GLOBAL NEEDS FOR LAND RECLAMATION

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1. Introduction - why the necessity of land reclamation arises

It is well-known, that the ancestors of modern agricultural crops were formed in such a way that conditions in the sites of their origin became ecologically optimum for given species. The person, cultivating wild plants by artificial selection, has raised their efficiency, but at the same time an external conditions changing stability which was peculiar to given species has been partly lost.

Using selection, the person has selected and has reproduced an extremely productive plants which 50 - 100 times exceeded productivity of their far ancestors. But under a high productivity a self-regulation (adaptation) opportunity of plant are essentially (3-5 times) reduced. A size of crop begin to depend essentially upon factors, which are small on their absolute magnitude (microcells, microdozes of toxic gases etc.) but which become limiting under an optimum level of the other factors.

Besides, during its migration from one area in another the mankind transferred plants to areas with very different environment which were not optimum for the given species any more, therefore at early stages of its development the mankind should resort to radical improvement of environment conditions, i.e. to meliorations.

A necessity of radical improvement of environment conditions arises in several cases: 1. If the highly productive agricultural crop is cultivated which was obtained by selection from a plant originated in given native-climatic conditions. 2. If the plants are cultivated under conditions, which are not really optimum for them, for example, on soils which properties are far from those in an area of the origin of these plants.

Thus, the contradiction between requirements of plants and conditions of an environment has served as driving force of development of land reclamation. Further at the big scales

of influences, contradictions have arisen between natural biological systems (soil biota and water objects) and conditions of environment changed by a man.

The result is that since the certain level, an essential increase of crops may be received only if all factors influencing growth and development of plants are regulated. Thus, the contradiction between desire of man to receive a high productivity of plants and impossibility to do it without exact regulation of set of factors of an environment has resulted in melioration appearance.(see The Necessity for Development of Land Reclamation)

Necessity of radical improvement of properties of grounds and conditions of an environment arises not only at agricultural activity, and for other grounds. According to it there are various kinds of melioration: 1. Land reclamation of agricultural purpose; 2. Land reclamation of settlements; 3. Melioration of grounds, occupied with the industry, transport, communications, defense; 4. Land reclamation of wood fund (but not wood melioration); 5. Land reclamation of water fund (for example, preparation of reservoir floor); 6. Land reclamation of historical-cultural, sanitary and recreational purposes.

Land reclamation of the agricultural grounds is subdivided into kinds according to the adjustable factor. Therefore professor B. S. Maslov offers to distinguish: 1. *Water melioration of soils* (hydromelioration) regulating amount of moisture in soil by an irrigation or drainage, agrowoodmelioration (creation of forest belts for detention of moisture and reduction of evaporation), agromelioration actions (plowing, harrowing, mulching etc.) . 2. *Chemical (food) land reclamations* – i.e. a regulation of amount of chemical substances: application of fertilizers, desalination of siols, change of reaction of soil solutions (for sour soils - liming, for solonetzes - plastering). 3. *Thermal land reclamations* - i.e. a regulation of amount of heat in soil: cooling humidifying, frost control, direct heating (for example, using a heat from thermal power stations), changing of thermophysical properties of soil: change of reflecting ability of soil (albedo) by means of mulching; changing of thermal capacity and heat conductivity of soils (changing of structure of a firm phase - density, friability), addition of sand, for example, (the ground becomes more friable in this case and faster dries up), addition of organic substance in order to increase a moisture capacity; deep loosening. Creation of an artificial relief results in changing of physical properties: porosity, density, water- and air permeability.

The best effect is achieved by using a complex land reclamations, i.e. a joint application of several kinds of land reclamation on the same site of the grounds.

In connection varying of plant requirements in the various periods of their development, a necessity of providing in each territory a required *meliorative mode* (i.e. change of the basic conditions of an environment depending on time) arises. According to definition of professor A. I. Golovanov a meliorative mode (i.e. a set of requirements applying to the controlled factors of soil formation and development of plants) provides an overall objective of land reclamation of the agricultural grounds (see Hindrances and Restrictions to Farming). The basic parameters of a meliorative mode: 1. Permissible limits of soil humidity in a root-inhabited layer; 2. Permissible limits of depths of subsoil waters; 3. A permissible direction and size of water exchange between the soil layer, spreading ground and subsoil waters; 4. Permissible limits of contents of toxic salts, pH; 5. Permissible

balance of humus and nutrients; 6. A permissible mineralization of irrigation waters; 7. Permissible limits of amount and quality of waste waters from meliorative systems.

It follows from the definition of land reclamation which has been given by the founder of the Russian meliorative science professor A. N. Kostjakov, that primary goal of agriculture and land reclamation is management of a water cycle and cindery nutritious elements with a view of progressive increase of soil fertility. Management of these processes is carried out by shifting a water and cindery elements from geological circulation into a biological one. It allows to prove their connection with circulation of energy because a transference of the cindery elements into biological circulation becomes possible after having accumulated them in a biomass, and it, in turn, can be made only under an influence of a solar energy. A.N.Kostjakov considered it possible to carry out such a management by complex melioration, i.e. the hydraulic engineering and agrotechnical influences regulating water, air, thermal, food and consequently a biological mode of soil.

Professor V.V. Shabanov offers to consider a complex land reclamations as a science about radical improvement (optimization) of all vital for plant factors of an environment. Technically complex land reclamation is a system of the procedures allowing essentially to increase a productivity of plants by means of influence on the factors of an environment which are basic for its growth and development. Thus an obligatory condition of a consequence complex land reclamations should be a progressing increase of fertility of soils and prevention of negative influence on associates biogeocenoses. Thus, the systems of complex meliorative regulation are a dialectically caused product of interaction of man and environment, produced during the long attempts of man to increase the productivity of natural biogeocenoses.

Last time, land reclamation becomes necessary for the grounds which are liable to ecological accidents and disasters, where the steady natural landscapes are destroyed. In this case there is a progressing loss of fertility of grounds, that is fraught with serious social - ecological consequences for life of many countries.

Besides each country is liable to periodic changes of climate which may last for some years. It may result in essential changes of structure of natural biogeocenoses, changes of landscape and social instability. Methods of complex meliorative regulation may be also used for stabilization of natural ecosystems.

Having considered the positive features of land reclamation, it is necessary to note also its negative features. Only a few of systems "are authorized" to make the basic changes of an environment. The necessity of procedures which change the nature, especially in the sphere of production of agricultural products, is fixed in our mind for a long time and it is promoted the formation of positive public opinion. There is no need to explain people that lives in deserts or in areas which are liable to often droughts, that an irrigation is a good thing, as it is not necessary to explain a benefits of the drainage to the people that lives in marshlands.

On the one hand there are growing requirements of preservation and non-interference into nature, on the other hand - there are resolute requirements to provide an acceptable

quality of life in a society, and this will inevitably result in the further intensification of all spheres of production including agricultural melioration. Now there is no alternative for the land reclamation of agricultural grounds (in the broad sense of melioration).

The quality of an environment at all stages of person development occupied a special position. In the majority of areas an environment does not correspond to human biological features and historical generated requirements for conditions, comfort and convenience of life and labour. Transformation of a nature, an aspiration to arrange a nature, to bring it into accordance with the usual centuries representations concerning a quality of life and requirements to the vital space, unlimited use of natural resources were and unfortunately remain a dominant direction of activity of the person who have developed the appropriate systems of activity and have created a necessary sections of fundamental and applied knowledge.

Since agriculture became cultural, it is necessary to remember constantly that agricultural crops may not live in any given conditions. In that case they either do not grow absolutely, or are unproductive. Precisely it is required to fix that fact that soil of an arable land and other agricultural grounds are not those soils which were formed evolutionally. There is no matter that many soils are already degraded or may degrade. The matter is that without cultivation the grounds could not have a necessary level of fertility at all.

They should be constantly improved, meliorated, and thus there are no basic differences between agroprocedures and engineering meliorations. If we want to receive an acceptable level of a crop then in any case it is achieved through technologies. The greater crop is required, the more intensive technology should be used and more precise an accuracy of necessary batching of providing of anthropogenous resources mast be. It is also actual from the other points of view: in practice an anthropogenous substances (fertilizers, chemical weed-killer and returnable water) frequently pollute the rivers, reservoirs, subsoil waters, and natural fertility of soils is spent irrevocable.

With engineering melioration or without them – an agriculture carries out the largest of all kinds of activity intrusion into biosphere, but there is no any alternative to agriculture. Therefore its rationality is also the basic ecological requirement.

The agricultural activity and also the meliorative one, which is closely connected to it should be carried out in conditions of the constant control and the responsibility. It is impossible to plan a development of an agricultural production in such conditions without an estimation of possible ecological consequences of all technological actions and receptions.

Undoubtedly, that now it is necessary to introduce widely the methods of complex melioration, which allow to raise crops essentially, to optimize an irrigation modes with a view of economy of water resources, to take into account cost of water and to make a choice of the best variant on this basis. In each project a natural necessity of land reclamation and its economic and social efficiency should be proved, and the ecological admissibility of realization of one or another kind of meliorative works should be estimated.

Technically a complex land reclamation is a combination of "dry" (agrowoodmelioration) and "water" (hydraulic engineering) land reclamation. Such combination should be especially varied for each region, area or field.

It allows satisfy not only the requirements of plants, but also the requirements of soil biota i.e. to realize the certain meliorative mode which is a set of requirements to adjustable factors of soil formation provided a radical improvement and the further increasing of soil fertility, and getting the given crop of agricultural crops under the certain economic restrictions.

Thus, land reclamations is carried out for the various purposes and the set of meliorative regulation types is various in every natural-climatic area.

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World Water Balance and Water Resources of the Earth, UNESCO, 1978 English version, page 598 *[The data concerning a development of irrigation in various continents are presented in this article. It is ascertained, that an irrigation is distributed in areas with rather damp climate. It is proved, that on drying systems an irrigation is also necessary. It enables a further opportunity to convert them into a systems of complex meliorative regulation.]*.

Biographical Sketch

Shabanov, Vitaliy Vladimirovich, Doctor of Technical Sciences, Professor of the Moscow State University of Environmental Engineering, Academician of the Russian Academy of Agricultural Sciences V.V. Shabanov was born on June 27, 1937, in Moscow, into the family of hydrologist. In 1964, he graduated from the Engineering Department of the All-Union Institute of Extension Education in Agriculture; in 1991, he took the retraining course in Ecology at Moscow State University and got the

diploma of Expert in Ecology

His scientific career started in the Yakutian Expedition of the Research Center of Moscow Institute of Hydraulic Engineering and Water Management, where he worked as a laboratory assistant and then junior researcher from 1956 to 1966. In 1966, he headed the works on the creation and maintenance of the automated system of water regulation on reclaimed lands in Byelorussia. From 1972 to 1987, he was the Head of the Laboratory of the Problems of Regulation of Water, Temperature, and Salt Regimes of Reclaimed Lands; since 1987, he has been a scientific supervisor of this laboratory. From 1981 to 1995, he headed the Chair of Multiple Use and Management of Water Resources. Since 1995, he has been a professor of the Chair of Amelioration and Rehabilitation of Lands of the Moscow State University of Environmental Engineering.

In 1969, V.V. Shabanov defended his Candidate Sci. dissertation on the feasibility of land reclamation measures; his Doctoral dissertation (1992) was devoted to quantitative methods of assessing and regulating the factors controlling crop development under conditions of reclaimed lands.

Scientific interests of Prof. Shabanov are connected with mathematical modeling of economic efficiency and environmental security of land reclamation projects, including the models describing the interaction between plants and environmental factors and the optimization of the use of water resources upon irrigation. His recent works were aimed at assessing changes in potential crop yields under various climatic scenarios and developing the methodology for monetary evaluation of environmental factors for land reclamation projects and optimization of investments.

Professor Shabanov is the author of more than 150 scientific works, including two monographs: "Bioclimatic Factors and Land Reclamation" (Leningrad: Gidrometeoizdat, 1973) and "Water Supply of Spring Wheat and Its Calculation" (Leningrad: Gidrometeoizdat, 1981). He is a co-author of two textbooks on the multiple use of water resources and related issues of environmental protection.

V.V. Shabanov has contributed four articles for the Encyclopedia of Life Support Systems.