European Proceedings of
Social and Behavioural Sciences
EpSBS

www.europeanproceedings.com
e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2022.03.154

FaR 2021
International Forum "Freedom and responsibility in pivotal times"

GREEN GROWTH TECHNOLOGIES IN SUSTAINABLE RURAL DEVELOPMENT: ECONOMIC ASPECT

Inna Anatolyevna Volkova (a)*, Ekaterina Anatolyevna Astashova (b)
*Corresponding author

(a) Omsk State Agrarian University named after P.A. Stolypin, Omsk, Russia, ia.volkova@omgau.org
(b) Omsk State Agrarian University named after P.A. Stolypin, Omsk, Russia, ea.astashova@omgau.org

Abstract

Green growth technologies have recently been actively used to improve the management of agricultural resources, ensure well-being through a more sustainable use of the rural potential. Regions with agrarian specifics should form a green growth strategy, since it is green technologies that can become a driver of territorial development. The dependence of rural sustainability on green technologies has been identified through the relationship between resources and agricultural production. Crop yields and animal productivity are determined in the context of temporal data, the relationship between the features is estimated using the correlation coefficients, the indicators presented in the official statistics of the Russian Federation and the constituent entities of the Siberian Federal District are used. The yield of grain crops, milk yield per cow act as linearly dependent features, a model of the correlation matrix is created. The studies established the determination coefficient, which made it possible to conclude that the yield of cereals is influenced by the volume and timeliness of the application of mineral and organic fertilizers. Dairy productivity depends on the reproduction abilities of animals, feed consumption and crop yields. Green technologies have been identified as contributing to reducing the risk of environmental impact, ensuring safety, resource efficiency, environmental friendliness, and contributing to the evolution from more primitive production methods to more economical, energy-efficient and socially adapted ones.

Keywords: Green technologies, rural areas, sustainable development

https://doi.org/10.15405/epsbs.2022.03.154
Corresponding Author: Inna Anatolyevna Volkova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

1. Introduction

The sustainable development of territories in the context of ecological representation is the main focus in the development of national, regional and organizational macro-strategies.

At the beginning of 2015, the UN Agenda outlined 17 sustainable development goals (SDG) and indicators for their achievement by 2030. The attitude to the environment is at the heart of each of these goals, and environmental sustainability as a decisive factor contributes to the achievement of the SDGs and ensures the health of the population on the planet (Bobylev et al., 2019).

Green technologies play a significant role in achieving the indicators set out in the sustainable development goals. Green growth technologies have recently been actively used to prevent pollution, eliminate adverse climatic impacts through the transition to green, cleaner energy, adapt to climate change, improve the management of agricultural resources, and ensure well-being through more the sustainable use of rural resources.

The implementation of the main goals is defined through a number of criteria and on the basis of certain principles that are critical in the realities of the green economy. The criteria of efficiency, accessibility and transparency, the principles of universality, integration and innovation enable synergy, food security, contribute to the development of the economy and meet the goals, which combined suggest a close relationship between the use of green technologies and the sustainability of rural development. To confirm this, it can be noted that the UNEP report states that the green economy is aimed at improving the well-being of people and contributes to ensuring the environmental balance in terms of sustainable development of the territories. Regions with agrarian specifics should develop a green growth strategy in order to ensure competitiveness, since it is green technologies that can become the driver of rural development, especially in terms of improving the quality of life of the population and using advanced agricultural production methods.

2. Problem Statement

Recently, the modern economy has not paid enough attention to ecology, the irrational use of natural resources, and the problem of meeting the endless growing needs of a person in conditions of limited resources. In their development rural territories faced problems of sustainable growth and development, since there is no reference to a decent level and quality of life of the rural population, the mechanism for self-developing territorial systems is not developed, the reproduction of natural resources is not ensured, the methods of agricultural production are not environmentally justified.

Sustainable rural development is possible due to the achievement of a number of effects from reducing the environmental burden on the soil, the use of organic farming technologies, and the greening of agricultural production. Many countries benefited from the development of crisis programs with an environmental component. G-20 countries allocate about 16% to green investments out of a $3.3 billion package of state measures to stimulate the economy. The environmental component of the anti-crisis package in the USA, Canada, Germany – 8-13%; France – 21%; China – 38%; South Korea – 81%; Russia – less than 1% (Kozhevina, 2015).

https://doi.org/10.15405/epsbs.2022.03.154
Corresponding Author: Inna Anatolyevna Volkova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

In Russia, the development of rural territories is designated as a priority in the State Program "Integrated Development of Rural Territories", which identifies specific components that intersect with the directions of the green economy, thus promoting rural employment and the use of environmental technologies in agricultural production. The state program provides for financing the welfare of the territories and in 2020 allocated 3.8 billion rubles from the federal budget, which made it possible to implement almost 6 thousand projects in 70 regions of the country. In 2021, the Government of the Russian Federation additionally allocated 3.6 billion rubles, which will help to complete about 30 projects and improve the housing conditions of about 12 thousand Russians. Besides, more than 184 million rubles subsidies are implied for the recovery of costs of agricultural producers to attract qualified staff.

Despite the relevance of this field of study, the assessment of the quality of management of sustainable rural development is not studied enough. The sustainable development model aimes to study the best practices, current state of activity, substantiate the optimality of the development scenario, determine the qualitative and quantitative parameters necessary to ensure a competitive level of the regional economy on the planning horizon until 2030.

3. Research Questions

3.1. Theoretical aspects of the study

Understanding the definition of "green technologies" from the point of view of its influence on the sustainable development of rural areas allows building an algorithm for strategic actions within the framework of regional development. Green technologies promote environmentally sound practices and the efficient use of natural resources.

According to the World Bank, the efficient use of resources as a basis for sustainable growth and development is possible through the use of green technologies. According to the OECD classification, the effect of green technologies is impossible without environmental management.

The European Environment Agency considers green technologies from a knowledge perspective. The Europe 2020 strategic program identifies the economy based on knowledge that is possible through the introduction of green innovations as a new initiative of the EU countries (Barysheva & Egorova, 2019).

In their studies Plunkett Research identified a component of the green economy, where a special place is given to technologies related to timber conservation, land protection, environmental production of agricultural products (Barysheva & Egorova, 2019).

The Working Group on Ecology and Environmental Management of the Expert Council under the Government of the Russian Federation notes that green technologies are similar to innovative technologies, the content of which is waste-free production, reuse or saving of natural resources.

Del Sarto (2016) suggests that it is possible to trace the impact of the environment on employment, including in determining the sustainability of rural development.

Capassoa et al. (2019) note that the measures to increase the efficiency of the use of raw materials can have a significant positive impact on the employment of the population in any region, which will contribute to sustainable development.

https://doi.org/10.15405/epsbs.2022.03.154
Corresponding Author: Inna Anatolyevna Volkova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

Bodewig (2020) notes that the principles of the green economy are now increasingly penetrating into all types of production and social activities; there is a need for green construction.

Reike et al. (2018) outlined the priorities of economic development and highlighted the full use of human capital, the reduction of unsustainable consumption of natural and other types of resources as the main factors.

Sachs et al. (2019) sees the solution to the problem of sustainable regional development through major structural changes based on the effective use of economic and financial potential.

Velis (2018) states that the main value of the green scientific and production cluster is to provide residents of the region with comfortable and favorable conditions for existence and development.

3.2. Practical results of the study

Sustainable rural development is interlinked with green technologies, which can be expressed through the assessment of the relationship between resources and agricultural production, namely crop yields and animal productivity. The authors of the study determined yield and productivity in terms of temporal data, estimated the relationship between the features using correlation coefficients, used the indicators presented in the official statistics of the Russian Federation and the constituent entities of the Siberian Federal District (see Table 01). Crop yields (Yy), milk yield per cow (Yn) act as linearly dependent signs. A correlation matrix model is generated and values from X1 to X8 are assigned to key indicators.

Table 1. Dependence of crop yields (Yy) in constituent entities of the Siberian Federal District

Constituent entity	Sown area for grain crops	Application of mineral fertilizers	Application of organic fertilizers	Number of tractors	Number of combine harvesters	Average monthly salary	Technological innovation costs	Investment in agriculture
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Altai Republic	0.26	0.25	0.13	0.73	0.68	-0.19	0.28	0.19
Republic of Tuva	0.33	0.14	0.46	0.28	0.09	0.46	0.40	0.44
Republic of Khakassia	0.22	0.73	0.59	-0.33	-0.38	0.58	0.12	0.27
Altai Territory	0.29	0.37	0.56	0.19	0.29	0.07	0.49	0.62
Krasnoyarsk Territory	0.14	0.71	0.42	-0.49	-0.29	0.51	0.55	0.38
Irkutsk region	0.53	0.53	0.49	-0.65	-0.53	0.61	0.29	0.23
Kemerovo region	0.57	0.38	0.43	-0.56	-0.47	0.57	0.11	0.45
Novosibirsk region	0.39	0.21	0.34	0.27	0.36	0.06	0.64	0.50
Omsk region	0.34	0.64	0.61	0.14	0.45	-0.11	0.67	0.57
Tomsk region	0.39	0.20	0.38	0.35	0.43	-0.07	0.43	0.11

https://doi.org/10.15405/epsbs.2022.03.154
Corresponding Author: Inna Anatolyevna Volkova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

One of the elements of the green technology is the introduction of organic fertilizers, the relationship with yields is noted in Khakassia, Krasnoyarsk Territory, Omsk and Irkutsk regions, nevertheless, agricultural organizations continue to use mineral fertilizers, which has a closer relationship with crop yields.

Technical availability and technical equipment have a significant impact on yields, and the use of gentle tillage technology has resonated in increased crop yields. On the contrary, the moderate and negative correlation shows the obsolescence of technology, a large percentage of its disposal, problems in the application of green technologies. Innovative technologies and investment in agricultural production lead to increased crop yields.

Table 2. Dependence of milk yield per cow (Yn) on a number of factors in the constituent entities of the Siberian Federal District

Constituent entity	Yield	Calf crop	Renewal of milking machines	Feed consumption	Technological innovation costs	Investment in agriculture	Average monthly salary
	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Altai Republic	0.15	0.79	0.28	036	0.46	0.37	0.35
Republic of Tuva	0.35	0.61	0	0.29	0.36	0.32	0.41
Republic of Khakassia	0.28	0.52	0.66	0.67	0.27	0.48	0.48
Altai Territory	0.08	0.68	0.48	0.45	0.69	0.54	0.46
Krasnoyarsk Territory	0.58	0.72	0.37	0.75	0.53	0.40	0.46
Irkutsk region	0.67	0.62	0.48	0.70	0.59	0.57	0.38
Kemerovo region	0.62	0.58	0.66	0.34	0.49	0.42	0.26
Novosibirsk region	0.11	0.70	0.32	0.64	0.19	0.31	0.25
Omsk region	0.62	0.56	0.44	0.61	0.67	0.52	0.57
Tomsk region	0.06	0.69	0.56	0.40	0.69	0.31	0.46

The milk yield of the cattle population depends on the level and quality of feeding, namely the balanced diet in terms of digestible protein and exchange energy, so the positive relation of these features is noted in Khakassia, Krasnoyarsk Territory, Irkutsk, Novosibirsk and Omsk regions (see Table 02).

The technical availability of production processes (manure handling, feeding, milking process) has a moderate connection with dairy productivity. The increase in milk yield is less responsive to innovative technologies and investment in milk production in terms of the use of green technologies.

The studies defined the determination coefficient, which made it possible to conclude that the yield of grain crops is influenced by the volume and timeliness of mineral and organic fertilizers (45% and 30%, respectively). Dairy productivity depends on the reproduction abilities of animals, feed consumption and crop yields (40%, 33% and 30%, respectively).

Therefore, along with traditional technologies the green technologies affect crop yields and productivity of agricultural animals, but in a pure and isolated form it is not possible to focus on increasing

https://doi.org/10.15405/epsbs.2022.03.154
Corresponding Author: Inna Anatolyevna Volkova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

the productivity of agricultural organizations only from the use of green technologies. There is still a need for additional follow-up studies.

4. Purpose of the Study

The main direction of green economy development is ecological agriculture, which is focused on the use of green technologies, which, in turn, allows to significantly reduce employment issues, increase the level and quality of life of the rural population while preserving the natural environment.

The purpose of the study was to determine the role and practical use of green growth technologies in the sustainable development of rural areas. In accordance with the purpose of the study, a number of tasks were set:

- to identify the problems with the use of green technologies in agricultural production;
- to explain the definition of "green technologies" from the perspective of its impact on sustainable rural development;
- to determine the vector of the relationship between green technologies, crop yields and animal productivity;
- to identify the application directions of green growth technologies in the sustainable rural development system.

5. Research Methods

The theoretical basis of the study includes the general scientific dialectical and economic-statistical methods: ranking, correlation, structural analysis, statistical processing of the information array.

The methodological basis of the study included the works of foreign and domestic economists on sustainable development, as well as legislative and regulatory acts on the introduction of green technologies, resolutions and orders of the Government of Omsk Region on creating conditions for economic growth, maintaining social stability, innovative development of the region.

6. Findings

In order to determine the directions of green growth technologies in the sustainable development of rural areas, the authors classified all technologies as follows (Kozlova & Volkova, 2020):

- green technologies in the development of the resource-targeted approach contribute to the optimal level of resource use to achieve the target vector;
- traditional technologies provide medium-sized production, which currently does not promote competitiveness in strategic development;
- obsolete technologies do not meet the requirements of agricultural production and are not able to ensure the adequate quality of products.

As noted above, sustainable rural development can primarily be achieved with regard to resource efficiency. Sustainability of development is identified through the following types of the potential:

- natural-climatic potential (Pnc);
- socio-economic potential (Psc);

https://doi.org/10.15405/epsbs.2022.03.154
Corresponding Author: Inna Anatolyevna Volkova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

- organizational and management potential (Pom);
- scientific and technological progress potential (Pstp).

Life cycle technologies:

- green (kg);
- traditional (kt);
- obsolete (ko).

At present, most agricultural organizations consider basic traditional technologies that do not correspond to the green development vector. But since the organizations formed an algorithm for the sequence of technological processes and optimized the resource consumption, it is advisable to assign the kt=1 value to traditional technologies, deviations towards the environmental component are indicated through a unit fraction value of 0.5, respectively green and obsolete technology are assigned coefficients: kg=1.5 and ko=0.5.

The use of resource potential depending on the type of technology may be represented as follows:

$Ip = k \cdot Pnc + k \cdot Psc + k \cdot Pom + k \cdot Pstp$,

where Ip – evaluation of resource potential utilization, points;

k – type of technology from the life cycle perspective.

The weighting coefficient is proposed to be calculated taking into account the significance of the indicator in the volume from 100:

Pnc=30, Psc=15, Pom= 35, Pstp=20.

The end result of the technology is the expansion of the output. Considering that the output volume (V) can either decrease or increase depending on the use of the potential, the base coefficient Cb is determined, which shows how much the yield of agricultural products decreases or increases under the influence of these factors:

$Cb\ min = Vmin / Vplan$;

$Cb\ max = Vmax / Vplan$.

$Wp = Cb (k \cdot Pnc + k \cdot Psc + k \cdot Pom + k \cdot Pstp)$,

where Wp – assessment of potential impact, points;

Cb – base coefficient (See in Table 3).

Table 3. Agricultural potential estimates

Technology	Resource potential				$C_{b\ min}$	$C_{b\ max}$
	P_{nc}	P_{nc}	P_{nc}	P_{nc}		
Green	45	75	150	45	75	150
Traditional	30	50	100	30	50	100
Obsolete	15	25	75	15	25	75

With the interaction of green and traditional technologies, agricultural potential can be used more effectively, which affects the sustainability of rural development. Green technologies reduce the risk of environmental impact, ensure safety, resource efficiency, environmental friendliness, and contribute to the evolution from more primitive modes of production, accumulation and consumption to more economical, energy-efficient and socially adapted ones.

https://doi.org/10.15405/epsbs.2022.03.154
Corresponding Author: Inna Anatolyevna Volkova
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

7. Conclusion

The studies carried revealed the following areas in the perspective of sustainable development of rural areas taking into account the introduction of green technologies:

- focus on sustainable development: introduction of green economy elements taking into account the interaction of economic, social, environmental and technological factors. The indicators of green growth and development should be reflected in strategic and operational development plans, contribute to socio-economic problems and be financially secured. These indicators take into account the close relationship of ecology with economic development, which determines better and healthier environment;
- transition to organic agriculture: soil renewal using artificial soil, compost production, its use as an organic, environmentally friendly fertilizer;
- introduction of recycling technology and cyclical production: modernization of production to obtain a double effect in the future during processing of raw materials, which will provide for economic efficiency, rational use of natural resources, ensure low-waste production;
- use of renewable energy sources: support and stimulation of the production of domestic renewable energy equipment;
- creating environmental thinking: stimulating support for sustainable development based on the principles of the green economy among all social groups of the society;
- formation and development of human resources potential: organization of a system of professional retraining and further training of staff in green and lean technologies;
- development of a conceptual system for sustainable rural development: determining the feasibility of implementing green growth technologies and assessing their effectiveness in the regional dimension;
- development of a regional employment policy: creating green jobs, increasing employment in the short-, medium- and long-term.

Thus, sustainable rural development is possible through the regional policy elements that promote green technologies in the production of environmentally friendly products, rational use of resources, and environmental care.

References

Barysheva, G. A., & Egorova, M. S. (2019). Green technologies: definition of the concept, stages of formation and role in the sustainable development of the economy. *Theory and practice of social development, 12*(142)*,* 48–54.

Bobylev, S. N., Kiryushin, P. A., & Kudryavtseva, O. V. (2019). *Green Economy and Sustainable Development Goals for Russia.* Faculty of Economics of Moscow State University named after M. V. Lomonosov.

Bodewig, K. (2020). *Shaping the Future Politics of the European Maritime Space.* European Commission. https://www.sipotra.it/wp-content/uploads/2020/07/Shaping-the-future-policy-of-the-European-Maritime-Space.pdf

Capassoa, M., Hansen, T., Heiberge, J., Klitkoua, A., & Steend, M. (2019). Green growth – A synthesis of scientific findings. *Technological Forecasting & Social Change, 146*, 390–402.

Del Sarto, R. (2016). Normative empire Europe: The European Union, its borderlands, and the "Arab Spring". *Journal of Common Market Studies, 54*(2)*,* 215–232.

Kozhevina, O. V. (2015). Sustainable development and green growth of agro-industrial regions. *Business Strategies, 3*(11), 14–20.

Kozlova, O. A., & Volkova, I. A. (2020). *Trends in the Development of Green Business: Experience of EU Countries and Russian Practice.* Nizhnevartovsk State University.

Reike, D., Vermeulen, W., & Witjes, S. (2018). The circular economy: new or refurbished as CE 3.0? – exploring controversies in the conceptualization of the circular economy through a focus on history and resource value retention options. *Resources, Conservation and Recycling, 137,* 246–264.

Sachs, J., Woo, W. T., Yoshino, N., & Taghizadeh-Hesary, F. (Eds.). (2019). *Handbook of Green Finance: Energy Security and Sustainable Development.* Springer Singapore.

Velis, C. (2018). No circular economy if current systemic failures are not addressed*. Waste Management & Research, 36*(9), 757–759.