SWOT analysis of ways to introduce innovations into agricultural production practices as a prerequisite for searching for promising areas in the field of agroforestry in the Russian Federation

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Abstract

This review aims to collect, analyse and systematize materials on ways to introduce innovations into agricultural production practices. Knowledge and understanding of the features of the mechanisms for introducing innovations allow us to evaluate agroforestry research in terms of its completeness. The basis of the research methodology is the methodological techniques of SWOT analysis. The result of the research is: the establishment of the main ways of introducing innovations into the practice of agricultural production; identifying the strengths and weaknesses inherent in these mechanisms; analysis of opportunities and threats associated with the implementation of innovations through these methods; assessment of the relationship between these tools. The main methods of promoting innovation in the field of agricultural production are: 1) the establishment of an advisory service, 2) the development and implementation of national and regional target programs, and 3) the creation and maintenance of an agroecological service. The identified ways of introducing innovation complement each other. Agroforestry research requires interdisciplinary research to integrate innovations in agroforestry development of territories into a broader agroecological context.

Keywords: method of introducing innovations, agricultural production, sustainable agricultural landscapes, advisory service, regional and national target programs, agroecological service, agroforestry

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Introduction

Agricultural production is the basis for ensuring food security of states (Zhuchenko, A.A. 2004; Dubinok, N.N. 2014; Ponisio, L.C. and Ehrlich, P.R. 2016; UNCTAD, 2017).

A threat to ensuring the production of agricultural products in the required volumes and required quality is negative environmental changes resulting from the irrational organization of the production process and climate change (Khitrov, N.B. *et al.* 2007; Challinor, A. *et al.* 2014; Lal, R. 2015; Kiss, M. 2019; Chaudhuri, S. *et al.* 2023). The most obvious of these changes in the natural environment is the loss of soil fertility (Oldeman, L.R. 1991; Pimentel, D. *et al.* 1993; Foley, J.A. *et al.* 2005; Imeson, A. 2012; Borrelli, P. *et al.* 2017; Cherlet, M. *et al.* 2018; Kertész, Á. and Křeček, J. 2019; Kulik, K.N. *et al.* 2023).

Agroforestry is one of the main types of reclamation. Due to the reclamation effect of woody plants, better conditions are created for the accumulation of humus and the supply of nutrients to plants (Abakumova, L.I. 2004, 2006; Barrios, E. *et al.* 2012; Kulik, K.N. and Pugacheva, A.M. 2016; Dollinger, J. and Jose, S. 2018; Marsden, C. *et al.* 2020; Ngaba, M.J.Y. *et al.* 2024). Important distinguishing features of this type of reclamation are the complex impact on land reclamation objects (Huang, W. *et al.* 1997; Kulik, K.N. *et al.* 2012;

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Trofimov, I.A. *et al.* 2014; Udawatta, R.P. 2017; Raj, A. *et al.* 2019; Melikhov, V.V. and Kulik, K.N. 2020; Voskoboynikova, I.V. and Ivonin, V.M. 2023). The properties of agroforestry, as a type of land reclamation, correspond to the trends in the development of agricultural production (Kosolapov, V.M. 2014; Vasilyeva, E.A. *et al.* 2014; Stavi, I. and Lal, R. 2015; Mansvelt, J.D. and Temirbekova, S.K. 2017; Trofimov, I.A. *et al.* 2018; USDA, 2019; Belokopytov, A.V. *et al.* 2022; Kesavan, A. *et al.* 2022). Agroforestry is a component of state policy in the field of ensuring the sustainability of agricultural landscapes (Rulev, A.S. and Koshelev, A.V. 2012; Buttoud, G. *et al.* 2013; Venna, R. and Burbi, S. 2023).

Many publications have been devoted to the current state of development of agroforestry work (Manaenkov, A.S. 1995, 1999, 2014, 2015; Nesvat, A.P. *et al.* 2011; Kulik, K.N. *et al.* 2012, 2015a,b, 2017, 2019, 2020; Kulik, K.N. 2014, 2015, 2018; Trofimov, I.A. *et al.* 2014; Kulik, K.N. and Pugacheva, A.M. 2016; Melikhov, V.V. and Kulik, K.N. 2018; Melikhov, V.V. and Kulik, K.N. 2020; Kulik, K.N. and Vlasenko, M.V. 2023). These works outline both the main achievements of agroforestry science and the difficulties of its development. The main modern problem, according to most authors, is the issue of a significant reduction in the area of existing protective forests. Many authors associate the reasons for this state of affairs with the transformation of the management system of the reclamation complex that occurred during the transition from a planned to a market economy (Strumilin, S.G. 1957; Baibakov, N.K. 1971; Nesvat, A.P. *et al.* 2011; Hruška, V. and Píša, J. 2019).

Diving into the problems of formulating future research allowed us to identify two important features of this process. The first feature is that identifying promising research areas is often associated with the perception of development trends at a general, conceptual level. Examples include such paradigms as adaptive landscape farming, nature-like technologies, zero land degradation, organic farming, smart villages, and others. The second feature is that an integral part of the process of searching for priority research areas is understanding the features of existing mechanisms for introducing innovations into agricultural practice. Methods or mechanisms for introducing innovations into practice are a kind of filter for differentiating theoretical concepts into viable and non-viable.

There are quite a lot of studies that reflect conceptual approaches to nature management. There are significantly fewer works devoted to generalizing existing mechanisms for implementing innovations in agricultural production practices. For this reason, the purpose of the study was to search for and generalize, using the SWOT analysis method, the properties of methods for implementing innovations in agricultural production practices. The objectives of the research included generalization of scientific works conducted in the Russian Federation and their comparison with world practices (European countries, the USA, China, India, Argentina, Brazil, and other countries). Expansion of the geographical coverage of sources involved in the analysis aims to increase the reliability of the identified generalizations.

Materials and methods

The object of research is published materials that describe specific ways to promote or introduce innovations into agricultural production practices. The achievement of the set goal was carried out in three stages.

The basis of the research methodology at the first stage is the methodological techniques used when handling scientific and technical information (Korkzhova, A.A. and Dera, V.G. 1985; Blumenau, D.I. 2002; Kushnarenko, N.N. and Udalova, V.K. 2006). The result of the research at the first stage of the ongoing research is the creation of a list of existing methods for introducing innovations into agricultural production.

The second stage of the research was a SWOT analysis of the identified mechanisms. SWOT analysis is a widely used method for

assessing and structuring information. SWOT analysis is based on the assessment and comparison of four parameters: the strengths and weaknesses of the assessed object in comparison with analogous objects and an analysis of the opportunities and threats of the environment in which the assessed objects operate (Russel, J. 2019; Uchitel, Yu.G. 2019; Baghernejad, J. *et al.* 2023).

The third stage of the research is to compare the specific features of protective afforestation with the potential of the identified methods for promoting innovation in agricultural production. This comparison is aimed at identifying the preferred methods for promoting innovation in the field of agroforestry.

Results

The literature review is based on 168 sources. The distribution of publications by analysis topics is presented in *Table 1.*

The data in the table allow us to judge the diversity of the areas of scientific research covered by the review. A summary of literary sources made it possible to identify three ways of introducing innovations into the sphere of agricultural production:
– creation of a consulting service;
– implementation of federal or regional target projects;
– creation of a service for monitoring the agroecological condition.

Consulting service

A large number of scientific articles have been written about consulting services in the agro-industrial complex, the history of their development, goals, the tasks they solve, the mechanisms of their organization, legal support, sources of financing and personnel provision (Akkanina, N.V. 2004; Kireeva, O.V. 2004; Demishkevich, G.M. 2007; Datsyuk, P.V. 2008;

Table 1. Geography of publications

No.	Subject area of research	Geography of research (number of sources)	Total number of sources
1	Agroforestry	Russia (25); China, England, European Union, USA (2–2); France, India (1–1)	35
2	Sustainable development of agriculture and rational use of natural resources	Russia (9); European Union, USA (3–3); China, India (2–2);, Czech Republic, England, Germany, Hungary, Israel, Italy, Japan, South America [Argentina, Brazil], Spain, Ukraine (1–1)	29
3	Environmental degradation. Climate change. Environmental legislation	USA (4); Russia (3); European Union, Hungary, India (2–2); England (1)	14
4	Consulting service, experience in organization and analysis of functioning	European Union (13); Russia (11); Australia (2); England, Germany, India, Italy, Norway, South America [Argentina, Brazil], Ukraine, USA, Zimbabwe (1–1)	35
5	Targeted state programs in the field of nature management, experience of organization and analysis of functioning.	Russia (11); European Union (4); Africa, China, USA (3–3); Japan (2); India (1)	27
6	Agroecological service, experience of its organization and analysis of its functioning	USA (4); Russia (3); European Union (2)	9
7	Methods of handling scientific and technical information. SWOT analysis. Management. History and philosophy of science.	Russia (8); USA (5); European Union, Ukraine (2–2); India, Israel (1–1)	19
8	*Number of sources in all topics*		*168*

Source: Author's own research.

Law 2008; Farinyuk, Yu.T. and Glebova, A.G. 2011; Baumgart-Getz, A. *et al.* 2012; Belyakov, A.M. 2012; Samarkhanov, T.G. 2016; Paschen, J.A. *et al.* 2017; Ingram, J.A. and Mills, J. 2018; Nayanov, A.V. 2018; Apazhev, A. *et al.* 2019; Nettle, R. *et al.* 2021; Turner, J.A. *et al.* 2021; Ingram, J. *et al.* 2022; De Rosa, M. *et al.* 2023).

Advisory services are an important way of implementing public policy in the field of agricultural production (Birner, R. *et al.* 2009; EU Commission 2009; Badmakhalgaev, L.T. and Zverev, V.V. 2012; Curry, N.R. *et al.* 2012; Yunusova, P.S. 2014; Knierim, A. *et al.* 2017; Chaudhuri, S. *et al.* 2021; Ankita, P.V. and Chaudhuri, S. 2022; Kosova, A. 2022). By creating a "cultural environment", this tool ensures the multi-functionality of agriculture (Van Huylenbroeck, G. *et al.* 2007; Renting, H. *et al.* 2009).

"Strengths". Where the interests of the agricultural producer coincide with the interests of the state, this tool shows excellent results. An example is the introduction of drought-resistant and high-yielding varieties of grain crops.

The "weaknesses" of the advisory service include the advisory nature of its activities. Using this tool, it is difficult to implement innovations that do not bring quick profits (Chaudhuri, S. *et al.* 2023). An example is the creation of protective forest belts.

"Possibilities" of the consulting service. The range of work on agroforestry is extensive, including inventory of existing protective forest plantations, development of plans for their reconstruction, etc. To popularize a small business in the field of agroecological services, it is important to remember the capabilities of the consulting service (Manaenkov, A.S. 1999; Kulik, K.N. 2015; Kulik, K.N. *et al.* 2015a, 2023).

The "threats" of the extension service include the need to maintain impartiality to the results of scientific research. This instrument should be used with caution when introducing controversial innovations. Specialists from different extension services may have different views on the same problem, entering into conflict with each other (Faure, G. *et al.* 2012; Eastwood, K. *et al.* 2017; Compagnone, C. and Simon, B. 2018; Ingram, J. *et al.* 2022). An example is the "nautil" technology. Replacing the mechanical method of weed control with a chemical method is not supported by all scientists (Pittelkow, C.M. *et al.* 2015). In some countries, the use of glyphosate, one of the main available herbicides used in this technology, is banned at the state level (USDA, 2019; Law 2021).

An important feature of innovations promoted through this mechanism are short cycles between implementation and the result obtained. This factor is explained by the structure of financing consulting services, which is organized on a "fee for service" basis. Knowledge becomes a commodity that can be bought and sold (Foti, R. *et al.* 2007; Labarthe, P. and Laurent, C. 2013; Prager, K. *et al.* 2016). Commercialization of this service leads to duplication and fragmentation of knowledge, the emergence of problems with the dissemination of scientific knowledge (Klerkx, L. and Proctor, A. 2013; Klerkx, L. 2020; Ingram, J. *et al.* 2022).

Overcoming negative aspects in the functioning of consulting services is associated with strengthening the role of the public sector as a coordinating entity, developing uniform methods that experts are guided by, standardizing the training of consultants and their certification (Klerkx, L. *et al.* 2017; Ingram, J.A. and Mills, J. 2018; Ingram, J. *et al.* 2022).

Federal or regional target programs

The program-target approach to the introduction of innovations into agricultural production practice is discussed in a number of scientific papers (Law 1995; Ando, M.A. 2020; Bondarenko, L. 2020; Pryazhnikova, O.N. 2020; Xue, E. *et al.* 2021; Davydenko, N. 2022; Voroshilov, N.V. *et al.* 2022).

The program-target approach is based on a government contract. This approach is also called the "public goods at public expense" approach (Law 1995; Bondarenko, L. 2020; Voroshilov, N.V. *et al.* 2022; Venna, R. and Burbi, S. 2023).

The history of the development of agroforestry reclamation work is a clear confirmation of the use of the program-targeted approach (Kulik, K.N. 2014; Manaenkov, A.S. 2014; Kulik K.N. *et al.* 2015a,b, 2019).

One of the most striking examples of a previously existing target program is the so-called "Stalin's plan for the transformation of nature" (Kulik, K.N. 2014). This target program was developed by scientists from the USSR Academy of Sciences. The system of measures was aimed at combating drought, preventing the development of erosion processes, and preventing the occurrence of dust storms in the southern regions of the USSR. Over the 5 years of implementing this plan, more than 2.3 million hectares of forest were created, an ecological framework of forest belts was created on agricultural fields, the slopes of gullies and ravines, the banks of reservoirs were planted with trees and shrubs, over 13,000 ponds and reservoirs were created. The implemented measures led to an increase in grain yields by 25–30 percent, vegetables by 50–75 percent, and grasses by 100–200 percent (compared to the yield in unprotected fields). To date, in the territory of the former USSR states, this plan has no analogues either in terms of the complexity of measures or their scale (Kashtanov, A.N. *et al.* 2001). Modern examples can be national and regional projects (Website a [The Future of Russia, National projects], Website b [Regional Target Program], Website c [Long-term Regional Target Program]).

It is important to note numerous striking examples of the implementation of agroforestry reclamation work from world practice. Thus, targeted state programs for the development of agroforestry exist in the USA (Garrett, H.E.G. and Buck, L. 1997; McClure, B.K. 1998). These strategies were intensively developed under President Franklin Roosevelt, after the phenomenon of "dust storms" (Website d [Storms on U.S.]). Similar targets exist in Europe (Zanchi, G. *et al.* 2007; Rigueiro-Rodríguez, A. *et al*. 2009; Smith, J. 2010a,b), in Japan (Fujita, K. and Shaw, R. 2010; Matsushita, K. 2015), in India (Basu, J.P. 2014), in China (Carle, J. and Ma, Q. 2005; Liu, B. *et al*. 2009; Website e [UN]), in African countries (Goffner, D. *et al.* 2019; Ksenofontova, N.A. and Grishina, N.V. 2019; Website a [FAO]) and other countries.

"Strengths" of the program-target approach. The given examples of previously completed work confirm the broad possibilities of this method in solving complex and large-scale problems in the field of nature management.

The following features can be attributed to the "weaknesses" of the program-targeted approach to the implementation of innovations:

– High cost. The implementation of large-scale plans in the field of agroecology is not always possible (Dubinok, N.N. 2014).
– The program-targeted approach is based on the formulation of clear, measurable goals. This tool does not fit well into complex formulations and multifaceted concepts, such as: changing the nature of nature management, achieving sustainable nature management, overcoming irrational, unsystematic use of pastures. Achieving target measurable indicators, expressed in units of planted trees or hectares of developed territory, does not always imply correction of the processes that led to the emergence of an environmental problem. As a result, situations may arise when the fight is waged not against the cause, but against the effect. An example is a publication dedicated to the thirtieth anniversary of the "master plan to combat desertification of black lands and pastures of Kizlyar" (Kulik, K.N. *et al.* 2018). It highlights a chain of events: the emergence of an environmental problem, a surge in public interest, the development and implementation of land reclamation measures, and overcoming the consequences of the environmental problem. This sequence tends to repeat itself; it is a closed cycle (Kulik K.N. 2014; Kulik, K.N. *et al.* 2023).
– Perhaps the main drawback of the program-target approach is the fact that this method allows for the accumulation of environmental problems that are obvious

within the framework of individual nature management. The fight against negative phenomena begins only when the problems acquire a certain scale. In many ways, this state of affairs is a consequence of the peculiarities of the innovation mechanism under consideration. This method of implementation does not cover the local level of management decision-making – the level of an individual agricultural enterprise.

"Possibilities" of the program-targeted approach. With regard to agroforestry reclamation works, the program-targeted method of introducing innovations is the only and non-alternative way to solve a number of issues, such as the problem of afforestation of sandy arenas (Manaenkov, A.S. 1999), creation of protective forest plantations along river banks (Kulik, K.N. *et al.* 2017).

The "threats" of the program-targeted approach include the potential overestimation of the capabilities of this method. A worldview based on the belief that any environmental problem can be solved incorrectly. There are many examples in human history when anthropogenic destruction of the habitat led to the disappearance of civilizations (Diamond, J. 2016).

Agroecological service

Establishment of a specialized service responsible for monitoring the agroecological state of lands, development and implementation of melioration solutions aimed at increasing soil fertility. There is no experience of introducing innovations into agricultural production practices through this tool in Russia and a number of countries. However, in global practice there are striking examples of successful promotion of innovations in the field of soil protection (Bennett, H.H. 1955; Armand, D.L. 1983; Pavlovsky, E.S. 1992; Krasnova, I.O. 1997; Broslavsky, L.I. 2010; Kulik, K.N. *et al.* 2015a,b).

The Natural Resources Conservation Service in the United States is a large government agency with approximately 12,000 employees. This service has different names. The Soil Conservation Service originally grew out of the Soil Erosion Control Service, which was founded in 1933. In 1994, the Soil Conservation Service (SCS) was renamed the Natural Resources Conservation Service (NRCS – see Website f). The official website of the American Natural Resources Conservation Service has been extended by the biography of Hugh Hammond Bennett (see Website g). In the text of this article we will use the name 'agroecological service'.

The main function of the agroecological service is to ensure the achievement of the goal of reproduction of renewable natural resources (primarily soil fertility resources) by involving and stimulating specific agricultural producers in environmental protection activities. With the participation of specialists from this service, monitoring of the state of agricultural landscapes is carried out. The result of generalization of the monitoring data is an assessment of the agroecological state of vast territories and identification of agricultural enterprises within the boundaries of which the agro-landscapes are characterized by the maximum manifestation of degradation processes. Based on the assessment of the agroecological state of the lands, melioration measures are developed. The introduction of these measures into practice is stimulated by tax and credit policies. The system of response measures is diverse. In the event of organizing the fight against the catastrophic development of degradation processes, decisions can potentially be made related to the deprivation of property rights or the right to extend the lease of land to owners who do not comply with the instructions of the agroecological service.

This service has a hierarchical structure – there is a head organization at the federal level and a network of regional branches. The service has the appropriate material and technical support. The material embodiment of the agroecological service (staff, buildings, office equipment, etc.) is only the final stage of its creation. For the successful functioning of such an organization, it is necessary to first

create a number of key elements in the areas of legislation, the organization of the provision of services for scientific support for the functioning of sustainable agro-landscapes and the judicial system (Lebedeva, A.N. and Lavrik, O.L. 1993; Bogolyubov, S.A. 2015; Ivanov, A.L. *et al.* 2022).

Improving the legislative framework is one of the prerequisites for ensuring the possibility of the emergence and functioning of the agroecological service. An example of a problem subject to legislative regulation is the issue of the need for legislative consolidation of the responsibility of the user of natural resources for the agroecological state of lands. The responsibility of the agricultural producer for the agroecological state of lands is manifested in his obligation to monitor the agroecological state of lands owned or leased, and the burden of implementing melioration measures aimed at preventing the development of degradation processes.

Many issues that are important to resolve when creating an agroecological monitoring service can be resolved by private licensed enterprises. Such issues include inventory of protective forest plantations, assessment of the state of small hydrological structures, etc. It is important to have modern methodological recommendations that allow standardization of typical work. When organizing the functioning of enterprises providing environmental services, it will be useful to take into account the experience of forming the cadastral engineer service (Law 2007, 2015, 2016).

Judicial system. It is necessary to have courts specializing in resolving disputes between participants in relations in the agroecological sphere (Lebedeva, A.N. and Lavrik, O.L. 1993; Bogolyubov, S.A. 2015).

Let us move on to the SWOT analysis of the agroecological service as a way of introducing innovations in the sphere of agricultural production.

The "strong point" of creating a specialized service for monitoring the agroecological state is the ability to organize the fight against degradation processes at the level of an individual agricultural enterprise. Organization of planning and implementation of melioration solutions through the agroecological service can change the nature of nature management in the agricultural sector. It can allow a transition from a scheme for combating consequences to a sequence based on the use of forecasting capabilities and the adoption of preventive measures to prevent the occurrence of degradation processes and phenomena.

The "weaknesses" of a specialized service for monitoring the agroecological state include the absence of such a service in a number of countries. To create it, it is necessary to overcome the disunity of various institutions and departments responsible for the implementation of state policy in the field of nature management.

An important circumstance in overcoming the problems of creating an agroecological service is taking into account the trends in the development of science associated with the digitalization of sectors of the national economy (Larichev, O.I. and Petrovsky, A.B. 1987; Saraev, A.D. and Shcherbina, O.A. 2006; Mayer-Schoenberger, W. and Cukier, K. 2014; Rosa Pires da, A. *et al*. 2014; Prause, G. and Boevsky, I. 2015; Vaishar, A. and Šťastná, M. 2019; Zhang, X. and Zhang, Z. 2020; Chaudhuri, S. *et al.* 2021; Szalai, Á. *et al*. 2021).

The "opportunities" of agroecological services lie in the unification of various spheres (scientific research, legislative activity, production activity and the activity of public administration bodies) within a single integrated cycle or a single production chain (Drucker, P.F. 2008; Adizes, I. 2014; Henry, N. 2014; Kulik, K.N. *et al.* 2023) of the process of creating sustainable agroforestry landscapes. As an example of a problem where it is important to build such relationships, we can consider the current "ownerless" legal status of previously created protective forest plantations. The situation may change. If an agricultural producer carries out its activities in such a way that the result is the development of degradation processes, then the agroecological service must issue it an

order on the need to carry out reclamation work, and also set a deadline for this work. Based on the monitoring results, the agroecological service must assess the adequacy of the reclamation measures carried out. The consequence of such an organization of the process will be the interest of agricultural producers in owning melioration structures and managing their condition in the most economical and effective way.

"Threats". Agricultural enterprises are aimed at making a profit. Agroecological service is based on the possibilities of using the state function to ensure compliance with laws. It is extremely important to maintain a balance between the environmental imperative and the economic basis of an agricultural enterprise. It is possible that situations will arise when compliance with all environmental requirements will be able to cause bankruptcy of an agricultural producer.

Discussion

The conclusions made in different countries about the properties of the tools for implementing innovations in agricultural production practice are similar. This fact allows us to assume that the main features of the tools for implementing innovations are largely determined by their internal structure or are "inherent to them from birth" and are less related to geography. Socioeconomic factors are certainly important, but they determine the nuances and features of the functioning of advisory services in individual countries, but not their main features.

Table 2 provides a summary of the SWOT analysis of methods for introducing innovations into agricultural production practices.

The analysis of the table allows us to formulate the statement that there is no single correct and appropriate way to promote innovations in agricultural production practice. Each method has its advantages and disadvantages. The methods considered are not antagonistic, but, on the contrary, complement each other. Successful implementation of innovations can only be achieved by using the entire palette of tools. In this regard, it should be noted that in many countries, including Russia, there is no such tool as an agroecological service. Its creation carries great potential for the implementation of innovations, including for agroforestry.

SWOT analysis of methods for introducing innovations into agricultural production practice allows us to feel the trends in the development of the agricultural production management system as a whole. When searching for prospects for the development of agroforestry measures, it is important to take into account the trends in the development of the "supersystem".

Agroforestry is the implementation of a set of melioration measures carried out to improve the properties of lands, including the reproduction of soil fertility, by using the useful functions of agroforestry plantations (Law 2023). Conceptually, the role and place of agroforestry is reflected in the scheme of complex melioration of agricultural lands presented in *Figure 1.*

The "strengths" of agroforestry are related to the duration of the reclamation effect. The service life of protective forest plantations under favourable conditions can reach tens, and in some cases, hundreds of years (Rulev, A.S. and Pugacheva, A.M. 2019). The "weaknesses" of agroforestry are related to the fact that the effect of agroforestry measures begins to appear only 7–10 years after planting trees (Kulik, K.N. *et al.* 2015a,b). The "strengths" and "weaknesses" of agroforestry are opposites that are due to one circumstance - the use of woody plants as an ameliorative agent.

The categories "Threats" and "Opportunities" are also dialectically related, they are determined by the need for scientific support of agroforestry works. Knowledge and understanding of the features of the landscape and environmental conditions of the territories – the properties of the soil cover, underlying rocks, geomorphological features of the relief, features of water and wind regimes – is a key condition for the effectiveness of agroforestry measures

Table 2. Summary table of SWOT characteristics of ways to introduce innovations into agricultural production practices

Method name	Advantages	Flaws	Possibilities	Threats
Consulting service	A good result in resolving those issues when the interests of the manufacturer coincide with the interests of the state, when the result is visible in the short term.	The proposals of the consulting service are not necessarily of a recommendatory nature.	A good tool for promoting new services and products on the market that have the potential to generate profit.	You need to be careful when promoting goods and services that cause discussions and disputes.
Software-targeted approach	There are numerous examples of successful solutions to complex, large-scale, long-term problems in the field of environmental management.	The mechanism is capital-intensive, the country's budget does not always have enough funds to finance long-term reclamation activities. The mechanism allows for the accumulation of environmental damage at the local level.	This mechanism has no alternative in a number of cases. Examples are the creation of protective forest plantings in sandy areas and along river banks.	A dangerous worldview is one based on the belief that any environmental problem can be solved. The history of the development of a number of civilizations testifies to the opposite.
Agroecological service	Organization of the fight against degradation at the agricultural enterprise level. Prevention the destruction of agricultural landscape elements is cheaper than restoring them.	There is currently no such service in a number of countries.	Possibility of uniting business, science, legislative and regulatory activities of government bodies within a single production chain aimed at creating sustainable and safe production of agricultural products.	A double-edged tool. The need to maintain a balance between economic development and respect for the environmental imperative.

Source: Author's own research.

(Petrov, N.G. 1996; Rulev, A.S. 2007, 2015; Sukhorukikh, Yu.I. *et al.* 2015). Technologies for designing, assessing forest growing conditions, preparing soil for planting tree species, maintaining forest belts, solving problems of creating a forest seed base, variety testing and zoning of tree species and other issues (Kulik, K.N. *et al.* 2015b, 2017, 2019) can be implemented in practice only by creating a supporting infrastructure. In one case, the need for scientific support is a "problem" – the reduction in the area of protective forest plantations in the context of the transition from a planned to a market economy. In another case, it is an "opportunity". Agroforestry specialists are potentially able to solve most of the problems associated with the functioning of the agroecological service. This statement is a further development of the thesis on the perception of protective forest plantations as an "organizing principle for the use of agricultural lands" (Kulik, K.N. *et al.* 2017, 95).

The idea that a turning point in the development of agroforestry is taking place is suggested by the broader context of perception of the problem of finding promising research directions. Thus, a historical analysis of the development of sciences in general (Kovalchuk, M.V. 2012) allows us to identify periods when the subject of research is frag-

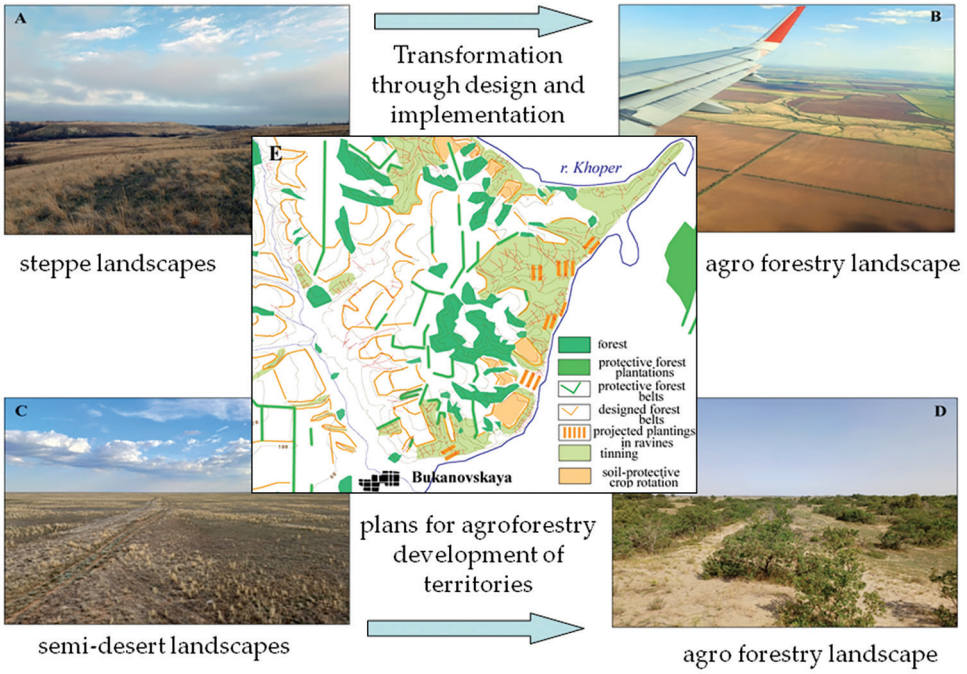

Fig. 1. Conceptual diagram of complex reclamation of agricultural land (by Tubalov, A.A. 2007). A = Steppe vegetation area, Gorodishchensky district, Volgograd region, Russia; B = Fragment of the implemented system of forest belts in the steppe zone, Ilovlinsky district, Volgograd region, Russia; C = Semi-desert vegetation area, Chernozemelsky district, Kalmykia Republic, Russia; D = Protective pasture afforestation in semi-desert, Nogai district, Dagestan Republic, Russia; E = Fragment of the agroforestry improvement plan, Kumylzhensky district, Volgograd region, Russia. *Source*: Authors' own research and processing.

mented and increasingly specialized branches of knowledge are formed, and periods when a common subject of research serves as the basis for unifying highly specialized branches of knowledge.

Repeating the same meanings, but in other words, can be found in works devoted to the generalization of patterns of system development (Altshuller, G.S. 2020). As an example, we can consider the rule of system development: growth of the system occurs to a certain limit, beyond which the system is included in the super system as one of its components, while the development of the system slows down sharply or stops, giving way to development at the level of the super system.

Events that occur in the future will either refute or confirm the conclusions made. The changes that are currently taking place inspire optimism. In Russia (based on the All-Russian Research Institute of Agroforestry), the Federal Scientific Centre for Agroecology of the Russian Academy of Sciences was created. The Soil Conservation Service in the United States was renamed the Natural Resources Conservation Service. The source and reason for these changes are related to the increasingly broad perception of the mission of these organizations.

Conclusions

The conducted research allowed to identify three ways of introducing innovations into agricultural production practice. These are meth-

ods such as: creation of consulting services; implementation of national and regional projects in the field of ecology; creation of a state agroecological service. SWOT analysis of these methods allowed to identify their strengths and weaknesses, opportunities and threats.

A promising direction of agroforestry research in the Russian Federation is the path associated with ensuring the creation and functioning of an agroecological service. This conclusion is associated with the specifics of agroforestry and the need to ensure the integrity of the application of existing methods for the introduction of innovations in agriculture.

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