Algorithm for the development of the Strategy for scientific and technological development of the crop sector of the Novosibirsk region

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Abstract. In modern conditions of a high level of uncertainty in the development of science, engineering and technology in economic sectors, it is necessary to learn how to manage this long-term process purposefully, which is possible through forecasting tools, for example, foresight methodology. This is especially true for agriculture, and in particular for the crop sector, where the level of uncertainty is much higher than in other sectors due to work with living organisms and the impact on the results of production of natural and climatic conditions. The consistent use of foresight tools made it possible to develop a Strategy for the scientific and technological development of the crop industry for the Novosibirsk region, the algorithm of which is presented in this article. The main feature of the Strategy will be the identification of promising areas of scientific and technological development depending on the natural and agricultural zoning of the region, which allows one to take into account the specifics of different regions of the Novosibirsk region to build a more accurate and high-quality forecast.

1. Introduction

The future is the answer to the challenges of the present. The construction of a strategy for the scientific and technological development of a particular sector of the economy is associated with a high level of uncertainty, which is due to the fact that over a long forecast period events of a climatic, economic, or political nature may occur that fundamentally change the situation in the industry. Such events are challenges for the region, the answers to which should be those areas of development of science, engineering and technology that will have a breakthrough impact on the economy of the crop sector.

Directing resources to overcome challenges in each of the zones will make it possible to reduce the level of differentiation of the region according to the conditions of agricultural production. The introduction of new technologies for the production of crop production in the economy, depending on the natural and agricultural zones where they are located, will make it possible to switch to an adaptive-intensive system for the production of crop production and put into practice the achievement of scientific and technological progress that contributes to the conservation of basic natural resources.
The purpose of this article is to create an algorithm for the development of a Strategy for the scientific and technological development of the crop sector in the Novosibirsk Region.

The object of study is the plant growing industry of the Novosibirsk region.

The subject of the study is an algorithm for the development of strategic documents in the crop industry.

The research methodology was based on general scientific methods of cognition, analysis and synthesis methods, abstract-logical and monographic methods, grouping method, and foresight methodology.

2. Natural and agricultural zoning of the Novosibirsk region

The Novosibirsk region is one of the largest regions of Western Siberia; agricultural land is located in three natural zones. In this regard, agriculture in the region is developed unevenly. In order to reduce the dependence of crop production on natural and climatic conditions, adaptation of production technologies to these conditions is necessary [1].

In accordance with the natural-agricultural zoning of Russia, the territory of the Novosibirsk region is represented by the following zones [2].

The West Siberian province of the southern taiga-forest Vasyugan agrolandscape region and includes the northern parts of Kyshtovsky, Northern, Kargatsky, Chulymsky, Ubinsky, Kolyvan administrative regions. The main agroecological groups of lands in this province are flat and waterlogged lands. The natural conditionality of the specialization of crop production for open-air lands is the production of green, succulent and roughage, brewing and feed barley, food grain of rye, oats and flax; for waterlogged lands - the production of green, succulent and roughage, mono-feed, as well as feed grain in more drained areas.

The central forest-steppe Barabá agrolandscape region includes Ust-Tarsky, the southern parts of Vengerovsky, Kuybyshevsky, Ubinsky, Kargatsky, Chulymsky, the north of Chanovsky, the east of Barbinsky, the north of Zdvinisky, Dovolensky, the southwest of the Kochenevsky administrative regions. The main agroecological groups of lands are low solonetzic (production of feed and food grains, green, succulent and roughage, field cabbage and cereal crops) and solonetzic (production of green and roughage).

The southern forest-steppe Barabinsky agrolandscape region includes the Tatarysk, Chanovsky, west Barabinsky and Zdvinisky, most of Krasnozersky, the north of Chistoozerny and Kupinsky administrative regions. The main agroecological groups of lands are small-solonetzic (production of feed and food grains, green, succulent and roughage, field cabbage crops) and solonetz (production of green and roughage).

The central forest-steppe Barabá agrolandscape region includes the Tatarysk, Chanovsky, west Barabinsky and Zdvinisky, most of Krasnozersky, the north of Chistoozerny and Kupinsky administrative regions. The main agroecological groups of lands are small-solonetzic (production of feed and food grains, green, succulent and roughage, field cabbage crops) and solonetz (production of green and roughage).

The North Predaltai province of the forest-steppe zone is represented by the north-forest-steppe (Kuznets-Prisalairsky, Berdsky, Kolyvano-Prisalairsky) and forest-steppe (Priobsky, Suzunsky) agrolandscape areas.

North-forest-steppe agrolandscape areas include the south of Kolyvan, Moshkovsky, Bolotinsky, Toguchinsky, Maslyaninsky, the east of Novosibirsk, Iskitimsky and Cherepanovsky administrative regions. The main agroecological groups of lands are flat (production of feed and food grains of wheat, rye, peas, oats; green, succulent and coarse fodder, field cabbage crops and flax), slightly erosive (the same as on flat lands), erosive, (production feed from perennial grasses of long-term use, interrupted for renewal of the grass stand by crops of cover crops or annual grasses) is highly erosive (tinning and organization of cultural hay-pasture rotations).

Forest-steppe Priobsky and Suzunsky agrolandscape areas include the east of Kochenevsky, the west of Novosibirsk, Iskitimsky and Cherepanovsky, Ordinsky, Suzunsky, administrative regions. The main agroecological groups of lands are flat (production of feed and food grains; green, succulent and roughage, field cabbage crops and soybeans), slightly erosive (the same as on flat lands plus oilseeds), erosive (production of feed from perennial grasses of long use interrupted for updating the stand by crops of cover crops or annual grasses), highly erosive (tinning and organization of cultivated hay-
pasture rotation) and low-saline lands (production of grain and food grains; green, juicy and roughage, oilseeds and soybeans).

The West Siberian (Kazakhstan) province of the steppe zone is represented by the north-steppe Prichano-Bagansky and Nizhnekarasuksky agrolandscape areas, including the southern parts of Chistoozerny and Kupinsky, Bagansky, Karasuksky, south-west of the Krasnozersky administrative regions. The main agroecological groups of lands are deflationally dangerous (production of feed and food grains; seed production of perennial and annual grasses; production of cereals and oilseeds; green, succulent and coarse fodder), strongly deflated dangerous (production of feed and food grains; cereals and oilseeds; green, succulent and roughage from perennial herbs), low solonetzic (production of feed and food grains; green, succulent and roughage; oilseeds), solonetzic land (fodder production using salt and salt-tolerant perennial grasses and grass mixtures) [3].

In our opinion, the Strategy of scientific and technological development of the crop industry should be based on the development of adequate answers to the challenges facing the industry of the region [4]. Table 1 presents agroecological (environmental problems arising from intensive agricultural production), agrobiological (biological problems (biological patterns) that affect crop production) and climatic (these are climate features that determine how agricultural production is conducted) challenges specific to each of the natural-agricultural regions of the Novosibirsk region. These challenges are fundamental in determining the directions of scientific and technological development of the crop industry [5].

Table 1. Agroecological challenges of the Novosibirsk region plant growing industry depending on natural and agricultural zoning.

| Zones                                      | Challenges                                                                                                                                                                                                 |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The West Siberian province of the southern taiga-forest zone | progressive degradation of hayfields and pastures with high potential productivity. The reason is the shortening of wet meadows and overgrowing of dry lands by the forest; depletion of forest resources leading to waterlogging of agricultural areas; lack of regulation of water flow through open channels; the lack of accelerated outflow of soil and groundwater by lowering the level of groundwater through drainage; complex hydrothermal conditions on the territory. |
| The North Predaltai province of the forest-steppe zone | severe degradation of the meadows of the river valley Karasuk, up to erosion on pastures and a decrease in productivity; in the river basin Suzun developed water erosion in the fields under the meadow and under arable land; tinned slope lands, organization of cultivated hayfields and pastures; the need to use hydraulic structures during land reclamation in the region; dissected terrain (many sloping lands). |
| The West Siberian province of the forest-steppe zone | degradation of meadows with high potential productivity; meadow plots are prone to overgrowing with small forests and shrubs; degradation of meadow saline soils under the influence of uncontrolled grazing (led to a decrease in productivity and stability of agrolandscapes); wind erosion on natural pastures due to plowing and load of cattle; irrational distribution of agricultural land associated with salinization of soils; rejection of deep soilless cultivation in the steam field of crop rotation; refusal to make lime-containing fertilizers on acidified soils; untidy forest shelterbelts; warehousing of household garbage (pollution of soil cover, groundwater); the need to use hydraulic structures during land reclamation in the region. |
| The West Siberian (Kazakhstan)              | wind erosion on manes, sometimes deflation reaches the bottom of dried lakes, transferring salt to the eastern part of the Baraba lowland;                                                                 |
3. The strategic planning algorithm
The definition of challenges for each natural-agricultural zone allows using foresight methods such as critical technologies, Delphi, and bibliometric and patent analysis to identify promising areas of scientific and technological development for the region’s crop production industry [6]. Figure 1 shows the entire algorithm of this process.

![Algorithm for the development of the Strategy for scientific and technological development of the crop sector of the Novosibirsk region.](image)

Critical technologies are a complex of intersectoral (interdisciplinary) technological solutions that create the prerequisites for the further development of various thematic technological areas, have a wide potential range of competitive innovative applications in the crop industry and make the largest
contribution to the implementation of priority areas for the development of science, technology and technology [7].

Critical technologies are answers to the challenges facing the region. The priority areas of science, technology and plant growing technologies should be formulated in the context of responses to the challenges facing the industry [8].

After critical technologies and promising areas of research and development are identified for each zone, it is necessary to build a forecast of the scientific and technological development of the industry based on three alternative scenarios [9]. In practice, the scenarios are realistic, optimistic and pessimistic in nature, which in this case is reflected in forecast indicators, areas of development of science, engineering and technology, and scenario conditions.

4. Conclusion

The need to develop a Strategy for the scientific and technological development of the crop sector for the Novosibirsk Region is determined by the possibility of concentrating the allocated resources on solving the main problems of crop production and providing the conditions for a technological breakthrough in the industry. Further visualization of the Strategy in the form of a roadmap allows you to determine the exact route to achieve the goals set by the authorities, research and educational institutions and agricultural producers. The development of alternative scenarios, which differ in both starting scenario conditions and final forecast indicators, makes it possible to reduce the level of uncertainty in the industry and provide for some of the most probable trajectories of its scientific and technological development.

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