

Environmental Science

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# Man-Made Ecology of East Kazakhstan

 Springer

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# Man-Made Ecology of East Kazakhstan

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# Preface

This book highlights the studies of differentiation problems of natural geosystems in East Kazakhstan which have an anthropogenic impact. The systematic methodology of comprehensive ecological assessment of anthropogenic impact on natural geosystems and their differentiations on the level of technogenic conditionality for ensuring rational environmental management and environmental protection is stated. The basis for the developments of geosystem approach allows to define stability of geosystems in space and time, which major factor of the organization is nature of lithogenesis and superficial drain interrelations and combination of gravel properties, and technique of geoecological division on the basis of target function creation concerning complex ecological assessments. Despite the abundance of the publications devoted to environmental problems, influence of a technogenesis on the environment is still poorly studied. Therefore, our research results of research can be used by research institutes at a further detailed geoecological research of the geosystems functioning dynamic under the technogenesis influence. Cartographic materials and offered nature protection activities allow developing optimal variants of problem solution on complex use of natural resources, and also can be used by the production, scientific, and other organizations setting the problems solution purpose concerning environmental protection and rational environmental management.

The anthropogenic impact and influence of a technogenesis on the environment and landscape components of East Kazakhstan are considered in the book. The idea of an acceptable environmental risk in the functioning of natural and man-made systems in modern society is given. As well as methodical bases of quantitative assessment of danger in environmental and technogenic risks are given. The traditional methods in geoecology and physical geography were used in this study.

The main purpose of the study is the complex ecological assessment of anthropogenic impact on natural geosystems and their differentiations on the technogenic conditionality level for ensuring rational environmental management and environmental protection.

The practical importance of the book consists of possibility of development of evidence-based recommendations and actions for conservation, quality management of the environment in order to decrease a degree of anthropogenic impact, and prevention of degradation processes.

The book can be useful to the research institutions, industrial, scientific, and other organizations establishing the purpose of the problem solution in environmental protection and rational environmental management. The offered cartographic materials on protection of the nature allow to develop optimal variants of the solution of tasks in comprehensive use of natural resources.

Almaty, Kazakhstan  
Almaty, Kazakhstan  
Urumqi, China/Almaty, Kazakhstan

Sairan Bayandinova  
Zheken Mamutov  
Gulnura Issanova

# Content and Structure of the Book

The outcomes of studies and research results in this book related to natural geosystems in East Kazakhstan are influenced by anthropogenic impact. The book has four chapters. Chapter 1, “Natural Factors of Forming and Development of Geosystems in East Kazakhstan” considers an overview of natural factors such as geological and tectonic features, topography, climate, soil and vegetation covers, landscape structure in formation of geosystems in East Kazakhstan. The chapter contains eight sections that describe the formation and development of natural geosystems in East Kazakhstan. Chapter 2, “Technogenic Conditionality in Development of Geosystems in East Kazakhstan” provides information and analysis on allocation methods of technogenic geosystems, theoretical substantiation for the organization of geosystems in East Kazakhstan, principles of identification and differentiation of geosystems in East Kazakhstan, characteristic of geosystems, geochemical analysis of technogenic impact and factors of technogenesis. Chapter 3, “Division of the Territory of East Kazakhstan According to the Level of Anthropogenic Impact” contains three sections providing information and analysis on methods in landscape and ecological division based on criterion function, sources of anthropogenic impact on geosystems in East Kazakhstan, division of the territory of East Kazakhstan according to the anthropogenic impact. Chapter 4, “Geoeological Bases of Nature Protection Measures and Actions” has three sections that consider problems and systems of nature protection activities and measures in East Kazakhstan. Chapter 5 contains “Conclusion” and Appendix.

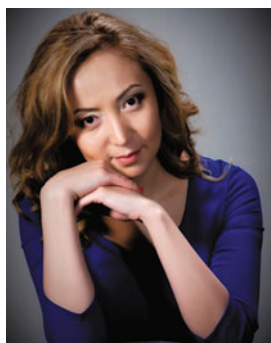


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## About the Authors



**Sairan Bayandinova** is a candidate of geographical sciences and an associate professor.

She studied bachelor and master degrees in Geography at the East Kazakhstan State University. In 2007, she studied a full-time postgraduate program at the Al-Farabi Kazakh National University and has defended a dissertation entitled “Technogenic conditionality of geosystems’ development of East Kazakhstan”.

Since 2004 she has been working as an associate professor at the Recreational Geography and Tourism Department of Geography and Environmental Management Faculty. She is a director of Student Service Centre «Keremet» in Al-Farabi Kazakh National University.

Her scientific interests are technogenic ecology, geoecology, alternative power engineering, and IT technologies.

She is an author of more than 70 scientific works in domestic, international and rating journals and conferences including four education guidances in Kazakh language such as “Technogenic Ecology” (2012; 2014), “Tourism Industry” (2015), “Logistics in Tourism” (2016).

She has participated in and coordinated the International and Local Projects and Programs such as the International project 543808-TEMPUS-1-2013-1-BE-TEMPUS-JPHES; Professional Training in the area of Information and Communication technologies in Russia and Kazakhstan based on the European standards of qualification (2013–2016); Basic Researches in the

area of Natural Sciences (assessment of soil energy); Development of Theoretical Bases and Efficiency Evaluation of use of Innovative Nature Protection Technologies for Recovery of Quality of Natural and Economic Systems in Almaty region (2012–2013); Ecological and Geomorphological Systems of platform-denudation plains in mining regions of Arid Zone of Kazakhstan (2012–2014); Development of mechanisms and guarantees for implementation of investments into forming of the objects of innovative infrastructure providing use of renewable energy resources and energy saving (2012–2014).

Since 2012, she has been the expert of projects by Ministry of Science and Education of Kazakhstan.

In 2004, she became the winner in the nomination “The Best Young Scientist of Al-Farabi Kazakh National University”. In 2011, she became the winner of “Talented Young Scientists” by Ministry of Education and Science of Kazakhstan. In 2015, she became the prize winner in the nomination “A leader of sales-2014 for the best educational publication in the Al-Farabi Kazakh National University”. In 2016, she became the winner of “The Best Teacher of Higher Education Institution” and awarded the medals “Honourable Educator of the Republic of Kazakhstan”.



**Zheken Mamutov** is a doctor of biological sciences and a professor. In 1962, he graduated from the Abay Kazakh Teacher Training Institute in a major of biology, chemistry, and bases of agricultural production. For many years, he has been working as a teacher at the Abay Kazakh Teacher Training Institute and a leading researcher and scientist at the U.U. Usmanov Kazakh research Institute of Soil Science and Agrochemistry. He has built international cooperation in research and training in young scientists between China and Kazakhstan. He took a position as a Deputy Director and Director at the Green Industry Institute, which was established by his initiative. The main purpose of the Institute was study and development of the saline soils in China. Now he is a permanent scientific consultant of this Institute. Since 2002, he is a professor of the Physical Geography Department at the Al-Farabi Kazakh National University. He has developed the

new theoretical basis of melioration of the saline soils; biochemistry of violation of carbonate balance in the saline soils of rice fields. Based on the developed theory, a number of methods of alkalinity regulation in saline soils and irrigating waters of rice fields are offered. The new technology of development of the saline alkaline soils under rice was implemented on more than 100 thousand hectares of rice fields of Kazakhstan, and passed production tests in North Korea, China, Russia, Ukraine, Uzbekistan, and Karakalpakstan. He is an author of a number of methodical developments, which are applied in abroad. He was the first in Kazakhstan who used an electronic microscope, gas and liquid chromatographs, amino-acid analyzers in relation to the studying of saline soils. He has developed a method of identification, a degree of a biochemical capability to alkali formation of irrigating waters in the rice fields. Fourteen candidates and two doctors of sciences have been prepared under his supervision.

His research interests are soil science, ameliorative geography, processes of soil dehumification, adaptive, and landscape system of agriculture.

He is an author of more than 200 publications, including 4 monographs, 15 recommendations for production, and 12 certificates of authorship.



**Gulnura Issanova** holds a doctorate degree in Natural Sciences and is an associate professor, scientist, and researcher at U.U. Uspanov Kazakh Research Institute of Soil Science and Agrochemistry and a scientific secretary at the Research Centre of Ecology and Environment of Central Asia (Almaty), Kazakhstan.

She studied bachelor's degree (B.Sc.) and master's (M.Sc.) degrees in Physical Geography at the Al-Farabi Kazakh National University and her doctoral degree at Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, China.

Her research interest is focused on problems of soil degradation and desertification, in particular, the role of dust and sand storms in the processes of land and soil degradation and desertification. She participates regularly in the International Scientific Activities (Conference,

Forum, and Symposium) on Environmental Problems as well as writes papers on the subject and takes part in local and international projects.

Gulnura Issanova has published many papers in international peer-reviewed journals with high level and wrote a handbook, “How to Write Scientific Papers for International Peer-Reviewed Journals”. She is the author of “Aeolian processes as dust storms in the deserts of Central Asia and Kazakhstan” published by Springer Nature, 2017 and co-author of the monograph, “Overview of Central Asian Environments” (in Chinese) and the handbook Methodical Handbook on Interpretation of Saline Soils (in four languages: Kazakh, Russian, English, and Chinese). Gulnura Issanova became a Laureate of the International Award “Springer Top Author” and awarded in the Nomination “Springer Young Scientist Awards” for high publication activity in scientific journals published by Springer Nature, 2016.

# Abbreviations

ASRK	Academy of Sciences of the Republic of Kazakhstan
ECMC	Ertis Chemical and Metallurgical Combine
ECSP	Ertis Copper Smelting Plant
EKCCC	East Kazakhstan Copper-Chemical Combine
EKRTDEP	East Kazakhstan Territorial Department of Environmental Protection
MC impacts	Man-caused impacts
MES RK	Ministry of Education and Science of the Republic of Kazakhstan
MPC	Maximum permissible concentrations
MSW	Municipal solid waste
NAPEP	National Action Plan for Environmental Protection
NTC	Natural and territorial complexes
OMPE	Ore mining and processing enterprise
PAH	Polycyclic aromatic hydrocarbons
PB	Polychlorinated biphenyls
RPP	Ridder Polymetallic Plant
SAS	Surface active substances
SNTS	Semipalatinsk nuclear test site
SPNA	Specially protected natural areas
UISP	Ust-Kamenogorsk iron-steel plant
ULZP	Ust-Kamenogorsk lead-zinc plant
UTMP	Ust-Kamenogorsk titanium-magnesium plant

# Chapter 1

## Natural Factors of Formation and Development of Geosystems in East Kazakhstan

### 1.1 Background of Research on Geosystems

Kazakhstani part of the Altai, the eastern sides of the Kazakh low hilled part, the basin of Zaisan lake, Tarbagatai, Priertis and other territories related to the administrative division of the East Kazakhstan region are included to territory of East Kazakhstan. Conditionally, we call this territory the East Kazakhstan.

At all times, territory of East Kazakhstan has attracted the attention of many outstanding researchers. It was the area of interest for many geographers: in 1771 P.S. Pallas, in 1829 A. Humboldt, in 1856–1857 P.P. Semenov Tian-Shansky, in 1863–1864 K. Struve and G.N. Potanin, in 1877–1878 N.M. Przhevalsky, in 1903 G.E. Groom-Grzhimailo. It was also visited by the following botanists: in 1734–1741 I. Gmelin, in 1793 I. Sievers, in 1826 K. Ledebour, K. Meyer and A. Bunge, in 1840 G.S. Karelin and I.P. Kirillov, in the years 1895–1911 V.V. Sapozhnikov, 1899–1910 A.N. Sedelnikov, in 1908–1910 and 1936 B.A. Keller; also by following geologists: in 1842 A. Chikhachev, in 1849–1851 A. Vlangali, in 1911–1914 V.A. Obruchev; by zoologists: in 1876 A.E. Brem. Much knowledge about the region was made by an exiled local ethnographer E.M. Michaelis (Kyzykbayev 1964; Chernykh 1971; Klink 1976a, b).

Beginning of knowledge about natural resources of the region started in the 17th century by F.A. Baykov, and in the first quarter of the 18th century by I. Unkovsky. Their travel diaries contained some geographical information about terrain from Tobolsk upwards along Ertis through the mountain ranges of Kalbin and Tarbagatay to Dzhungaria. In the second half of the 18th century, along with expedition of I.G. Gmelin and P.S. Pallas, many researchers such as father and son the Laxmanns, I.M. Renovants, E.M. Patrin, P. Shangin, I. Sievers, F. Ridder, and others worked here. As a result, quite thorough information on orohydrography, soils, flora, fauna, minerals and population was obtained. Most of the materials were connected with Rudny Altai, where mining crafts began to develop in the 18th