
BOOK
REVIEWS

The Degradation and Fate of Chernozems¹

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In 2008, Head Researcher of the Dimo Institute of Soil Science and Agricultural Chemistry, Merited Scientific Worker, and Honorary Member of the Academy of Sciences of Moldova Prof. I.A. Krupenikov celebrated his 96th birthday and the 75th anniversary of his fruitful scientific, pedagogical, and public career.

For more than 50 years, Krupenikov has been involved in the study of chernozems; he is the author of numerous papers and books about these soils. At the age of 95, he prepared a generalizing monograph on chernozems, their history, and their future. His latest book is devoted to the memory of Krupenikov's teachers and friends V.A. Kovda and I.P. Gerasimov.

In its contents, this is a purely scientific monograph. In its style, it is also a journalistic essay. In 2006, M.I. Gerasimova in her review of the previous book by Krupenikov (*Eurasian Soil Science*, vol. 39, no. 3) called it "a new type of popular scientific literature." The new book is written in the same manner. The author does not restrict himself to the classical scientific style of writing. He complements the scientific discussion with relevant examples from his personal experience and memoir pieces; the author clearly expresses his attitude towards the problems under discussion. Krupenikov explains the reasons for this style of writing, and one cannot but agree with him.

Indeed, the lively style and relatively simple language allows Krupenikov to suppose that this book should attract the attention of a broad circle of readers. The emotional richness of the writing is intended to convey the concern of the author about the fate of chernozems and other soils to the reader.

The following excerpt from the book illustrates this concern in an eloquent way: {My scientific life, particularly since the mid 1950s, has been tightly linked with chernozems. I have been examining this soil in different parts of Eurasia and, especially, in Moldova for nearly 70 years, and I have to admit with pity that chernozems have lost a lot of their magnificent power and beauty

over those years. Many chernozems have ceased to provide generous rewards for a farmer's labor, and their economic and ecological power have been depleted. It will make me cry if people destroy this inimitable wonder of nature—chernozems (the eternal breadwinners)—by the end of our century.}

The author tries to understand the consequences of the radical changes in land ownership rights within the former Soviet empire and to outline the main tendencies related to the changing attitude toward soil as a means of production. He argues that it is vitally important to overcome the indifferent attitude of landowners and official authorities toward the fate of chernozems. We should admit that his reproach to soil scientists for being insufficiently active and insistent in their advocacy in favor of soil care policies is quite fair.

Krupenikov considers the problem of the degradation of chernozems from the historical point of view. He reminds us of the past of these soils (with due reference to Dokuchaev's works), analyzes their present state on the basis of extensive factual data, and calls for urgent measures to avoid the loss of chernozems in the future.

As an expert, Krupenikov is rather pessimistic about the future: "By the end of the 21st century, chernozems may disappear almost completely if extraordinary measures for their conservation are not undertaken on a large scale."

The book has an usual structure, though its logic is quite reasonable. An important scientific problem—the problem of chernozems' degradation—is discussed in the first part of the book from the viewpoint of a well-known pedologist with exceptionally rich experience (the reader may judge about this from the autobiography of Krupenikov and from the impressive list of Krupenikov's works that are included in the third part of the book). In the second part of the book, Krupenikov pays due tribute to V.V. Dokuchaev and to his direct "teacher, advisor, and friend" N.A. Dimo.

Half of the book (its first part) can be considered a separate monograph on the degradation of chernozems. The first attempt of Krupenikov to classify different kinds of soil degradation was made in 1990 and only concerned water erosion. In the new monograph, Krupenikov analyzes previous attempts to classify soil deg-

¹ Krupenikov, I.A., *Chernozems. Vozniknovenie, sovershenstvo, tragediya degradatsii, puti okhrany i vozrozhdeniya* (Chernozems: Their Origin and Perfection, the Tragedy of their Degradation, and the Ways of Their Conservation and Revival), Chisinau: Pontos, 2008, 284 pp.

radation processes and concludes that the principles of the existing classification systems are rather vague. He argues that some general idea of such a classification is needed.

According to Krupenikov, the term degradation should not be used to identify all the processes worsening soil quality. Different kinds of soil degradation should be specified, and the relationships between them should be studied.

Krupenikov considers the traditional approach towards soil degradation processes to be too narrow. He suggests that soil (chernozem) degradation processes should be considered in a more comprehensive manner: the identification of particular degradation processes should be supplemented by the analysis of the relationships between them; it is also necessary to suggest methods to control the development of soil degradation under particular conditions. Furthermore, Krupenikov suggests that the analysis of soil degradation processes should be based on two theoretical concepts: (a) the concept of elementary pedogenetic processes developed by I.P. Gerasimov and (b) the concept of the ecological functions of soils in the biosphere as formulated by V.I. Vernadsky and V.A. Kovda and developed by G.V. Dobrovolskii and E.D. Nikitin.

According to Krupenikov, the particular mechanisms of soil degradation are related to changes in the elementary pedogenetic processes (their intensification, retardation, or distortion). Soil degradation results in the disturbance of soil ecological functions. Thus, Krupenikov considers the following triad: elementary soil-forming process—soil degradation—ecological soil functions.

The central place in the first part of the book belongs to the systematized list of the types and kinds of degradation of cultivated chernozems. It is presented in the form of a table, in which the particular kinds of degradation, the elementary pedogenetic processes responsible for their manifestation, their effect on the ecological soil functions, and the methods to control them are given.

Overall, the author described 40 kinds of soil degradation grouped into five types: (a) chemical degradation (10 different kinds), (b) physical degradation (8), (c) biological degradation (8), (d) profile degradation (10), and (e) geographic and biospheric degradation. The extension of the list of soil degradation processes (up to 40 different kinds!) is explained by the appearance of new kinds of degradation of chernozems in recent decades (e.g., soil contamination by radionuclides or the development of strongly waterlogged (mocharic) chernozems) and by the detailed subdivision of other kinds of soil degradation. Thus, among the processes of the biological degradation of chernozems, the author specifies devertebration (a decrease in the population of soil vertebrates) and de-enzymation (a decrease in the activity of enzymes). The separation of the fifth type of soil degradation—geographic and

biospheric degradation—seems to be rather artificial. Krupenikov distinguishes it as an integral type of degradation resulting from the interaction of particular kinds of chemical, physical, biological, and profile (changes in the morphology of the soil profile) degradation. The geographic (biospheric) degradation of chernozems means the disturbance of the ecological functions of these soils in the biosphere. It is usually observed over large areas.

Krupenikov does not consider the suggested systematization of degradation processes to be free of criticism. He believes that further discussion in this field may be fruitful. Though the system of soil degradation processes developed by Krupenikov concerns cultivated chernozems, it may also be applied to other soils, including gray forest and chestnut soils bordering chernozemic areas.

The geography of the different kinds of soil degradation in Moldova is thoroughly discussed in the book. The author argues that the degradation processes are differently manifested at different hierarchical levels of the soil cover organization. This problem is discussed by Krupenikov on the basis of the hierarchy of soil systems suggested by American scientists (*Opportunities in Basic Soil Science Research*, 1992; Russian translation, 2000). Krupenikov agrees with the general logic of this hierarchy; at the same time, he suggests that some transitional units between different hierarchical levels should be added to it. Thus, Krupenikov suggests that the level of elementary soil areas (as defined by V.M. Fridland) can be considered an intergrade between the pedon level and the catena level. The level of hydrographic basins (catchments of different orders) can be considered an intergrade between the catena level and the level of geomorphic regions. According to Krupenikov, the latter level can be replaced by the levels of soil and/or agrosol regions. The levels of soil zones and provinces can be distinguished in the transition from the level of geomorphic regions and the pedosphere level.

Krupenikov considers the problem of degradation of chernozems to be an interdisciplinary problem. The ecological, biospheric, agronomic, economic, legal, aesthetic, and moral aspects of this problem should be taken into account upon the development of soil conservation strategies and the corresponding laws. The organization of a soil conservation service is necessary.

The second part of the book is entitled “95 Years of My Life, Including 75 Years in Soil Science.” It is opened with an article “Our Patriarch” prepared by Corresponding Member of the Academy of Sciences of Moldova S.V. Andriesh and devoted to Krupenikov. Andriesh gives a general review of the scientific work performed by Krupenikov at the Dimo Institute of Soil Science and Agricultural Chemistry. Six major directions of Krupenikov’s studies are outlined: (1) the inventory and mapping of Moldavian soils, (2) the classification of Moldavian soils (in particular, Krupenikov

was the first to separate a specific subtype of chernozems under xerophytic forests), (3) the agropedological zoning of Moldova and the study of the major regularities of its soil geography, (4) the assessment of the soil quality (soil bonitation), (5) the comprehensive study of Moldavian chernozems with the determination of their statistically significant characteristics, and (6) the preparation and edition of the three-volume monograph *Pochvy Moldavii* (Soils of Moldavia) (1984–1986).

Beyond these works, Krupenikov is known throughout the world as the author of the first comprehensive monograph on the history of soil science published in 1981.

Andriesh pays tribute to Krupenikov as a popularizer of soil science and geography.

The second part of the book also includes two papers written by Krupenikov and devoted to V.V. Dokuchaev (“The Magic of the Name and Personality of V.V. Dokuchaev”) and N.A. Dimo (“N.A. Dimo: Natural Scientist, Philosopher, and Statesman”). It should be noted that Nikolai Aleksandrovich Dimo played a very important role in the life of Krupenikov; in 1958, being a director of the Institute of Soil Science

in Chisinau, Dimo invited Krupenikov to head the Department of Soil Science.

An autobiography of Krupenikov and a full list of his publications are included in the third part of the book. The autobiography is not just a record of Krupenikov’s life; in fact, it is a significant part of the history of our science. Krupenikov’s bibliography includes more than 600 titles, including 35 monographs. The first paper was published by Krupenikov in 1937. More than 50% of his works during the last 50 years have been devoted to chernozems.

A list of more than 40 publications (mainly, in various encyclopedias) devoted to Krupenikov as a botanist, soil scientist, and geographer is also included in the book.

In one of the digressions from the main subject of the book, Krupenikov poses the following question: “What was my life devoted to?” He gives a simple answer: “It was devoted to soils, mostly chernozems, and to soil science.” Seneca suggested that deeds are a better measure of a life than years. The book under review is, for certain, a great deed of a creative and devoted person.