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Protection and reproduction of resource potential of soils in conditions of climate fluctuations

The purpose. To assess influence of climatic factors on the state of soils and to develop directions on protection and reproduction of their resource potential. **Methods**. Analysis, synthesis, system, statistical, and monitoring researches. **Results**. Influence of climate fluctuations upon evolution of edaphic processes and regimes is shown. It is proved that irrigation is one of the major factors of adaptation of agrarian complex to global climate fluctuations. **Conclusions.** To ensure stable control over edaphic resources it is necessary to create efficient system of monitoring, as well as soil-and-information centre as a constituent of global information net.

Key words: soil, climate, degradation, resource potential, information centre.

The problem setting. To-date, increase in anthropogenic loading-pressure on soil; disbalanced land-use policies; spread-out of soil-degraded land-areas, and worldwide climate aridization taken altogether, make up the realm of sustainable soil management as a first-priority field of activities for protection and rational use of soi-resources, stop-degradation movement and achievement of land-degradation neutrality [1].

Factors of soil-protection and agro-land potential- restoration must be considered as very important objects of governmental policy, because they reveal vast resources for increase of agro-industrial produce-output, and contribute to solution of food security problems in Ukraine, alongside preservation and rejuvenation of natural biodiversity reserve.

One of these tasks is to provide pre-conditions for well-balanced genesis of natural soil cover, while suspending negative processes that take place across fertile land-sites of Ukraine. In order to (i) ensure a harmonious equilibrium between [anthropogenic soil-loading pressure] and [natural soil potential], and

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thus to (ii) rejuvenate and maintain all-round productive and ecologically friendly functioning of soils, a new form of sustainable (i.e. soil-saving) land-management strategy is required [2].

A successful use of soils' potential is nowadays retarded by the global climate change and relevant processes of water regime- aridization and deterioration that lead to disbalance among major nutrient matter-substances in soil, thus reducing their mobility and accessibility to crop- plants [3, 4].

The nutritional regime management should be aimed at enhansing the soil-fertility and re-establishing a stable balance between rates of nutrients' intake and removal from soil, that would contribute to strength of agrocenoses-resistance against unfavorable conditions. Such an oblique influence by climatic factors on soil- fertility state is a threat to future prospects of food supply-provision to planet Earth inhabitants.

The climate change induces a multi-faceted impact on all components of natural and man-shaped landscapes. Climatic conditions impose both direct and oblique effects on soil-biota livelihood and soil- formation processes.

At the same time, temperature and humidity rates are also important factors for environmental conditions that regulate character of soil- biological processes.

Hence, it is extremely important to determine [space ↔ time] patterns of soil evolution, and elaborate theoretico-practical pre-conditions for (i) success in confrontation against potentially negative climate-change effects, (ii) enviro-climatic adaptation of agro-industrial sector to natural and climate-dependent conditions, and (iii) restoration of the soil-resource potential.

Purpose of research: to assess an impact of climatic factors on state of soils and to verbalize guidelines for protection and restoration of the soil-resource potential.

Research methodologies: a set of upgraded analytic, synthetic, systemic, statistical, monitoring & research- methods and techniques.

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Research results expected: since the agricultural potential of arable soils enables normally harvesting 40 to 45 mio. tons/ ha grain a year (owing to natural soil-fertility), the expected research-results promise future yield-prospects of 70 to 80 mio. tons at the expense of resource and supply-provisions (such as fertilizer inputs, land irrigation, chemical soil-melioration and other relevant techniques).

Sussessful realization of soil-cover potential is hampered by: (i) moisture deficiency (up to 70 - 80% across the total territory), (ii) imbalance of soil-supply with nutrient inputs, (iii) wrong choice of plant-sorts/ species for crop-rotations, (iv) ineffective methods of land- use, alongside (v) dehumidification, physical soil-degradation and other negative events.

Rational use of Ukrainian soil resources is only possible under conditions that their quality-factor is considered in view of soil-genesis, particles' size composition, moisture-supply percentage, and presence/ absence of agronomically unfavorable soil-properties.

In Ukraine, the climate change is (i) characterized by accelerated rates of average per-annum air-temperature elevation (plus 0.4°C in 10 years as compared to that around the globe), and (ii) accompanied by decrease in number and amount of atmospheric precipitations (resulting in activized climate- aridization in factually all parts of Ukraine), alongside the onset of vast desertification processes across the Ukrainian Steppe zone.

The climate-aridization factor threatens to (i) weaken the soil-humification processes; (ii) accelerate the soil-salinization activity; (iii) reduce the total acreage of meadow-chernozem and meadow soil-areas, and (iv) aggravate the problems of moisture-supply availability to crop-plants.

In general, one can expect significant changes in bio-climatic status of our environment and indices of soil-yielding productivity. Due to [5] estimates, temperature- rise from only 1°C to maximum envisaged climate-warming rate

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can widespread the latitudinal boundaries of isothermal zones by 160 to 350-400 km off, respectively.

As a result of the climate change, the total areal of dry and very dry subzones of Ukrainian agro-lands has increased by 7%, and to-date, the aridization phenomena have already spread out across 29.5% of entire Ukraine's terrain (i.e., 11.6 mio. ha (or 37%) of arable lands nationwide).

Provided if a transition to renovated soil-irrigation policies is realized, and areal of irrigated soil- sites is expanded, the main future concern should be laid on (i) minimization of land-ameliorative burden on soil (via rationally thought-of water-consumption normatives) and (ii) re-targeting the agricultural strategies towards adaptive landscape-supporting ecologically friendly systems.

The would-be policies of rejuvenation and management of Ukrainian irrigated soils should be based on several convincing assumptions, such as:

- efforts to renovate the past-time technological land-irrigation model are nowadays not only an outdated and unsuccessful attempt, but also reflect economically back-stopping and environmentally-harmful threats;
- core of innovative solutions is in determining the place, role and prospects of land irrigation re-development in terms of present-day agricultural soil-management systems and food security guaranties;
- tactics of land irrigation should be considered as a complex system of interconnected unified methods of soil fertility management, agro-technological procedures and activities;
- availability of high-quality, trustworthy, reliable and complete normative-methodological and mapping-informative databases being constantly updated;
- main objects of land irrigation strategy are soils and the soil-cover. If land-irrigation methods and modes are incongruent with soil properties and regimes, such land-irrigation policy is ineffective or even harmful to the environment, as evidenced by numerous examples cited.

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In this manner, ameliorative agriculture in Ukraine is a main factor of: (i) adaptation of national economy agrarian sector to global climate-changes, (ii) ensuring high-efficiency agro-economic prospects under unfriendly climatic/ weather conditions, (iii) promoting the Ukraine into a stable and competitive agro-/ food-producer in the world market arena, and (iv) upgrading socio-economic and environmental standards for rural population lifestyle and rural areas proliferation [6].

The problem of climate change and its impact on development of agro-industrial economy and food security- prospects is today one of central issues among the 21st century global long-term challenges, including the international Agenda priorities.

The United Nations Food and Agricultural Organization (FAO) aids all the climate change-affected countries in mitigating relevant negative effects and adapting to their consequences through a number of projects and programs in areas of: (i) analysis, simulation and mapping the climate change impacts' consequences; (ii) assessment of agricultural sustainability against negative changes; (iii) integration of agro-production-branch strategies into national adaptation plans via appropriate food security programs, and (iv) adaptation of soil-irrigation policies to climate-change phenomena [7].

A prosperity-promising idea is to implement agricultural "climate-optimized" approaches (based on acknowledging the close relationship between the sustainable agriculture and strategies aimed at promotion of rational resources' management and soil-conservation), alongside restoration of biodiversity and natural resources as well.

On December 5 every year, globally, all the soil-devoted communities celebrate the World Soil Day event, whose main purpose is to highlight the outstanding importance of soils to ensure the food-safety, healthy ecosystems and people's well-being lifestyle worldwide.

In 2017, the global Soil Day event's attention was focused on topical issues related to negative soil-degradation and soil- contamination phenomena.

A considerable part was dedicated to the role of soil-organic carbon in

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mitigating the climate change after-effects.

The Inter-Governmental Technical Group for Soils (ITPS) planned to launch the Global Map of Soil-Organic Carbon (GSOCmap), the world's first carbon-devoted map, elaborated with a comprehensive approach based on broad public activities and national contributions from FAO-member countries.

In Ukraine, a National Digital Map of Soil-Carbon Resources (within 0-30 cm-deep strata) is being prepared to eventually become an integral part of a relevant Global Map.

To ensure the sustainable management of soil resources, the first-priority action is to create an effective system for monitoring and restoration of soils' fertility.

At the Fifth Plenary Assembly of the Global Soil Partnership, FAO- 2017), a new International Initiative - the creation of a Global Soil Information System (GSIS) was approved.

The National Scientific Center ISSAR is a Member-Representative of Ukraine in the GSPPA- Program.

To-date, the work has been started on establishing a Soil- Information Hub aground the National Scientific Center ISSAR, as an integral part of the Global Soil-Information Network, intended to provide:

- the governmental/ state-power bodies with information on soil resources in order to set forth well-balanced land policies and civilized land- marketable relations;
- the Ukraine's welcome-invitation to the Global Soil-Information System;
- the Local Self-Governed Bodies with information on procedures of Regional Development Programs;
- the land- management, relevant profile R&D institutes and control bodies with information on soil resources, forms of productive soil-use and level of soil-quality judgement;
- the project-investors, business structures and stakeholders with qualitative information on the investment attractiveness of a given territory, and/ or the

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land (soils) feasibility to crop-plants cultivation.

In general, the ongoing establishment of the Soil Information Center will become a soild pre-condition for: (i) sustainable management of Ukrainian soil resources, (ii) optimization and provision of information (on quality of soils) to all sectors of soil-communities) and (iii) contribution to sustainable development of Ukraine under uneasy climate change conditions.

Conclusions

Due to the vulnerability of Ukraine's soil resource assets to climate change, it is necessary to adapt the agricultural soil-management system to arid-climate conditions.

Major guidelines of Ukrainian agro-production industry adaptation of are aimed at deepening the agricultural specializations in close wiew of soil-ecological conditions of agro-crop-plants' disposition; the cultivation of drought-resistant hybrids and varieties; governing the plants' transpiration via optimal choice of fertilization methods; fighting against non-nproductive soil-moisture losses by aid of innovative soil- tillage systems, mulching technologies, development of land-irrigation techniques etc.

One of the most cardinal tools of increasing the water-supply availability is a soil-devoted land- irrigation policy, which requires development of climate-adaptive and ecologically safe (i.e, compensatory) agro-landscape systems to be maximally tuned to specific features of natural landscapes, and eco- reclamation status of agro-lands under irrigation.

Application of the entire complex of measures to improve the soil-water regime, alongside the preservation of soil-moisture reserves shall minimize the heavy burden of climate drought on status of agricultural landscapes, and ensure rich yields of agricultural crops' produce.

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