

Innovational Mechanisms of Biotechnologies Support in Forest Sector for Providing Economic Security of the State

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Received: January 12, 2015 Accepted: February 3, 2015 Online Published: June 13, 2015

doi:10.5539/ass.v11n20p41

URL: <http://dx.doi.org/10.5539/ass.v11n20p41>

Abstract

In this article the mechanisms of biotechnologies support in the forest sector are viewed. Forest biotechnology has big perspectives in Russia, allowing fulfilling various socio-economic tasks – from creation of new medicinal drugs to new technologies of growing forests and improving the ecology of forest ecosystems.

It has been established that methods of innovational biotechnologies in forest-based sector are at the stage of scientific research of sectorial scientific and research organizations. In order to successfully implement biotechnologies in forestry, support and greater attention from the government are needed.

One of the mechanisms of supporting forest biotechnologies and innovational development of forest sector could be the creation of Technical research Center for development, scaling, and commercialization of biotechnologies. The place and role of the Center in regional forest cluster is established. A tool of creation of the Center should be a public private partnership which allows combining and harmonizing the interests of the government, scientific and business societies in the sphere of building of bioeconomics in the Russian Federation. The authors emphasize that these Centers of scaling would allow providing full-scale development of bioindustry in regions of Russia in all sectors of biotechnology.

Keywords: innovational technologies, biotechnologies, support mechanism, technical research center of biotechnologies scaling, public private partnership, economic security

1. Introduction

For innovational development of modern economy, three ways of development of technologies are crucial: informational technologies, nanotechnologies, and biotechnologies. Biotechnologies are rightly included into the priority sectors of economy development, for they cover almost all spheres of human life and activities and in certain events (lack of provision, environment pollution, depletion of mineral resources) support the national security of the country (Oloyede, 2008). Nowadays, biotechnology turns from the usual sector into the strategic development factor of economies of certain countries and world economy (Schulte-Bisping, 1999).

The share of the Russian Federation in the global amount of biotechnological production does not exceed 0.2 % (25 years ago - 5 %). For comparison: share of the USA is 42%, the European Union – 22%, China – 10%, India – 2%. (Figure 1). It's estimated that world market of biotechnological production will reach 2 trillion USD by 2025; growth rates for certain market segments vary from 5 - 7 to 30% annually (Berndes, 2003).

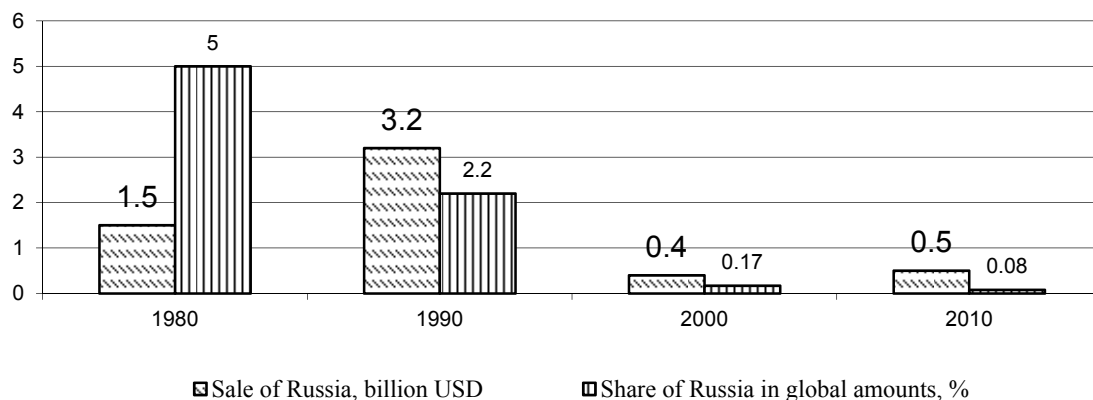


Figure 1. Share of Russia in global amounts of biotechnological production

Researchers of this problematics discern four groups: forest biotechnologies, management of forests, preservation and reproduction of forest genetic resources, and creation of biotechnological forms of trees with given features and biological means of forest protection (Kudryavtseva, 2014).

It is important to note that during the last years, within the forest sector, biotechnologies are used both for forests protection, and for creation of new forms of woody plants with given features, production of planting material, creation of plantation crops with short rotation, waste utilization, and for house-building.

Scientific literature fully proves the necessity of using biotechnologies in various spheres of economy (Belyakov, 2009). However, in practice there is a certain underestimation of the role and meaning of biotechnologies in forestry (Field, 2008). Investments in biotechnologies are not enough; in the structure of Russian venture capital market, biotechnologies occupy only 2% share. At the same time, the necessity for providing a stable functioning of national economy over long term, for creation of new kind of production, and for strengthening ecological frame of the territories creates conditions for development of biotechnological complex of the country. Moreover, beginning from 2012, there functions the Complex Program for Development of Biotechnologies the Russian Federation up to 2020 – Biotech 2020 and work plan “Development of biotechnologies and genetic engineering”, which proves the importance of creating innovational mechanisms for biotechnologies support in forest sector for providing national security of the country.

One of the tools of economy modernization, including the sphere of biotechnologies, is development of cluster infrastructure and creation on it basis of centers for biotechnologies scaling. It should be noted that about 10 clusters have formed in the sphere of biotechnologies (Cluster of pharmaceuticals, biotechnologies, and biomedicine (Kaluga oblast), Yaroslavl pharmaceutical cluster, Altai biopharmaceutical cluster, etc.). At the same time, the above clusters do not possess the centers for biotechnologies scaling (Popkova, 2013).

2. Materials and Methods

Within the research, a short analysis of the state of biotechnologies in forest sector is conducted, factors which are complicating the commercialization of innovational biotechnologies are shown, programs of biotechnologies support which are implemented by domestic development institutes are analyzed, and the mechanism for biotechnologies support in forestry is designed.

While conducting the research, a complex approach for research of biotechnologies in forestry was realized; the sources of information regarding the tools of support of biotechnologies in forest sector were regional informational resources, data of monitoring of printed and online business and specialized issues, analytical reviews, and materials of marketing and consulting companies for the period of 2009-2013.

The research assumes that mechanisms for biotechnologies support in forest sector are necessary, first, for improving environmental situation by means of increasing areas of good forest ranges, expansion of possibilities for using recreational function of forests, and, second, for using the “quick” forest technology in order to solve the problems of soil erosion and realization of development potential of cellulose and paper and furniture trade.

In order to determine the priority forms of support, it is necessary to study the demand for “green” biotechnology production and condition of forest science in whole which determines the creation and transfer of technological

solutions. For conducting of research, informational letters with questionnaires and offers for participating in the research were prepared and sent (including e-mails).

While conducting the research, the following methods of comparison, collation, polling, and examination were used:

- Polling of employees of leading institutions of forest science;
- Determining, systematizing, and establishing importance of factors which determine the creation, development, and scaling of biotechnologies in forest sector (giving priorities), and accommodation of the experts' opinions was performed on the basis of calculation of Kendall's coefficient of concordance;
- Desk study including analysis of current demand for production of biotechnologies in forest sector. During the desk studies, experience and forms of biotechnologies support were studied, and infrastructure of support at regional level was evaluated. Based on the comparative analysis, vectors of biotechnologies support in forestry were determined.

A significant part of the research results in the sphere of forest biotechnologies was often discussed at the conferences of various levels. The aim of the present research is not only to view and summarize the scientific results of research in the sphere of forest biotechnologies, but to find a possibility for their practical use, including scaling, in forest sector.

3. Results

At the present time, the condition of forest resources is considered to be unsatisfactory, which is caused by increase of anthropogenic load, expansion of agricultural activity, absence of appropriate mechanisms of fighting forest fires and forest diseases, and irrational timber harvesting. Balance of forest resources disposal and forest reproduction is shown by diagrams of Figure 2.

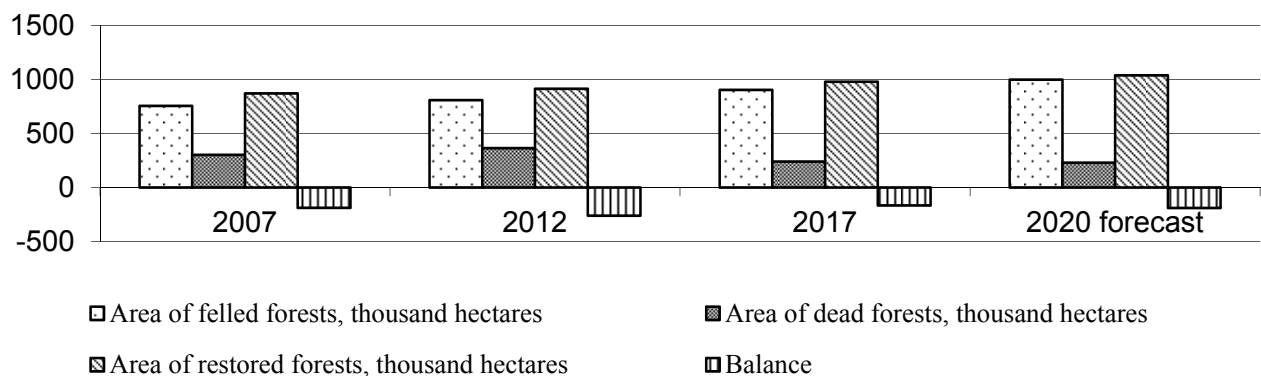


Figure 2. Dynamics of forest resources disposal and forest reproduction and their forecast

The reasons for unsatisfactory forest reproduction are related to, first of all, use of planting material of low quality and violation of technology of forest crops creation. Moreover, in the system of forestry management, forest reproduction is financed on leftovers; in 2008-2013, financing decreased more than twice, leaving 8,055 million rubles, while financing of forest crops creation does not exceed 20% of the above sum. Under limited financing, new technologies of forest reproduction are needed which allow reducing the gap of forest reproduction and timber consuming by means of transfer of forest plantations quickened growth technologies and use of biotechnologies (Morkovina, 2014). Biotechnologies are one of the main directions of innovational economics, together with nanotechnologies and informational technologies. Forest biotechnology possesses a lot of perspectives for development in Russia, allowing solving various socio-economic tasks, from creation of new medicinal drugs to new technologies of forest cultivation and improving ecology of forest ecosystems.

In Russia, in view of lag from the world level of innovational biotechnologies, the methods are still at the stage of scientific development of sectorial research organizations and first cases of practical application. Moreover, in view of existing contradiction, a disagreement of economic interests of the subjects in the sphere of natural

resource use is a serious threat to economic security. Most part of biotechnologies which are used in forestry has vegetative reproduction through tissue culture and use of molecular markers (Pullman, 1998).

Results of inquiry between famous scientist of technical research centers for forest sector allowed determining that the current system of scientific organizations of forestry includes five institutes for scientific research (Russian Research Institute for Silviculture and Mechanization of Forestry, Saint-Petersburg Research Institute for Forestry, Far Eastern Research Institute for Forestry, Northern Research Institute for Forestry, All-Russian Research Institute for forest Genetics, Selection, and Biotechnology), 4 forest experimental stations, and 4 specialized laboratories. The leading institutes on the sphere of forest biotechnologies are Saint-Petersburg Research Institute for Forestry (Saint-Petersburg) and All-Russian Research Institute for forest Genetics, Selection, and Biotechnology (Voronezh) (Morkovina, 2013). A certain experience in the sphere of forest biotechnologies is accumulated in the branch of the Institute of bioorganic chemistry of academics M.M. Shemyakin and Y.A. Ovchinnikov of Russian Academy of Science (Pushchino, Moscow oblast) and in the Institute of forest of Karelia scientific center of Russian Academy of Science (Petrozavodsk).

In these institutions, experience of molecular marking for evaluating genetic variety of forest vegetation is accumulated, banks *in vitro* for preserving forest genetic resources are created, there is an experimental database of perspective forms and hybrids, and genetically modified forms of woody plants with new featured for plantation growing are created.

In the current condition of complication of global situation and decrease of possibilities for transferring leading western technologies, the actuality of development of domestic scientific, technological, and production base of bioindustry rises substantially. This base should be able to provide ecological security of the country and production based on the principles of popular bioproducts for agriculture industry, ecology, etc.

However, there are serious barriers for the development of forest biotechnology. First, it is lack of modern legislation, standards and technical regulations, and ecological standards which hinders development of certain segments of biotechnology; lack of qualified staff and deficit of financing research and development, in particular sectoral science. At the same time, European experience proves that official donations are a main driver for domestic market development.

Most part of questioned employees of the leading institutions of forest science thinks that industrial implementation of innovational biotechnologies need financing at the domestic level.

It should be noted that Complex Program for Development of Biotechnologies the Russian Federation up to 2020, approved by order of Government of the Russian Federation dated April 24, 2012 № BII-II8-2322, and plan for biotechnologies development, approved by order of Government dated July 18, 2013 № 1247-p., in the sphere of forest biotechnologies there should be created a center for forest biotechnologies, network of DNA laboratories, and plantations of quick-growing forest on the area of 68 thousand hectares. We think that one of the mechanisms of supporting forest biotechnologies and innovational development of forest sector might be the creation of Technical research Center for development, scaling, and commercialization of biotechnologies within the regional forest cluster (Figure 3).

The aim of creating regional biotechnological cluster is acquisition of maximum amount of timber of good quality by the means of decreasing of time and expenses for productive crops – forest plantations.

It is known that plantation growing is oriented at the quickened production and involves high level of using selected planting material, intensive agricultural technology, silvicultural attendance and amelioration (Marris, 2009). With that, for establishing plantations, large amounts of plantation material of quick-growing woody plants are needed. Production of large amounts of planting material of quick-growing and economically valuable forms of woody plants is possible on the basis of clonal micropropagation in the Technical research Center. Thus, creation of the Center should be viewed as an effective tool for supporting biotechnologies in forest sector.

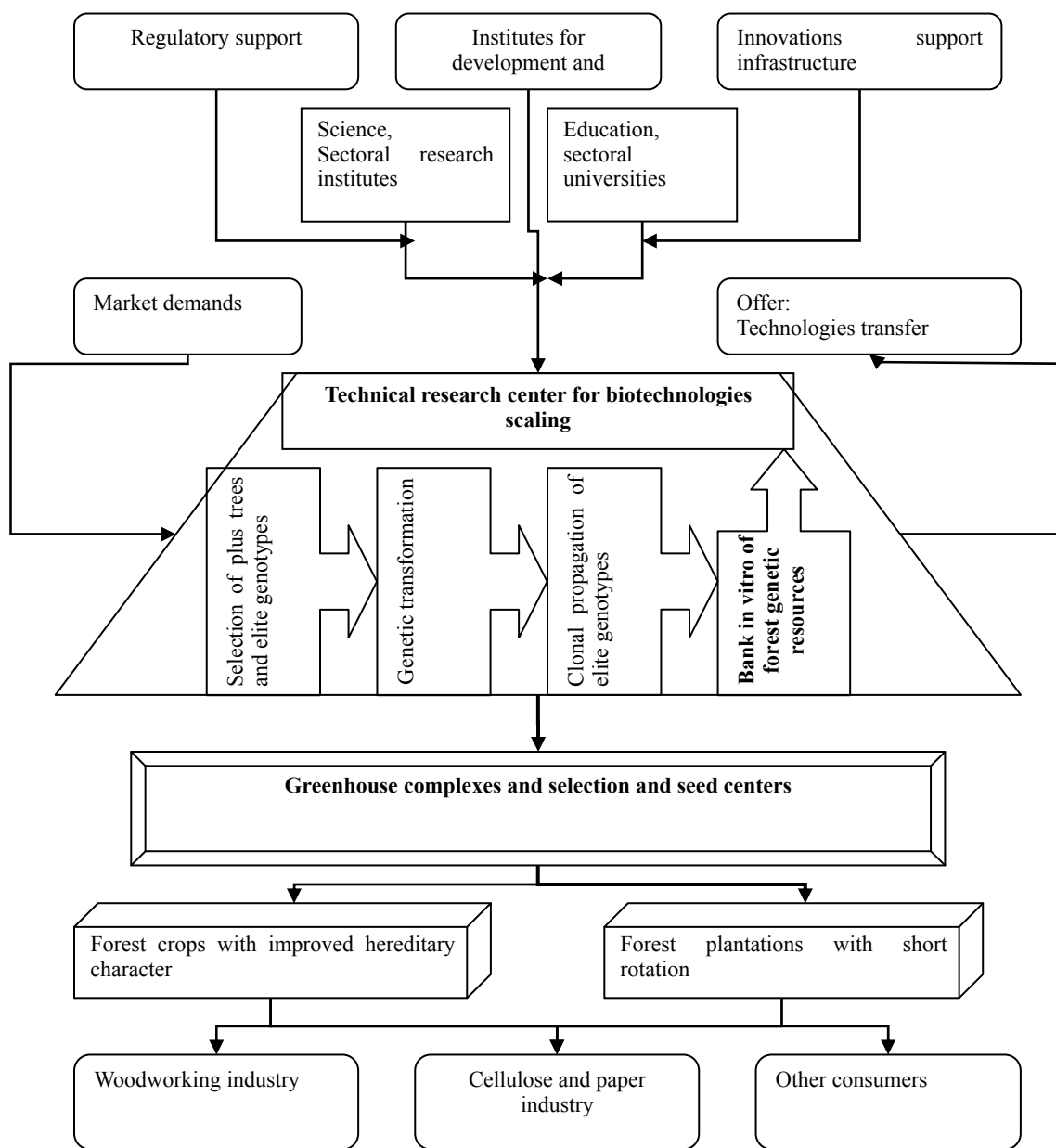


Figure 3. Role of technical research center for biotechnologies scaling in regional forest cluster

It should be noted that creation of the Center would allow solving the following tasks:

- creation of banks *in vitro* for preservation of forest genetic resources;
- development of biotechnological forms of forest crops with improved features;
- transfer of methods for molecular marking for evaluation of woody plants genetic variety, genetic certification of seeds, monitoring phytosanitary condition of forest gardens, controlling origin legality of timber, etc.
- providing production of planting material of quick-growing and economically valuable woody plants on the basis of clonal micropropagation for plantation forest growing.

Thus, the creation of centers for biotechnologies scaling in forest sector would favor implementation of new technologies for artificial forest reproduction which are better than traditional ones due to the quality of planting material.

It should be noted that the Center's functions might be substantially expanded by means of providing variety of services for forest business:

- engineer, research, and consultation services for development of technological processes, technological plans, and technologies for production equipment;
- expert evaluation of technological solutions;
- technological and ecological consulting and audit;
- providing services of prototyping;
- providing services of collective use of equipment;
- providing services of products and technologies development;
- providing services of research and development commercialization (promotion and implementation of new technologies at production facilities);
- services for solving issues of intellectual property;
- training for production facilities in the sphere of biotechnologies commercialization;

An instrument for creation of the Center might be a public private partnership, which would allow combining and harmonizing interests of government, scientific, and business societies in development of bioeconomics in the Russian Federation.

4. Discussion

At present time, forestry is on the threshold of huge changes, caused by development of biotechnologies. This applies to Russia and the whole world.

In practice of forest protection and forest crops creation, various biotechnologies groups are used in different countries (Yanchuk, 2001):

- creation and production of biological means of forest protection against infestants and pathogens;
- clonal micropropagation of plants (including somatic embryogeny) for quick propagation of selected achievements and production of planting material of high quality;
- methods of genetic transformation for creating new forms of woody plants with given character (USA and China are leaders in commercial use of these technologies);
- methods of molecular marking for increasing efficiency of selection genetic certification of seeds and plants, monitoring phytosanitary condition of planting material and forest gardens, controlling origin legality of timber, preservation of forest genetic resources.

In Russia, the priority in biotechnologies belongs to pharmaceutical and medical industry. At the same time, biotechnologies in forestry would guarantee a breakthrough in the issues of preserving biological variety and of reproduction of high-yield forest resources in short time and with minimal cost (Korchagin, 2014).

For creation of high-yield forest crops and innovational technologies, it's necessary to use planting material with enhanced hereditary character (Driesshe, 1976). Biotechnologies are used in forestry within modification of timber tissue, reduction and extraction of lignin (Carson, 2004).

Profits from biotechnology in forestry lie in economic advantage for the sector, including acquisition of "quick" timber with plantation growing, increase of production, lower prices for consumers, and growing modified trees for easier wood processing.

Advantages of biotechnologies from the point of view of ecology lie in preserving biological variety of forest trees and mitigation of global warming (Kirillov, 2012).

During the last years in Russia, a variety of tools for supporting biotechnologies development was used. For increasing efficiency of forestry, a mechanism for supporting forest biotechnologies should be developed; the mechanism should provide formation and realization of priority innovational and investment projects in biotechnologies, including their practical adaptation and scaling.

5. Conclusion

Over the last years, there is a growing interest of scientists, ecologists, and foresters for forest biotechnologies, considering the fact that forest ecosystems perform unique functions in providing ecologic, social, and economic goods and services. During the research, it is concluded that current system of supporting the sectoral

biotechnologies does not comply with the requirements of the time. There are no mechanisms of tax, tariff, and budgetary stimulation of the enterprises which develop and implement biotechnology. At the same time, North-west and Central Black Earth regions of the Russian Federation possess unique possibilities for development of biotechnological production in forest sector which would provide hundreds of work places and favor the development of the regions.

A basis of innovational mechanism of supporting biotechnologies in forest sector of these regions should be technical and research centers for biotechnologies scaling.

At the same time, development of biotechnologies and their commercialization in Russia are impossible without governmental support.

We think that, for providing economic security of the country in forest sector, it is necessary to:

First, improving legislation in the direction of helping implementation of biotechnologies and development of biotechnological production in forest sector;

Second, development of the plan of effective measures of governmental support of biotechnologies development in forest sector, which includes tax and financial bonuses;

- creation of technical and research centers for biotechnologies scaling as an effective mechanism of transfer and commercialization of the results of scientific research and development in forest sector.

Commercialization of forest biotechnologies is possible, on the basis of scaling centers:

- clonal micropropagation of valuable genotypes of woody plants;

- molecular marking for identification and genetic marking of forest genetic resources;

- biological means of forest protection;

- for forest pathology monitoring, monitoring of forest reproduction and control for turnover of round timber on the basis of molecular and genetic methods.

Technical and research centers for biotechnologies scaling which are created on the basis of public private partnership allow providing full-scale deployment of bioindustry in regions of Russia in all sectors of biotechnology and becoming an integrator of existing projects and programs and a self-developing mechanism of generation of new ideas, project offers, and investment (innovational) projects of various state of readiness.

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