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Economic Trend in Developing Sustainable Agriculture and Organic Farming

Tlektes Espolov[1*], Aidos Espolov[1], Nurlan Satanbekov[2], Kanat Tireuov[1], Janiya Mukash[1], Zhenisbek Suleimenov[1]

[1] Department of Management and Organization of Agribusiness, Kazakh National Agrarian University, Almaty 500010, Republic of Kazakhstan
[2] Department of Economic and Finance, University named after Abay Myrzakhmetov, Almaty 020000, Republic of Kazakhstan

Corresponding Author Email: t.espolov79@rambler.ru

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ABSTRACT

This study examines the importance of organic production for sustainable consumption and evaluates the economic efficiency of cultivating spring barley using organic methods. Field experience was used to determine the profitability of organic cultivation, and laboratory and field observations were conducted on spring barley grown using organic fertilizer. Results show that the maximum yield of spring barley (4.39 t/ha) and profitability (118%) were achieved when applying 50 t/ha of manure with straw by-products and using Ecostern biodestructor at 1 l/t. Challenges in collecting and interpreting market trends and demand data for eco-products may limit the research. Further research may investigate the impact of environmental sustainability on the economic performance of eco-farms and demand for organic products. The practical significance of the research makes it useful for developing norms and practical approaches to organic agriculture and solving environmental problems.

1. INTRODUCTION

The market for organic farming products is currently one of the fastest growing sectors of the food market in the world. The deterioration of the quality of food on the market for several years has led to the fact that consumers began to look for high quality products for health. Organic foods with high nutritional quality have become the answer to this interest [1].

According to IFOAM, sustainable agriculture is the efficient production of safe and high-quality food in a way that protects and enhances the natural environment and social and economic living conditions. In addition, organic farming is a type of farming that uses natural means of production to take advantage of nature and ensure sustainable soil fertility and crop yields. The basic idea of sustainable agriculture is not only to maximize profits from cultivation but also to take care of the environment for our future and that of the next generations. The principles of sustainable agriculture are closely related to the surrounding ecosystem. The use of this system brings tangible benefits to the environment by improving air and groundwater quality, reducing greenhouse gas emissions and energy consumption from non-renewable sources, and increasing biodiversity in agroecosystems and agricultural landscapes.

Due to the exclusion of artificial fertilizers and pesticides, organic farming does not introduce harmful substances into the environment, contributes to the development of life in ecosystems, and has a positive impact on both the conservation of biodiversity and the natural landscape. Sustainable development of agriculture also ensures the food independence of the country, producing agricultural raw materials, goods, and services. The effective and sustainable functioning of the food industry in a market economy determines economic security, preventing falling into dependence on other states. At the same time, environmentally sustainable cultivation aims to develop and establish optimal methods for growing plants that would ensure the sustainability of ecosystems, reduce the negative impact on the environment and human health, and improve product quality.

Ahmed et al. [2] argued that organic food serves sustainable consumption because it is produced according to principles that are as similar as possible to natural crops, without the use of artificial fertilizers, feed additives or chemical plant protection products. Organic farming is a system that seeks to produce food sustainably, that is, in accordance with local ecological, social, and economic conditions [2].

According to Willer et al. [3], since the early 1990s the dynamics of growth in demand for organic food, especially in highly developed countries, has increased by an average of 20%. Organic farming is also intensively developing in Kazakhstan, as the number of producers of organic food of sustainable agriculture (farms, agricultural enterprises, processing plants, etc.) is increasing, and the supply of organic products in the market will increase [3, 4].

For producers of organic products an important aspect remains profitability and income from growing crops. Since the yield of crops in organic farming, as a rule, is not high, and to produce a sufficient amount of products requires more land resources, it contributes to additional costs and higher prices for finished products. Therefore, it is necessary to conduct detailed studies on obtaining the economic effect when using the system of organic farming.

This study aims to analyze the economic trend in the development of sustainable agriculture, optimize the value of organic production for sustainable consumption, as well as to establish economic efficiency in the organic way of growing

spring barley, which makes the topic relevant. The novelty of this scientific work is the study of the relationship between economy and ecology in agriculture and farming. This research may help to understand how environmentally sustainable agriculture can become cost-effective.

The results can be applied in the development of scientific and practical approaches to the development of organic agricultural production, including the cultivation of grain crops.

2. LITERATURE REVIEW

The development of sustainable agriculture is a strategy to utilize environmental resources and economic services while preserving natural capital for the next generations. Research on environmentally sustainable agriculture focuses on developing optimal cultivation methods that would ensure the sustainability of agricultural ecosystems to climate change and negative impact on the environment, reduce the cost of cultivation, and improve the quality and safety of products. In addition, these studies should analyze the interaction between ecosystems and agroecosystems, identifying the impact of various methods of tillage, fertilizers, and plant protection on natural biodiversity and soil fertility.

Willer and Sahota [5] in their papers noted that in 2012 organic farming in Europe covered 11.2 million hectares, of which 9.96 million hectares in the European Union, which amounted to almost 90% of their total area in Europe. The area under organic crops from 2012 to 2022 increased by more than 65%. In 2022 the production of organic food in Europe employed more than 300 thousand people [5]. According to Yuan [6], one of the important elements of sustainable agricultural production is the production of organic food. The growing number of producers of organic agricultural products and cultivation area gives hope that in the near future the range of organic products offered in the market will significantly expand [6].

However, simply producing organic products today is not enough to find a buyer. Yoshikawa [7] believes that an important element influencing consumer interest in organic food is the proper organization of the supply chain. Consumers interested in healthy and safe food often live in large urban agglomerations, so it is important that these products are available in the stores they visit [7].

According to scientists, sustainable agricultural production should be characterized not only by the fact that all people should always have access to sufficient and nutritious food, but also that this food should be produced with minimal impact on the environment [8-10]. Organic products are characterized by a balanced content of nutrients, do not contain harmful chemical additives, preservatives, chemical impurities, artificial fertilizers, antibiotics, hormones and genetically modified organisms and their residues. Organic products usually have more pronounced characteristics, such as fruits and vegetables have a clearer smell and taste, are more flavorful, have a denser consistency (due to the higher content of dry matter) and stay fresh longer, they also have lower nitrate and nitrite content (on average, even by 2-3 times) than those produced by traditional methods [11].

Lu et al. [12] believe that central to organic farming is that it contributes to soil fertility and biodiversity conservation, and production methods are adapted to the area and avoid the use of chemicals [12]. Ecologically sustainable agriculture and organic farming can stabilize vulnerable ecosystems under various natural and climatic conditions in the presence of severe degradation of agricultural land and water scarcity, and reduce pest infestation [13]. Mariappan and Zhou [14] argued that organic agriculture can contribute to meaningful socio-economic and environmentally sustainable development. This is due to the profitability in applying organic principles of available local resources' effective management (seed varieties, manure, etc.) [14].

Alim and Lup noted that certified organic products provide producers with access to international markets, which will contribute to higher revenues [15]. In addition, organic farming reduces the risk of underharvesting, stabilizes the income of producers and, therefore, increases food security [16-19]. Thus, the purpose of the study is to analyze the importance of organic production in the development of sustainable agriculture, as well as to establish the economic efficiency of the organic method of growing spring barley. To achieve the defined goals, the authors needed to solve the following tasks:

summarize the theoretical basis regarding the essence of sustainable agriculture,

investigate the main trends in the development of organic agricultural production in the Republic of Kazakhstan,

determine the profitability of the organic method of growing spring barley.

The practical significance of the results is the possibility of developing scientific and practical approaches to the development of organic agricultural production, and the practical implementation of the main scientific provisions will contribute to solving environmental problems in the development of sustainable agriculture and organic farming.

3. RESEARCH METHODS

Theoretical basis of the performed research was the main conceptual provisions, narratives, recommendations, and conclusions presented and substantiated in the fundamental and applied research of leading scientists in the field of organic agriculture and soil science. The IFOAM (International Federation of Organic Agriculture Movements), UN (United Nations), FAO (Food and Agriculture Organization of the United Nations), as well as monographic and periodical literature and results of the authors' own research were used to summarize the theoretical basis regarding the essence of sustainable agriculture in the economic system [20, 21]. The researched materials were analyzed using the comparison and grouping method, as well as the abstract-logical method, which was aimed at studying the economic trend in the development of sustainable agriculture and organic farming.

To study the main trends in the development of organic agricultural production in the Republic of Kazakhstan, the authors used the reports of the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan [22] and the Ministry of Agriculture of the Republic of Kazakhstan [23]. In addition, a field experiment was laid to determine the profitability of the organic method of spring barley growing using laboratory and field observations of spring barley, which was grown under conditions of organic fertilizer application. The study was conducted on the fields of X region of the Republic of Kazakhstan in 2019-2021.

The research was conducted under controlled conditions on

dark chestnut slightly saline soils of the University. These soils have medium-loamy composition, characterized by the thickness of the humus layer of 46 cm and the highest humus content (3.1%). Easily hydrolyzable nitrogen content is 6.2 mg per 100 grams of soil, labile phosphorus forms (5.8 mg per 100 grams of soil), exchangeable potassium (54.4 mg per 100 grams of soil). The soil pH is 6.8.

The sown area of the experiment was 60 m^2, the accounting area was 46 m^2, repetition was 3 times. The following crops were grown in 5-field crop rotation: rapeseed - winter wheat - annual grasses - corn for grain - spring barley. It was decided to place 50 t/ha of manure on grain (under corn) for plowing area with aftereffect on subsequent crops. The system of organic fertilization implied the study of extensive and organic crop rotation: without fertilization (control) and with fertilization with straw by-products using Ecostern biodestructor at the rate of 1 l/t (option A) and without treatment (option B). The yield of spring barley was accounted in the phase of wax maturity of the grain by weighing on electronic weighing scale with recalculation to the standard 14% moisture content. Economic efficiency of spring barley growing was determined by the cost of 1 ha, the total profit, the cost of 1 ton of production, and the level of profitability. The cost price (CP) was the ratio of production costs to the harvest of spring barley from 1 ha according to the variants of the experiment:

$$CP = PC / C$$

where, C – spring barley crop from 1 ha/ t;
RC – production costs.

To estimate the profit (P) from the sum of the gross output cost, production costs were subtracted according to each variant of the experiment:

$$P = GOC - RC$$

where, P – profit, UAH;
GOC – gross output cost, UAH;
RC – production costs, UAH.

The profitability level (PL) was estimated by dividing profit by production costs and multiplying by 100%:

$$PL = P / RC \times 100\ \%$$

In addition, statistical analysis was performed in data analysis to determine the mean and relative values of the effect of organic fertilizer level on spring barley yield and comparative analysis to compare the data obtained for 2019-2021 at the 5% probability level.

4. RESULTS

The market for organic products in the world is increasing every year. Over the past twenty years the area of agricultural land used by organic farms in the world has increased from 17.3 to 72.3 million hectares. This is approximately 0.87% of all agricultural land on the globe. With the development of organic farming in the world, there is also a trend of increasing consumption of products produced by environmentally friendly methods (Figure 1).

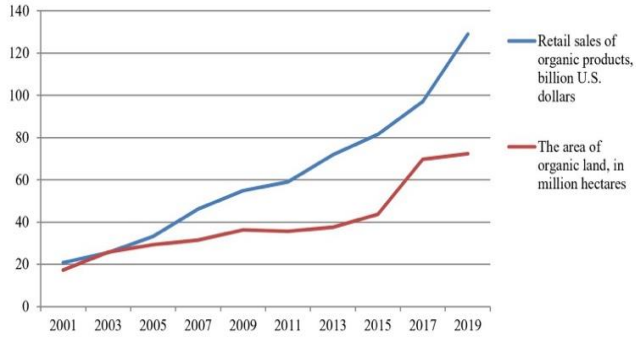

Figure 1. Total area and sales of organic products in the world, 2001-2019
Source: The Food and Agriculture Organization of the United Nations

It is important to note that according to the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, the country occupies a key position in organic agriculture in Central Asia. The area of organic farming in Kazakhstan in 2021 amounted to about 300 thousand hectares, which is almost six times more than in 2001 (Figure 2). The country produces more than 25 types of crops organically, with 19 companies engaged in processing organic products. At the same time, the country ranks 6th in the area of organic farming among Asian countries. It is important to note that Kazakhstan is characterized by significant potential for the development of organic agriculture due to the availability of ecologically clean agricultural land and the growing interest of the population in organic products.

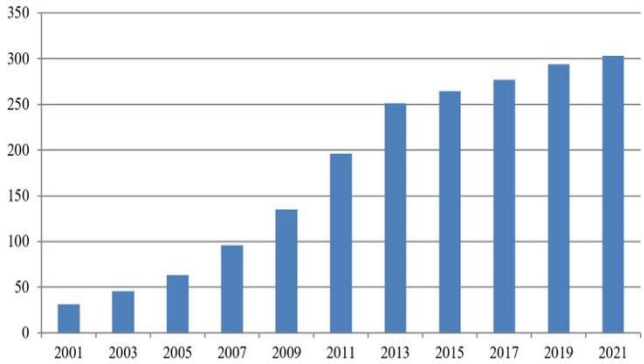

Figure 2. The area of land under organic farming in the Republic of Kazakhstan in 2001-2021, million hectares
Source: The Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan

Thus, the sector of organic production in Kazakhstan and the world as a whole is developing dynamically, and concern for a healthy lifestyle and the environment is the main motive for the purchase of food, the prices of which are about 30-50% higher than average. In the course of the field trial, the regularities of changes in the yield of spring barley grain when using organic fertilizers were determined. Thus, it was found that the crop uses the effect of litter manure, as well as responds to the direct effect of by-products even without the use of biodestructors. The study found that the highest yield (4.39 t/ha) and the largest increase in grain yield (0.57 t/ha) were when using the fertilizer with straw by-products and with Ecostern biodestructor, which added 14.9% relative to the control variant (Table 1).

Table 1. Yield of spring barley grain under organic farming system, average for 2019-2021

Variant	Yield, t/ha	Increase to control, t/ha	% of control
Without fertilizers (control)	3.82	-	-
Variant A	4.39	0.57	14.9
Variant B	4.25	0.43	11.3
NIR05	0.13	0.06	-

The development of agricultural products obtained by ecological methods is, as in the case of any other production, conditioned by the demand for products and their economic efficiency. Economic efficiency of crop production is the result expressed by the payback of resources and costs in the process of production, and the main indicator of economic efficiency of cultivation is conditionally net income.

Economic indicators of growing crops indicate the feasibility of using a particular agronomic measure in the technological process of cultivation, but at the same time they may vary depending on the pricing policy in the state and the world market for organic food products. As a result of calculating the economic efficiency of spring barley growing under organic farming system it was determined that the highest profit (292 USD/ha) and, accordingly, the level of profitability of 118% were obtained in the variant of applying 50 tons/ha of manure with straw by-products with biodestructor. Profitability indices in the control variant and in the variant of applying 50 t/ha of manure with straw by-products without biodestructor were 97 and 109%, respectively (Table 2).

Table 2. Economic efficiency of spring barley growing under organic farming system, 2019-2021

Variant	The cost of 1 ton of production, USD	Profit, USD/ha	Profitability, %
Without fertilizers (control)	104.6	207.9	97
Variant A	91.5	292	118
Variant B	94.6	274.2	109

Therefore, summarizing the results of research on spring barley cultivation, one can assert that the system of ecologically sustainable agriculture allows a producer to receive income and at the same time to grow environmentally friendly products. This is mainly possible due to the following factors:

1. The use of biological plant protection, which reduces the cost of purchasing chemicals and saves on the cost of their processing.
2. The increase in the price of environmentally friendly products. Today, more and more consumers are striving to buy healthy and environmentally friendly products. Therefore, prices for those products are usually higher than for conventional ones.
3. Improving the quality of the soil and reducing the cost of fertilizing it. Due to the use of biological and fertile green fertilizers, the number of beneficial microorganisms in the soil grows, increasing its fertility.
4. Reducing energy costs. The eco-sustainable agriculture system also involves the use of alternative energy sources, such as solar panels or wind turbines. This approach reduces energy costs and makes production more environmentally friendly.

Thus, the eco-sustainable agriculture system enables producers to receive income and at the same time grow environmentally friendly products, which may be beneficial in the long term. It is also important to note that for the Republic of Kazakhstan, taking into account the depletion and degradation of soils, secondary salinization, erosion, water scarcity, as well as soil pollution by chemicals, it is crucial to increase the use of organic fertilizers, as they can have a regenerative effect on the soil.

5. DISCUSSION

Sustainable agriculture and organic farming are first and foremost a system that has a positive impact on the natural environment, which in turn contributes to the widely understood agroecological benefits. On the other hand, organic farming is a response to the changing structure of market demand and growing consumer awareness, and growing consumer interest means more opportunities to sell organic products [13, 24].

Jiang et al. [25] believe that in the system of ecologically sustainable agriculture, products are produced in a sustainable natural environment and have very high-quality indicators, are safe for health, do not contain harmful compounds or chemical and genetic modifications [25]. Organic food differs from conventional food with lower content of nitrates and nitrites, as well as pesticides, and higher content of dry matter, phenolic compounds, vitamins, and some minerals. The advantage of organic products is that they are subject to continuous monitoring and certification, which allows one to maintain the proper level of quality at each stage of production [26].

The concept of sustainable development implies the maintenance of constant socio-economic progress and harmonizes with the state of the natural environment and means maintaining a balance in at least three dimensions: economic, social, and ecological.

Rockström et al. [27] believes that one of the main areas of discussion is the profitability of organic production compared to conventional agriculture. This problem is associated with the volatility of prices for organic agricultural products compared to those grown by traditional agriculture. The weaknesses of this system of farming are the high cost of production, lack of developed distribution network, the fragmentation of supply and demand, and short storage time of products [27].

However, Smith et al. [19] proved that organic products are becoming more popular every year, which provides an opportunity to increase and diversify the range of organic products, and in the future, perhaps, lower their prices, which will encourage consumers to turn to this type of food more often, which is also confirmed by the study [19]. In addition, R. Singh argues that the economic benefits in the form of farm income in organic farming can usually be higher than in conventional farming. However, this largely depends on regional conditions and the type of agricultural production [28].

The study also correlates with the opinion of Froehlich et al. [29], who argue that organic farming can bring a stable high income and be a sustainable alternative to the prevailing traditional agricultural model [29, 30].

Scientists have identified several important effects of organic farming. Compared to conventional farming, they noted such phenomena as reduced use of plant protection products and less soil degradation [31], reduced soil erosion and increased soil fertility [32], reduced greenhouse gas emissions [9], minimized loss of nitrogen in the biological system [10]. This confirms the compliance of organic farming with the principles of sustainable development.

Thus, the development of organic farming is an opportunity equally for sustainable production and consumption. However, it is important to convey to consumers the importance of sustainable consumption for the health and life of both current and future generations, as well as the need to take care of social well-being, which is the natural environment and environmental resources [33].

It is very important that organic farming through the return of organic matter to the soil contributes to increasing its fertility and crop yields, which was also noted in the study conducted. In this regard, soils tend to have a higher content of organic matter, which leads to the fact that they are less prone to erosion and can hold more water. Accordingly, organic management practices in ecologically sustainable agriculture can prevent soil degradation and provide restoration of already degraded soils [34, 35].

One of the possible limitations of the economic trend in the development of eco-sustainable agriculture and organic farming may be the lack of integration of economic, social, and environmental aspects in research. For example, research may focus mainly on the economic aspects of eco-producers. In this case, studies do not consider their impact on the environment and social aspects, such as employment and income of residents [28-31].

The diversity of rural regions and different growing conditions may complicate the generalization of research results. Some cultivation methods may be effective for some regions but not produce the same results in others. In addition, there is a possibility of problems with the collection and analysis of data on the financial performance of eco-farms. These data may be insufficient or limited. This especially applies to small-scale industries. In their case, the lack of relevant data can impair the industries' efficiency and their impact on the local economy.

The main practical management ideas and innovative conclusions that can support the development of eco-sustainable agriculture and organic farming:

1. The introduction of eco-friendly plant cultivation methods can reduce the cost of chemical fertilizers, pesticides, and other harmful substances, thereby lowering production costs.
2. The development of eco-friendly products supported by government programs, as well as incentive measures for farmers and other market participants, can increase the demand for these products and make them more accessible to consumers.
3. The use of technologies and innovations, such as eco-friendly irrigation systems or energy-efficient water and electricity conservation devices, can improve production efficiency and reduce environmental impact.
4. The developed interaction between farmers and consumers can help increase demand for eco-friendly products and ensure market stability.
5. The close cooperation between scientists, government agencies, farmers, and businesses can help develop and implement innovative technologies and methods that improve product quality and reduce environmental impact.

Based on the results obtained, the prospect of further research could be the study of qualitative indicators of organic products, as well as additional research on the profitability of growing other types of crops, such as legumes, oilseeds, vegetables or fruits and berries.

6. CONCLUSIONS

The problems of increasing population, global economic growth, degradation of natural resources, as well as climate change, lead to the integration of elements of environmental sustainability in agricultural production processes. Recent years are characterized by a growing share of organic farming in the management of agricultural land. The increasing demand for organic products in the world is primarily due to the growing awareness of consumers about the impact of food quality on human health.

Sustainable agriculture consists of methods to minimize the depletion of natural resources, retain more carbon and organic matter in the soil, and reduce erosion. Organic agriculture, in turn, involves the integration of environmentally friendly practices that are characterized by low external costs, thereby increasing the availability of food for the population.

The implementation of the principles of sustainable development can be an important differentiating factor in the market for agricultural products. They provide a better basis for risk management by reducing the amplitude of price and income fluctuations. As a consequence, the development of an effective strategy that takes into account the principles of sustainable development can be an important element of creating advantage and competitiveness.

World statistics show an annual increase in the amount of total area and sales of organic products. In Kazakhstan, despite the fact that the market of organic products is small, there is a tendency of its dynamic growth, as in 2021 the area of organic farming in the country was about 300 thousand hectares, which is almost six times more than in 2001.

In the course of field testing, it was found that under the organic farming system with the introduction of 50 t/ha of manure with straw by-products and using biodestructor, the maximum indicators of spring barley grain yield (4.39 t/ha) and profitability (118%) were obtained. In this regard, it can be argued that the system of sustainable agriculture enables a producer to grow environmentally friendly products and at the same time receive a stable income.

The novelty of the present study is the research on the relationship between economy and ecology in agriculture and agriculture. In addition, this study reveals how environmentally sustainable agriculture can become economically profitable. This study's limitations are the possible problems with data collection and interpretation of market trends and demand for eco-products. These limitations are due to the existing problems of determining market prices for organic products and the dependence of the market on various factors. The direction of further research may be aimed at more in-depth research on the impact of environmental sustainability on the economic performance of ecological farms. Further studies may also investigate the market in terms of the demand for organic products.

The practical and scientific value of the study results is their possible use in the development of standards and practical approaches to the development of organic agricultural

production and sustainable agriculture and will contribute to solving environmental problems in the use and protection of land resources and the environment.

REFERENCES

[1] Lemeilleur, S., Allaire, G. (2019). Participatory Guarantee Systems for organic farming: reclaiming the commons. In: Working Papers MOISA 2019-2 (No. 914-2019-3059). Institut National de Recherche pour l'agriculture, l'alimentation et l'environnement (INRAE), France. https://doi.org/10.22004/ag.econ.292325

[2] Ahmed, N., Thompson, S., Turchini, G.M. (2020). Organic aquaculture productivity, environmental sustainability, and food security: Insights from organic agriculture. Food Security, 12: 1253-1267. https://doi.org/10.1007/s12571-020-01090-3

[3] Willer, H., Lernoud, J., Huber, B., Sahota, A. (2019). The World of Organic Agriculture, Statistics and Emerging Trends 2019 at BIOFACH 2019. Organic and Beyond Company, Frick, Switzerland. https://www.organicworld.net/yearbook/yearbook-2019.html, accessed on Jan. 17, 2022.

[4] Ayapova, J.M. (2017). Indicators and criteria for assessing the state of food security: The experience of Kazakhstan and foreign countries. Proceedings of the Voronezh State University of Engineering Technologies, 79(1): 445-450. https://doi.org/10.20914/2310-1202-2017-1-445-450

[5] Willer, H., Sahota, A. (2020). The world of organic agriculture, statistics and emerging trends 2020 at BIOFACH 2020. Messezentrum Nürnberg, Germany: Unpublished. https://orgprints.org/id/eprint/37557/, accessed on Jan. 17, 2022.

[6] Yuan, M. (2021). Geographical information science for the United Nations' 2030 agenda for sustainable development. International Journal of Geographical Information Science, 35(1): 1-8. https://doi.org/10.1080/13658816.2020.1766244

[7] Yoshikawa, Y. (2022). Japan's Food Self-Sufficiency Debate Overlooks the Core Problem. The Diplomat. https://thediplomat.com/2022/05/japans-food-self-sufficiency-debate-overlooks-the-core-problem/, accessed on Jan. 17, 2022.

[8] Singh, M. (2021). Organic farming for sustainable agriculture. Indian Journal of Organic Farming, 1(1): 1-8. https://www.cpublishingmedia.com/wp-content/uploads/2020/11/Organic-Farming-for-Sustainable-Agriculture.pdf, accessed on Jan. 17, 2022.

[9] Veldhuizen, L.J., Giller, K.E., Oosterveer, P., Brouwer, I.D., Janssen, S., van Zanten, H.H., Slingerland, M.A. (2020). The Missing Middle: Connected action on agriculture and nutrition across global, national and local levels to achieve sustainable development goal 2. Global Food Security, 24: 100336. https://doi.org/10.1016/j.gfs.2019.100336

[10] Tahat, M.M., Alananbeh, K.M., Othman, Y.A., Leskovar, D.I. (2020). Soil health and sustainable agriculture. Sustainability, 12(12): 4859. https://doi.org/10.3390/su12124859

[11] Malkanov, B.S., Auteleyeva, L.T., Ismagulova, G.T., Wisniewski, J., Belkot, Z., Anusz, K. (2020). Quality and safety of agricultural products in the Shuchinsk-Burabay Resort Zone. Fish. Medycyna Weterynaryjna-Veterinary Medicine-Science and Practice, 76(10): 585-588. https://doi.org/10.21521/mw.6462

[12] Lu, H.L., Chang, Y.H., Wu, B.Y. (2020). The compare organic farm and conventional farm to improve sustainable agriculture, ecosystems, and environment. Organic Agriculture, 10(4): 409-418. https://doi.org/10.1007/s13165-020-00278-3

[13] Aschemann-Witzel, J., Ares, G., Thøgersen, J., Monteleone, E. (2019). A sense of sustainability? How sensory consumer science can contribute to sustainable development of the food sector. Trends in Food Science & Technology, 90: 180-186. https://doi.org/10.1016/j.tifs.2019.02.021

[14] Mariappan, K., Zhou, D. (2019). A threat of farmers' suicide and the opportunity in organic farming for sustainable agricultural development in India. Sustainability, 11(8): 2400. https://doi.org/10.3390/su11082400

[15] Alim, I.D., Lup, A. (2019). Organic farming: From definitions and concepts to the agricultural business and even politics. Scientific Papers. Series "Management, Economic Engineering in Agriculture and Rural Development", 19(2): 11-16. https://managementjournal.usamv.ro/pdf/vol.19_2/Art1.pdf, accessed on Jan. 17, 2022.

[16] Nafil, A., Bouzi, M., Anoune, K., Ettalabi, N. (2020). Comparative study of forecasting methods for energy demand in Morocco. Energy Reports, 6: 523-536. https://doi.org/10.1016/j.egyr.2020.09.030

[17] Viana, C.M., Freire, D., Abrantes, P., Rocha, J., Pereira, P. (2022). Agricultural land systems importance for supporting food security and sustainable development goals: A systematic review. Science of the Total Environment, 806: 150718. https://doi.org/10.1016/j.scitotenv.2021.150718

[18] Kim, K., Kim, S., Park, C.Y. (2020). Food Security in Asia and the Pacific amid the COVID-19 Pandemic. Asian Development Bank (ADB), Mandaluyong, Philippines. https://dx.doi.org/10.22617/BRF200176-2

[19] Smith, O.M., Cohen, A.L., Rieser, C.J., Davis, A.G., Taylor, J.M., Adesanya, A.W., Jones, M.S., Meier, A.R., Reganold, J.P., Orpet, R.J., Northfield, T.D., Crowder, D.W. (2019). Organic farming provides reliable environmental benefits but increases variability in crop yields: A global meta-analysis. Frontiers in Sustainable Food Systems, 3: 82. https://doi.org/10.3389/fsufs.2019.00082

[20] FAO. (2022). FAOSTAT Database. http://www.fao.org/faostat/en/#data, accessed on Jan. 17, 2022.

[21] IFOAM. (2023). Official web site. https://www.ifoam.bio/, accessed on Jan. 17, 2022.

[22] Stat Gov. (2023). Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. https://stat.gov.kz/search, accessed on Jan. 17, 2022.

[23] Ministry of Agriculture of the Republic of Kazakhstan. (2023). Official web site. https://www.gov.kz/memleket/entities/moa?lang=kk, accessed on Jan. 17, 2022.

[24] Yadava, A.K., Komaraiah, J.B. (2021). Benchmarking the performance of organic farming in India. Journal of Public Affairs, 21(2): e2208.

https://doi.org/10.1002/pa.2208
[25] Jiang, G., Ameer, K., Kim, H., Lee, E.J., Ramachandraiah, K., Hong, G. P. (2020). Strategies for sustainable substitution of livestock meat. Foods, 9(9): 1227. https://doi.org/10.3390/foods9091227
[26] Borowski, P.F., Patuk, I. (2021). Environmental, social and economic factors in sustainable development with food, energy and eco-space aspect security. Present Environment & Sustainable Development, 15(1): 153-169. https://doi.org/10.15551/pesd2021151012
[27] Rockström, J., Williams, J., Daily, G., Noble, A., Matthews, N., Gordon, L., Wetterstrand, H., DeClerck, F., Shah, M., Steduto, P., de Fraiture, C., Hatibu, N., Unver, O., Bird, J., Sibanda, L., Smith, J. (2017). Sustainable intensification of agriculture for human prosperity and global sustainability. Ambio, 46: 4-17. https://doi.org/10.1007/s13280-016-0793-6
[28] Singh, R., Jat, N.K., Ravisankar, N., Kumar, S., Ram, T., Yadav, R.S. (2019). Present status and future prospects of organic farming in India. In: R.S. Meena (ed) Sustainable Agriculture, pp. 275-299. Scientific Publishers, India. https://krishi.icar.gov.in/jspui/bitstream/123456789/39563/1/sustainable%20agriculture_Chapter%2012%20-9-33.pdf, accessed on Jan. 17, 2022.
[29] Froehlich, A.G., Melo, A.S., Sampaio, B. (2018). Comparing the profitability of organic and conventional production in family farming: Empirical evidence from Brazil. Ecological Economics, 150: 307-314. https://doi.org/10.1016/j.ecolecon.2018.04.022
[30] Rajam, G.S.M. (2021). Sustainable agriculture through organic farming in India. Agriculture and Food: E-Newsletter, 3(5): 172-175. https://www.researchgate.net/publication/351411170_Sustainable_Agriculture_through_Organic_Farming_in_India, accessed on Jan. 17, 2022.
[31] Artuzo, F.D., Allegretti, G., Santos, O.I.B., da Silva, L.X., Talamini, E. (2021). Emergy unsustainability index for agricultural systems assessment: A proposal based on the laws of thermodynamics. Science of the Total Environment, 759: 143524. https://doi.org/10.1016/j.scitotenv.2020.143524
[32] Jain, M., Solomon, D., Capnerhurst, H., Arnold, A., Elliott, A., Kinzer, A.T., Knauss, C., Peters, M., Rolf, B., Weil, A., Weinstein, C. (2020). How much can sustainable intensification increase yields across South Asia? A systematic review of the evidence. Environmental Research Letters, 15(8): 083004. https://doi.org/10.1088/1748-9326/ab8b10
[33] Guiné, R.P., Florença, S.G., Barroca, M.J., Anjos, O. (2020). The link between the consumer and the innovations in food product development. Foods, 9(9): 1317. https://doi.org/10.3390/foods9091317.
[34] Araujo-Enciso, S.R., Fellmann, T. (2020). Yield variability and harvest failures in Russia, Ukraine and Kazakhstan and their possible impact on food security in the Middle East and North Africa. Journal of Agricultural Economics, 71(2): 493-516. https://doi.org/10.1111/1477-9552.12367
[35] Lotter, D.W., Seidel, R., Liebhardt, W. (2003). The performance of organic and conventional cropping systems in an extreme climate year. American Journal of Alternative Agriculture, 18(3): 146-154. https://doi.org/10.1079/AJAA200345