

Commercialization of innovative technologies in agro-ecology: Problems and solutions

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Efficient use of natural resources of the Republic of Kazakhstan is impossible without economic optimization and stabilization of agro ecosystems at the present stage of development of agriculture. Sustainable agricultural production is highly dependent on the rational use of land and soil fertility status, which are associated with the function of maintaining life of plant organisms. The ever-increasing burden on the environment highlights the organization management and protection of land in a number of strategic priorities of agriculture.

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Kazakhstan is situated on both continents, Europe and Asia, and occupies an area of 2724.9 square kilometers. More than a quarter of the territory of the country is steppe, while deserts and semi-deserts constitute half, and the remaining quarter is occupied by mountains, the sea, lakes, and rivers. There are forests and plantations located on nearly 22 million hectares in Kazakhstan, as well as 11 thousand rivers, more than 7 thousand lakes and reservoirs; vegetable fund exceeds 6000 species, diverse wildlife. The terrain spreads from the vast lowlands, located below sea level, till the highest mountain ranges up to 5000 meters.

There are a lot of climatic zones in the country: steppe, semi-desert, desert, foothills, and mountainous areas due to the geographical location of the country. This has influenced the formation of soil and soil types, from the black soil to the sand, and their distribution on the whole area. 81% of the total area of 272,5 million hectares is used as agricultural land (Table 1).

TABLE 1. NATURAL AND ECONOMIC AREAS OF THE LAND OF KAZAKHSTAN, THOUSANDS OF HECTARES (ACCORDING TO THE AGENCY OF LAND RESOURCES OF REPUBLIC OF KAZAKHSTAN)

№	Natural area	Type of soil	Total amount	For agrarian use
1	Forest-steppe	Black soil	758.2	506.2
2	Steppe	Black soil, South black soil	26448.0	23514.7
3	Arid steppe	Chestnut soil, Dark chestnut soil	62386.6	55539.6
4	Semi-desert	Light chestnut soil	37258.6	33851.6
5	Desert	Brown soil, taky soil, sand	112152.3	83601.3
6	Foothill desert and steppe, desert, mountain areas	Grey-brownish soil, Dark chestnut soil, Mountain soils	33486.0	25571.3
7	Total		272490.2	222584.6

As it is known, the dominant sector of the economy of the country is agriculture. The climatic conditions are favorable for the cultivation of crops in the north and the region is the main area where spring wheat, oats, and barley are traditionally

cultivated. Kazakhstan is in the third place in the CIS after Russia and Ukraine on grain production. Eastern Region is focused on the cultivation of a number of commercial crops like sunflower, flax and others. Desert and semi-desert areas are widely used in central and south-western parts of Kazakhstan as seasonal pastures for cattle.

Cotton, sugar beets, yellow tobacco, and rice give high crops in the southern foothills and river valleys with a lot of heat and irrigation. There are a lot of fruit orchards and vineyards in that area.

The country has traditionally been engaged in sheep, horse, camel, cattle breeding. As summer pastures meadows are used in the east and south-east of the country.

As the intensification of agricultural production creates opportunities for positive human impact on soil properties, crop yields and product quality is controlled. Along with this, an increase in anthropogenic pressure on agro ecosystems leads to undesirable consequences in the environment.

Considerable manifestation of ecological trouble in the agro-industrial complex is related to the predominance of extensive farming. Degradation of ecosystems and their components is influenced by a number of natural and anthropogenic factors, the cumulative effect of which stimulates the development of various negative processes. Kazakhstan is the agro-oriented country. More than 20 million hectares of the land is in agricultural use. This area has decreased to 15 million hectares in comparison with the last decade.

Among the reasons contributing to the alienation of land from agricultural use are:

- Anthropogenic contamination of areas adjacent to industrial fabrics, oil, and gas production and processing industry, nonferrous metals, and ferrous metallurgy, etc.;
- The development of processes of water and wind erosion;
- Salinity, desertification, soil dehumidification;
- The impact of chemicals and agricultural loads;
- The prevalence of extensive farming and inadequate use of fertilizers, and others.

For example, extensive and continued use of agricultural land in violation to the basic law led to the fact of low level of humus and plant, available forms of nutrients. Thus, the humus content has decreased by 22-25% in the most fertile soil of the country (black soils), by 14% in chestnut soil, and by 30 % in the gray soil for the last 60 years, according to the Kazakh Research Institute of Soil Science and Agricultural Chemistry named after Uschanov U. Overall, the share of soil with low humus level increased by 6.8%, with an average content from 40.5 to 34.0% within 22 years only.

Local scientists do conduct research projects and develop innovative technologies in agro-ecology to solve the problems of ensuring the well-being of agro-ecological soil and agro-ecosystems in general, such as:

- application of innovative technologies of natural sorbents (like a chemically neutral zeolites schungites etc.), that could reduce the load on the soil and flow of toxic substances in plant production;
- technology of application of chemicals, local fertilizers, natural minerals in contaminated soils (like a precision farming, introduction of chemicals for the period of organogenesis, fertilizer new generation nano-fertilizers etc.);
- activities, including innovative technology remediation and bioremediation of contaminated soils (microbiological methods, the use of by-products of oil and gas, phyto-reclamation etc.);

- high-tech energy saving technologies of cultivation of Agricultural crops agrophytocenosis;
- mechanisms of carbon sequestration in soils in order to optimize their humus condition;
- systems of agricultural machinery and implementation for tilling and natural grazing land contaminated with heavy metals, oils, and other radio nuclides, and
- contaminated crop processing technology, food products, meat, and milk production, to ensure the purity of normative food.

Thus, the list of new developments shows that the introduction of something new is always a step ahead and research efforts should be focused on finding ways to put these developments into production. Feature of the market is that without the technological development of an adequate response to the call is not possible. Therefore, the response of the developers of these projects, technologies, and products to market, which is realized in the form of an investment project should include using of new technologies. The investment project should include steps for implementation in this case, such as the preparation of techniques. Therefore, there is a problem of commercialization of scientific and technological activities, i.e. how to bring the results of relevant research and technical activities to the stage of the final product, capable of bringing entrepreneurial profit.

Mechanism of technology transfer can be carried out as follows:

1. Into the newly organized company such as a spin-out and joint venture or operating companies. A relatively short-term financial gain is expected in this case;
2. Into other research organizations for further research. An increase in research resources and a strategic advantage at a minimum financial return in the early stages are expected.

The complication of the transfer to existing companies is much higher than in all other cases.

Concerning the technology of commercialization in agro ecology, the potential developers of finished products may face a number of challenges. Among them are the following:

- scientific and technical. These are possible on early stages of the project when the principal feasibility of technology and general technical sufficiency of the basis for its implementation are being clarified;
- financial difficulties are associated with the possibility of violations to the planned financial flows (the level of economic stability in the country), so it needs to make assessment of the sustainability of financial flows to their indignation in the volume and time, and include measures to reduce them, such an insurance, involvement of the experienced professionals, obtaining government guarantees and tax exemptions;
- legal challenge is related to errors in the documentation of the activities, the presence of gaps in the law in relation to new activities in the field of intellectual property through business innovation;
- composition of developers, the quality of the group of performers, the feeling in some sense or other public recognition, level of qualification, the level of motivation;
- unfavorable reaction of the local authorities and people, the reluctance to break the stereotypes of their own behavior and actions;
- marketing issues are associated with the wrong strategy and technology implementation;

- differences in mentality and business traditions, necessity to use a large variety of systems and means of communication;
- low level of law culture;
- imperfect circuit of technology of commercialization, and
- initial stage of commercialization (presentation in exhibitions, newsletters, databases, specialized magazines, the Internet, search for investor, broker etc).

Thus, further research activities on scientific innovation should be undertaken in order to identify opportunities for successful commercialization and implementation of the Strategy of Industrial and Innovation Development of Kazakhstan.