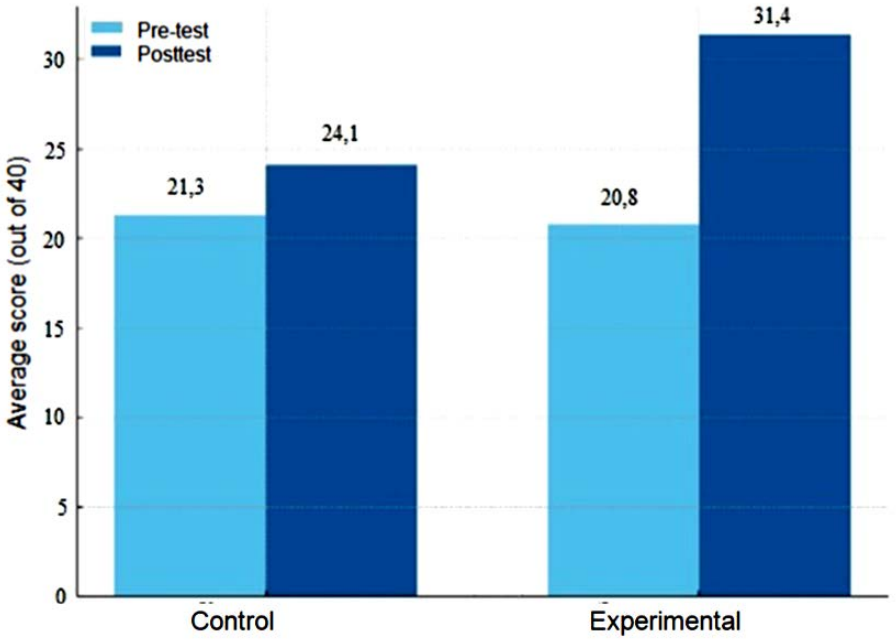

Figure 1 – The results of diagnostics of control and experimental groups

During the study, it was found out that the use of interactive teaching methods such as case analysis of specific geopolitical situations (e.g., Irtysh–Ili between Kazakhstan and China; Syr Darya and the Aral Sea between Kazakhstan and Uzbekistan), predictive modeling of hydrological regime changes until 2050, and project-based tasks aimed at resolving both hypothetical and real conflicts on transboundary watercourses not only provides students with a solid knowledge base but also fosters analytical, critical, and anticipatory thinking. This is particularly important in the context of evolving educational standards and growing geopolitical instability in the Central Asian region.

A qualitative analysis of surveys and written reflections from students in the experimental group demonstrated an increase in motivational engagement: 85% of participants noted the high relevance of the subject matter for understanding real-world ecological and geopolitical threats, while 76% reported improved ability to independently seek solutions to conflict situations (Table 2).

Table 2 – Results of the survey of students in the experimental groups

Question	Yes (%)	No (%)
Do you consider the topic of transboundary rivers relevant for understanding real threats?	85	15
Has your ability to find solutions to conflicts on your own improved?	76	24
Do you feel an increase in interest in the discipline after completing the course?	81	19
Do you find it useful to use case studies and mapping models?	88	12

An assessment of project tasks and oral presentations showed a stable formation of the following competencies:

- the ability to identify the causes and consequences of transboundary geoecological conflicts;
- the capacity to apply international legal norms in conflict analysis;
- readiness for intercultural and interstate dialogue in the development of joint solutions;
- formation of understanding of water resources as a shared component of natural capital.

Thus, the conducted study confirmed the hypothesis that the use of innovative educational technologies in combination with international legal and environmental sources of knowledge contributes not only to a deeper understanding of complex theoretical concepts such as "*transboundary river"*, "*geoecological conflict"*, "*watershed"*, and "*water resource allocation"*, but also to the development of systemic and environmentally oriented thinking of students.

Moreover, the comparison of the obtained results with the data of other studies including scientific publications by the Institute of Geography and Water Security of the Republic of Kazakhstan, the Regional Environmental Centre for Central Asia, and UNECE projects demonstrates their consistency and confirms the importance of studying transboundary water conflicts as a key component of training specialists in the field of education.

Conclusion. The research findings confirm the effectiveness of applying innovative teaching methodologies in the study of transboundary rivers and geoecological conflicts arising in Central Asia. During the research, a methodology was developed and tested based on integration theoretical aspects with applied analysis of water conflicts, and with the use of international legal instruments such as the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992), as well agreements between neighboring states of the region.

The experimental data demonstrated that the use of interdisciplinary approaches such as case analysis, forecasting of river discharge changes, and the implementation of digital models and international legal norms significantly enhances students' analytical and critical thinking skills. Special emphasis was placed on the development of students' competencies related to the resolution of transboundary geoecological conflicts and the application of practical knowledge for resolving real and hypothetical environmental challenges in the region.

In the context of studying geoconflicts as a core subject of geoconflictology, it is recommended for future researches to focus on in-depth analysis of educational curricula and teaching methodologies aimed at training future geography educators. Particular attention should be given to the development and implementation of methods that foster development of students' skills in analyzing, synthesizing, and evaluating information related to geoconflicts.

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Information about the authors:

Issabayev Anuar Toktamyssovich – PhD student, "8D01505-Geography" educational program, I. Zhansugurov Zhetysu University, Republic of Kazakhstan, 040009, Taldykorgan, 187a I.Zhansugurov Str., tel.: 87783451902, e-mail: anuar_1089@mail.ru.*

Jan Andrzej Wendt – PhD, Professor University of Gdansk, Republic of Poland, 80-309 Gdansk, 8 Bażyńskiego Str., tel.: +48604751770, e-mail: jan.wendt@ug.edu.pl.

Tokpanov Yerkin Aipovich – Candidate of Geographical Sciences, Associate Professor, Department of natural sciences, I.Zhansugurov Zhetysu University, Republic of Kazakhstan, 040009, Taldykorgan, 187a I.Zhansugurov Str., tel.: 87072419121, e-mail: tokpanov1960@mail.ru.

Kerimbay Bayan Suleimenovna – PhD, Senior Lecturer of the Department of natural sciences, I.Zhansugurov Zhetysu University, Republic of Kazakhstan, 040009, Taldykorgan, 187a I.Zhansugurov Str., tel.: 87012109442, e-mail: bayan.kerimbay.65@mail.ru.

Исабаев Ануар Токтамысович – 8D01505-География ББ бағдарламасының PhD докторанты, І. Жансүгіров атындағы Жетісу университеті, Қазақстан Республикасы, 040009 Талдықорған қ., І.Жансүгіров көш. 187а, тел.: 87783451902, e-mail: anuar_1089@mail.ru.*

Jan Andrzej Wendt – PhD, Гданьск университетінің профессоры, Гданьск университеті, Польша Республикасы, 80-309 Гданьск қ., Бажиньск көш. 8, тел.: +48604751770, e-mail: jan.wendt@ug.edu.pl.

Токпанов Еркин Аипович – география ғылымдарының кандидаты, жаратылыстану пәндері кафедрасының қауымдастырылған профессоры, І. Жансүгіров атындағы Жетісу университеті, Қазақстан Республикасы, 040009 Талдықорған қ., І.Жансүгіров көш. 187а, тел.: 87072419121, e-mail: tokpanov1960@mail.ru.

Керімбай Баян Сүлейменқызы – PhD, жаратылыстану пәндері кафедрасының аға оқытушысы, І.Жансүгіров атындағы Жетісу университеті, Қазақстан Республикасы, 040009 Талдықорған қ., І.Жансүгіров көш. 187а, тел.: 87012109442, e-mail: bayan.kerimbay.65@mail.ru.

Исабаев Ануар Токтамысович – PhD докторант ОП 8D01505 – География, кафедра естественных дисциплин, Жетысуский университет им. И. Жансугурова, Республика Казахстан, 040009 г.Талдыкорган, ул. И.Жансугурова 187а, тел.: 87783451902, e-mail: anuar_1089@mail.ru.*

Jan Andrzej Wendt – PhD, профессор Гданьского университета, Республика Польша, 80-309 г. Гданьск ул. Бажиньскего 8, тел.: +48604751770, e-mail: jan.wendt@ug.edu.pl.

Токпанов Еркин Аипович – кандидат географических наук, ассоциированный профессор кафедры естественных дисциплин, Жетысуский университет им. И. Жансугурова, Республика Казахстан, 040009 г.Талдыкорган, ул. И. Жансугурова 187а, тел.: 87072419121, e-mail: tokpanov1960@mail.ru.

Керімбай Баян Сүлейменқызы – PhD, старший преподаватель кафедры естественных дисциплин, Жетысуский университет им. И. Жансугурова, Республика Казахстан, 040009 г.Талдыкорган, ул. И.Жансугурова 187а, тел.: 87012109442, e-mail: bayan.kerimbay.65@mail.ru.