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INCREASING FOOD QUALITY AT SMART FARMS AS A PROMISING PATH FOR THE SUSTAINABLE DEVELOPMENT OF AGRICULTURE AND FOOD SECURITY

Abstract: *We elaborate on the features of the impact of smart farms (technologies), used for the improvement of product quality, on the UN SDGs that are connected with food security and sustainable development of the agrarian sector.*

The presented specifics of the implementation of smart technologies are considered in the context of the creation of farms, which structure and organisation are based on innovative digital, genetic and process solutions (experience of China) and in the context of the use of certain optimisation solutions (experience of other leading countries in the sphere of agriculture). We show the necessity to solve the problems of product quality through the implementation of technologies that can oppose climate change and are aimed at environmental protection.

The methods used in this work include the method of complex analysis, statistical method and method of classification.

The scientific novelty of this research lies in the identification of the modern characteristics of the influence of smart farms (technologies), used for the increase in product quality, on the social and economic Sustainable Development Goals.

Keywords *Food quality, Agricultural production, Smart farms, Digital technologies, Climate change, Biodiversity, Agriculture, Crop yield.*

1. Introduction

A food crisis is a threat to the lives of millions of people and a danger for countries most of which population are below the poverty line. The problem of famine in the 21st century, where there are a lot of new opportunities and solutions, from artificial intelligence to new forms of responsible management of consumption in developed countries, shows that all parties that can solve it must be involved in this process. Although food problems mostly concern poor underdeveloped countries, improvement of food quality and expansion of the opportunities for independent provision of the main categories of agricultural products will allow reducing their export in countries that are world-leading food exporters. In its turn, this will allow expanding the opportunities for solving the problem of famine in the most underdeveloped countries and will support national food security.

Effective functioning of agriculture is connected with crop yield, the quality of

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agricultural land use, productivity of cattle breeding, level of seed quality and livestock feed, and proper climate and technical conditions that are required for each sector of agrarian production. These components are the basis of the quality of agricultural products and influence the effectiveness of the business in this sphere (Sofina, 2019). Developments in the digital economy and R&D in the agrarian sector, along with their hybrid models, allow creating new technological solutions and implement the so-called smart farms of various scales. Wide dissemination of such structures, oriented at the increase in food quality, is a precondition for achieving the Sustainable Development Goals that are connected with food security and agriculture.

In this paper, we aim to identify the features of the achievement of food products quality improvement under the conditions of the functioning of smart farms, as the promising path for sustainable development for agriculture and food security. For this, we determine the leading countries in agricultural production, dwell on the rating positions of the countries by the efficiency of the indicators of food security and agriculture, elaborate on the rating of the countries by the indicator of state regulation of product quality standards (including agrarian), evaluate the level of the leading countries in agricultural production by the indicator of the efficiency of the agrarian sphere and regulation of the quality of agricultural products' standards, and identify and characterise the specifics of the improvement of the quality of food products given the implementation of smart farms.

2. Materials and method

To discover the specifics of the influence of smart farms as the basis for product quality growth on the SDGs in the context of food security achievement and agriculture, we studied the works devoted to this problem at the level of separate countries. These include the works of Sofina (2019), Monroy-Torres et al. (2021), John and Babu (2021), Kassa (2017), Iitembu et al. (2022), Birhanu et al. (2022), Erenstein et al. (2022), Obembe et al. (2021), Ceglar et al. (2020), Laidig et al. (2021), Abdelmageed et al. (2019), Polukhin et al. (2021), Zhang (2018), and Washizu and Nakano (2022). The above works allowed formulating the specifics of implementing smart farms in countries that demonstrate effectiveness in this direction.

The methods used in this research are as follows: the method of complex analysis is used to assess the state and effect of the implementation of smart technologies in the activities of national agrarian sectors; the statistical method is used to determine data on the indicators of the considered sector's functioning; the method of classification is used to systematise the features of the influence of smart farms (technologies) on the studied variables.

3. Results

The modern leading countries in agricultural production have rich traditions and, at the same time, solve food security problems. The leaders in agricultural production are listed in Table 1.

The countries (Table 1) are world leaders in the sphere of agricultural production. These countries satisfy the domestic demand for food and influence food security in the world, including in the most underdeveloped countries.

The specific features of the leading countries in agricultural production are as follows:

- In the context of the main types of products that are produced and sold in the markets (including export). The leaders in wheat production are China, India, and the Russian Federation. The USA and China are leaders in the production of corn. In the USA, the achievements of modern genetics and smart technologies within the main processes of crop growing and harvesting are used (Erenstein et al., 2022);

- Smart farms are used in specific types of activities, for functional support in the agrarian business. In China, this direction acquired the scale of a national programme due to the country's focus on an increase in food security and the goal to achieve world leadership in this sphere.

Table 1. Specific features of the leading countries in the sphere of agricultural production.

Country	Specific features of agricultural production	Specific indicators
China	World leader in the production of vegetables, fruits, poultry, grain, and eggs. Food security is based on rice, corn and wheat. These crops account for 90% of the agrarian production in China. Smart farms have been implemented since 2019; they include vertical plantations on walls; growing crops along roads.	Vegetable production volume: 500 million tons per year (50% of world vegetable production). Agricultural products export equalled $133,100 billion in 2019. Agricultural potential and productivity: grain production accounts for 25% of world production; cotton production equals 26.5 million bales.
USA	Wheat, soy, corn, and cotton are the main agricultural products. Government support for reconstructive and climate-oriented agriculture (subsidies for programmes in this sphere equal $20 billion in 2022). In the sphere of implementation of smart agriculture, isolated intellectual solutions are used, without a comprehensive approach.	The main agricultural products account for 90% of all crop areas. The first position in production belongs to corn (247.882 million tons per year), and the second – to soy (74.6 million tons per year). Agriculture and adjacent sectors account for 5% of the national GDP.
Brazil	Main types of agricultural products: soybeans, cassava, coffee, sugar, beans, cotton, corn, rice, wheat, and bananas. The implementation of smart agriculture is peculiar for the use of climate optimisation programmes that are aimed at the improvement of land, and provision of food security at the national and international levels. The implementation of innovations in agriculture is characterised by the creation of flexible smart technologies, which are easily adapted to the climate conditions of various regions.	Soy crops account for 7% of Brazilian territory. Brazil is the world leader in coffee production. Crops are grown on 41% of Brazilian territory (0.861 billion acres). Revenues from selling agricultural products account for 25% of the national GDP.
India	World leader in the production of jute, milk and beans. The second largest producer of peanuts, wheat, rice, cotton, vegetables, sugar cane and fruits. India is among the top 20 producers of poultry, fish, cattle, plantation crops and spices. Smart agriculture was developed due to the national programmes of climate-optimised agriculture, with government support for climate-oriented start-ups. The implementation of smart farms allowed raising the quality of agrarian products and increasing their value added. Support for smart farms is to solve the problem of drought in certain regions and prevention of food security risks.	58% of the able-bodied population is involved in the sphere of agriculture. Revenues from cattle breeding and gardening account for 60% of the Indian agrarian sector's revenues. Revenues from agricultural activities account for 17.8% of the national GDP (2019-2020).

Russian Federation	Main crops: potato, oats, sunflower, barley, wheat, rye, and soy. The implementation of smart agriculture features the mandatory use of IT to detect the level of agrochemicals and pesticides; the use of digital engineering technologies to raise crop quality (use of new digital solutions in soybean production).	Wheat production occupies 21.9% of cultivated areas (23 million hectares). Grain production occupies 50 % of cultivated areas. Revenues from selling agrarian products account for 6% of the national GDP. Agriculture ensures 16 % of the employment of the able-bodied population.
France	Main products: pork, dairy products, beef, beet, potato, wheat and grape. The use of smart farms allows achieving the annual growth of value added from the sales of agricultural products - 4%. Subsidies for such farms are strictly regulated, most of the personnel and owners of the farms are aged 60+, no prospects for attracting the young generation. Low level of the speed of digitalisation due to the focus on traditions in agriculture and the focus on the EU standards of product quality.	730,000 farms in the country; 7% of the population work in forestry and agriculture.
Mexico	Main types of agricultural products: corn, fruits, eggs, poultry, dairy products, coffee, and sugar cane. Smart technologies are used for increasing the effectiveness of certain directions of agricultural production. As of year-end 2020, there were 127 smart farms in the country.	Cattle breeding occupies 50% of the country's territory, and crop production – 15 % of the country's territory.
Japan	Main agricultural products: rice, barley, soybeans, wheat, fruits, and vegetables. Integrated agriculture allows preserving the biodiversity of territories, which ensures the achievement of the SDGs in the context of the preservation of water and land resources.	Revenues from selling agricultural products account for 2% of the national GDP. About 10% of the able-bodied population works in agriculture. The average area of a farm is 1.2 hectares.
Germany	Main crops: barley, sugar beet, and wheat. Smart technologies are used for the maintenance of climate conditions, assessment of the chemical structure of products, and technical work.	World's third largest producer of barley (9.5 million tons per year). World's fourth largest producer of sugar beet (26 million tons per year). World's tenth largest producer of wheat (1 million tons per year). More than 80% of the territory is used for forestry and agriculture. More than 80% of farmers own land plots larger than 120 acres. Around 1 million people work in agriculture.
Turkey	Main types of agricultural products: poultry, dairy products, beef, grain, vegetables, and fruits. Smart technologies are used for digital apps for the analysis of soil, irrigation (cloud technologies); precise and effective use of fertilizers and pesticides; development and delivery of quality seeds and saplings (with the help of drones).	Turkey is the world's tenth-largest agricultural producer. About 20% of the able-bodied population work in agriculture.

Source: Created by the authors based on Tractorguru (2022), Nytimes (2022), Unfccc (2022), Ibef (2022), Tadviser (2022), Statista (2022), FAO (2022), and Polukhin et al. (2021).

Let us consider the countries' ranks by the indicator of food security, which is assessed through the indicator of Prevalence of undernourishment (Table 2). This is a percentage ratio of the population with undernourishment problems to the total population. Its value of 2.5% is the most common value for countries that have no food security threats.

Table 2. Dynamics of the indicator Prevalence of undernourishment for the selected countries

No.	Country	Value, %					Change			
		2018	2019	2020	2021	2022	2018-2019	2019-2020	2020-2021	2021-2022
1	USA	2.5	2.5	2.5	2.5	2.5	0	0	0	0
2	Ireland	2.5	2.5	2.5	2.5	2.5	0	0	0	0
3	China	9.6	8.7	8.6	2.5	2.5	-0.9	-0.1	-6.1	0
4	South Korea	2.5	2.5	2.5	2.5	2.5	0	0	0	0
5	France	2.5	2.5	2.5	2.5	2.5	0	0	0	0
6	Germany	2.5	2.5	2.5	2.5	2.5	0	0	0	0
7	Hungary	2.5	2.5	2.5	2.5	2.5	0	0	0	0
8	Luxembourg	2.5	2.5	2.5	2.5	2.5	0	0	0	0
9	Japan	2.5	2.5	2.5	2.5	2.5	0	0	0	0
10	Italy	2.5	2.5	2.5	2.5	2.5	0	0	0	0
11	Brazil	2.5	2.5	2.5	2.5	2.5	0	0	0	0
12	Canada	2.5	2.5	2.5	2.5	2.5	0	0	0	0
13	Turkey	2.5	2.5	2.5	2.5	2.5	0	0	0	0
14	Israel	2.5	2.5	2.5	2.5	2.5	0	0	0	0
15	Russian Federation	2.5	2.5	2.5	2.5	2.5	0	0	0	0
16	Kazakhstan	2.5	2.5	2.5	2.5	2.5	0	0	0	0
17	Lithuania	2.5	2.5	2.5	2.5	2.5	0	0	0	0
18	Egypt	4.5	4.8	4.5	4.7	5.4	0.3	-0.3	0.2	0.7
19	Mexico	4.2	3.8	3.6	7.1	7.2	-0.4	-0.2	3.5	0.1
20	India	14.5	14.8	14.5	14	15.3	0.3	-0.3	-0.5	1.3
21	Ethiopia	28.8	21.4	20.6	19.7	16.2	-7.4	-0.8	-0.9	-3.5
22	Namibia	28.8	25.4	27.3	14.7	19.8	-3.4	1.9	-12.6	5.1
23	Mozambique	26.6	30.5	27.9	32.6	31.2	3.9	-2.6	4.7	-1.4
24	Republic of Congo	28.2	37.5	40.3	37.7	37.7	9.3	2.8	-2.6	0
25	North Korea	40.8	43.4	47.8	47.6	42.4	2.6	4.4	-0.2	-5.2
26	Haiti	46.8	45.8	49.3	48.2	46.8	-1	3.5	-1.1	-1.4

Source: created by the authors based on Sdgindex (2018), Sdgindex (2019), S3.amazonaws (2020), Sdgindex (2021), and Sdgindex (2022).

The analysis showed that food security in the context of the considered indicator has been ensured in most countries that demonstrate a high level of agricultural production (the USA, France, Germany, Japan, Brazil, Turkey, and the Russian Federation) and in other countries with high economic growth rate (Table 2). Such leaders in the sphere of agricultural production as Mexico (4.2% in 2018, 3.8% in 2019, 3.6% in 2020, 7.1% in 2021, and 7.2% in 2022) and India (14.5% in 2018, 14.8% in 2019, 14.5% in 2020, 14% in 2021, and 15.3% in 2022) demonstrated a decrease in the considered indicator.

Certain tendencies of regress on the considered indicator in Mexico are the lowest for countries of Central America (Statista, 2022). The categories of population that face undernourishment include mostly people from disadvantaged families (including children. Despite Mexico being the export of agricultural products, it still has problems with food security. According to Monroy-Torres, et al. (2021), the problem of undernourishment in Mexico, as well as the general problem of food security, increased during the pandemic and in the post-pandemic period (2020-2022). During this period, the provisions of the law on the right of all citizens to food were neglected, because food producers reduced the quality of food. This reduction was connected with the growth of water and air pollution and an increase in waste. All these factors led to the reduction of the food production level and the dissemination of undernourishment as the basis for the emergence of the risks to the SDGs in the sphere of food security. Further implementation of smart technologies, which are used at the modern stage in 44.5% of all farms in the country (Monroy-Torres, et al., 2021) should facilitate the resolution of problems of production quality support. A decrease in the use of *the milpa* system, which implies intercropping, connected with the absence of the required workforce, led to the reduction of food volumes at the level of farms (Novotny et al., 2021). The transition to monocultures led to the reduction of nutrition value and product quality of food consumers by the local population of certain rural territories of Mexico. Accordingly, the return to the technologies of *milpa* and the use of digital technologies, which would stimulate ecologisation and growth of yields will allow reaching the country's food security goals.

A significant level of malnutrition is also peculiar to India. This is caused by the transition to the production of monocultures and the disappearance of certain crops that were grown by households for their own needs. The process of the "green revolution" in India's agriculture, which took place in the 1960s, allowed raising the level of food security and reducing the level of malnutrition. This process was connected with the growth of productivity and increased use of pesticides, which reduce the quality of food products and value added during export. The implementation of technological solutions, which stimulate the growth of agricultural production, in 2018-2021 led to the reduction of product quality in the context of generally acknowledged standards (John and Babu, 2021).

We should also mention the achievements of China, which was able to ensure the reduction of the level of Prevalence of undernourishment down to the indicator of developed countries, this taking place in the post-pandemic period. In 2018, this indicator equalled 9.6%, in 2019 – 8.7%, in 2020 – 8.6%, and 2021-2022 – 2.5%. Such positive results were due to the realisation of the national programme in the sphere of smart farm implementation.

Table 2 contains the values of the undernourishment indicator in the poorest countries of the world, namely:

- Ethiopia, which, however, has positive transformations due to the use of smart technologies in the selection of optimal sorts of grain (corn) under different climate conditions (Kassa, 2017). For this, the means of AI (big data) were used – to determine the most acceptable sorts of corn for growing (Birhanu et al., 2022). This led to an increase in national food security;
- Namibia, where certain improvements in the stabilisation of food security were connected with the creation of aqua farms, which allows addressing the problem of malnutrition and improving the national GDP. At present, legislative consolidation of a range of measures that facilitate the liberalisation of doing business in this sphere takes place (Iitembu et al., 2022). The functioning of aqua farms implies the use of technologies for preserving biological diversity during agricultural production;
- Mozambique, the Republic of Congo, North Korea, and Haiti. Not all of these countries have a low level of agricultural productivity (e.g., North Korea demonstrates certain improvements in the agrarian

sphere), but all of them have insufficiently effective technologies of management in this sector.

The indicator of the SDGs in the context of agriculture efficiency is considered using the indicator Cereal yield in Table 3.

Table 3. Dynamics of the indicator Cereal yield in the selected countries.

No.	Country	Values, tonnes per hectare of harvested land					Change			
		2018	2019	2020	2021	2022	2018-2019	2019-2020	2020-2021	2021-2022
1	USA	8.1	8.1	8.3	8.7	8.7	0	0.2	0.4	0
2	Ireland	8.2	8.2	8.8	7.1	7.1	0	0.6	-1.7	0
3	France	5.7	5.7	6.9	6.9	6.9	0	1.2	0	0
4	South Korea	6.8	6.8	6.7	6.6	6.6	0	-0.1	-0.1	0
5	Hungary	5.1	5.1	5.8	6.3	6.3	0	0.7	0.5	0
6	Germany	7.2	7.2	7.3	6.2	6.2	0	0.1	-1.1	0
7	Egypt	7.1	7.1	7.3	7.1	7.1	0	0.2	-0.2	0
8	China	6	6	6	6.1	6.1	0	0	0.1	0
9	Japan	5	5	6	5.9	5.9	0	1	-0.1	0
10	Luxembourg	5	5	5.3	5.9	5.9	0	0.3	0.6	0
11	North Korea	4.1	4.1	4	3.6	3.6	0	-0.1	-0.4	0
12	Brazil	4.2	4.2	5.2	4.8	4.8	0	1	-0.4	0
13	Italy	5.6	5.6	5.2	5.3	5.3	0	-0.4	0.1	0
14	Israel	5	5	3.6	3	3	0	-1.4	-0.6	0
15	Canada	3.9	3.9	4	3.9	3.9	0	0.1	-0.1	0
16	Lithuania	3.9	3.9	4.2	3.2	3.2	0	0.3	-1	0
17	Turkey	3.1	3.1	3.3	3.2	3.2	0	0.2	-0.1	0
18	Mexico	3.7	3.7	3.8	3.8	3.8	0	0.1	0	0
19	India	3	3	3.2	3.2	3.2	0	0.2	0	0
20	Russian Federation	2.7	2.7	3	2.6	2.6	0	0.3	-0.4	0
21	Kazakhstan	1.3	1.3	1.4	1.4	1.4	0	0.1	0	0
22	Ethiopia	2.5	2.5	2.5	2.4	2.4	0	0	-0.1	0
23	Namibia	0.5	0.5	0.4	0.5	0.8	0	-0.1	0.1	0.3
24	Republic of Congo	0.8	0.8	0.8	0.8	0.8	0	0	0	0
25	Mozambique	0.8	0.8	0.9	0.8	0.8	0	0.1	-0.1	0
26	Haiti	1	1	1.1	1.1	1.1	0	0.1	0	0

Source: created by the authors based on Sdgindex (2022), Sdgindex (2018), S3.amazonaws (2020), Sdgindex (2019) and Sdgindex (2021).

Only five out of ten leaders in agricultural production were able to achieve high (8-10 tons per hectare) and medium indicators of Cereal yield (5 – 7.9 tons per hectare).
The following countries demonstrated high values of the indicators:
- USA, in which there had been high climate losses of crops (14-21%)until 2017 – especially in the state of Kansas, the key region of winter wheat cultivation (14-21%) (Obembe et al., 2021). This was resolved with the help of implementing new solutions in R&D and digital technologies, which allowed assuaging the negative impact of weather change. Namely, new adapted sorts of wheat were introduced – they were able to withstand the negative impact of climate;
- France, where the increase in wheat yields was connected with the use of the means of AI in agriculture (Use of big data and analytics), which allowed forecasting the models of crop yield depending on climate

change (Ceglar et al., 2020). Thus, modern smart technologies positively influence the speed of solving problems in the determination of the optimal characteristics of seeds and the processes of agricultural production management in France;

- Germany (7.2 tons per hectare in 2018 and 2019; 7.3 tons per hectare in 2020; 6.2 tons per hectare in 2021 and 2022). As shown in Table 3, there was a certain reduction in cereal yield in 2020, caused by climate change and problems with the workforce which potential decreased after the COVID-19 pandemic. On the whole, the value of 6.2 tons per hectare is considered rather substantial. It was achieved in Germany and France due to the successful selection management under the conditions of climate change with the help of the use of big data and analytics. The research showed that climate change influences the sustainability of certain sorts of cereals and the plant structure (Laidig et al., 2021). Accordingly, geneticists face the necessity to create adaptable sorts. These directions of the vulnerability of the structure of sorts are determined with the help of the digitalisation of climate influence analysis;
- Egypt (7.1 tons per hectare in 2018 and 2019, 7.3 tons per hectare in 2020, and 7.1 tons per hectare in 2021 and 2022). Egypt conducts systemic work on the increase in food quality, connected with crop research, including wheat production. While at the end of the 20th century, Egyptian scholars in this sector focused on the creation of high-quality sorts that were able to ensure cereal quality, in the 2010s–2020s they applied digitalisation tools connected with robotisation in the systems of irrigation and seed planting. At present, the programmes on the use of smart digital technologies in the optimisation of seed planting spots, their robotised planting, monitoring of the quality of the processes of growth and creation of unique adaptable sorts that are resilient to deficit irrigation and abiotic stress are developed (Abdelmageed et al., 2019);
- China (6 tons per hectare in 2018, 2019, and 2020, 6.1 tons per hectare in 2021 and 2022). As noted above, China has a national programme of implementation of smart farms, which will ensure sustainable growth of agricultural production and increase food security. Accordingly, an increase in wheat yields is connected with investments in the expansion of cultivated areas and financing of digital technologies that are used for works in the sector of the management of agricultural production processes. The current strategy of smart agriculture is a component of a new national strategy "One Belt. One Road", which implies the government's investing in the growth of the effectiveness of sectors' functioning and growth of product quality (Zhang, 2018). In the context of agriculture, this strategy envisages the focus on two directions: growth of quality products' export and meeting domestic demands;
- Japan (5 tons per hectare in 2018 and 2019, 6 tons per hectare in 2020, 5.9 tons per hectare in 2021 and 2022) (Table 3). Japan retained a medium level of cereal yield, without demonstrating high indicators. This was partially due to the insufficient focus on smart digital technological solutions. At the modern stage, the level of implementation of intelligent technologies in Japanese agriculture is assessed at 50%. Given the ageing of personnel and farmers in this sector, it is possible to assume that further development will be supported through the attraction of an external workforce or large-scale robotisation. Workers at Japanese farms are not ready enough for the use of new knowledge in the sphere of monitoring of the quality of crops and work standards. Thus, the government implements digitalisation projects, within which the work at technological lines that are used for planting, harvesting and irrigation works will be conducted in the automatic regime; deep knowledge and experience will not be required from workers (Washizu and Nakano, 2022).

Countries with a low level of agricultural productivity (mainly countries of Africa) and, accordingly, low quality of food products, have significant problems with food security.

Table 4 presents a rating of leading countries in agricultural production in the sphere of product quality regulation.

Table 4. Level of product quality regulation (including in the sphere of agricultural production).

No.	Country	Rank
1.	USA	21
2.	France	25
3.	China	77
4.	India	81
5.	Germany	13
6.	Brazil	84
7.	Mexico	70
8.	Japan	19
9.	Turkey	74
10.	Russian Federation	98

Source: created by the authors based on WIPO (2022).

It should be noted that Germany and Japan demonstrate a high level of quality standards regulation, while for the USA and France this level is medium. This is reflected in the management of the quality of products that are produced on farms that use smart digital technologies. The other six countries that are leaders in agricultural production have not formed the proper regulation of product quality standards, which leads to the corresponding threats in the sphere of food security.

4. Discussion

It was proved that the growth of the quality of food that is produced at smart farms and/or using smart digital technological solutions is the basis for the improved achievement of the SDGs given the productivity of the agrarian sector and food security. We described the specific features of the use of the tools of smart digital technologies by countries that are leaders in agricultural production. The most important tools include the following:

- Means of AI, connected with the analysis of big data and robotisation of main processes;
- Digital genetic engineering, responsible for the search, development and implementation of adaptive sorts of crops, which take into account current climate change;
- Digital applications, created with the use of programming, AI, and the Internet, allowing for monitoring of soil, assessment of climate characteristics, and analysis of the application of fertilisers and pesticides.

It was discovered that only China implements a strategic national programme on smart farms. China's achievements in this sphere show that the government policy is aimed at an increase in product quality, and this, in its turn, facilitates the growth of food security.

Other leading countries and countries that demonstrate positive tendencies in agriculture and food security use certain elements of digitalisation to solve the related tasks (increase in crop yield, reduction of environmental impact, preservation of biological diversity, creation of adaptive sorts of crops, and implementation of innovative production processes.

The discovered features of strict government regulation of quality facilitate the increase in food quality. This particularly applies to food products that are exported and contribute substantially to the growth of GDP. This measure is also a necessary condition for the provision of national food security of a country, connected with the prevention of famine and with quality of nutrition, as well as the absence of negative influence on the environment. As for the focus on food product quality and preservation of biological diversity, we should note the positive experience of Japan, which supports the sustainable development of land and water resources, ensuring agrarian production and food security.

5. Conclusion

The analysed experience of countries in the achievement of the agricultural products' quality in the context of the focus on smart technologies showed that most countries have positive results, which, apart from economic efficiency, affect the sustainable development of the sector, helping to reach zero hunger.

New solutions, developed with the use of R&D and digital tools, could be used by the poorest countries. In this issue, they may rely on international organisations and funds and certain developed countries. Provision of food security and achievement of high indicators of product quality will allow helping poor groups of the population and reducing quick climate change which takes place partially due to unregulated agricultural activities.

The perspectives of implementing smart farms (based on the experience of China) will allow dealing with the problem of rational use of territories where agricultural production is conducted (vertical plantations). The example of China demonstrated that rapid growth of the agrarian sector was achieved thanks to successful reforms with the use of digitalisation tools, with the proper support and control.

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