

CHAPTER 1

CURRENT TRENDS IN ECONOMIC DEVELOPMENT

TASKS OF SUSTAINABLE DEVELOPMENT OF ISRAELI AGRICULTURE: ITS ACHIEVEMENTS AND OPPORTUNITIES OF COOPERATION FOR UKRAINE

Nadiia Reznik¹, Serhii Dolynskiy², Anastasiia Savchuk³

¹Doctor of Science (Economics), Professor of the Department of Management, National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine, e-mail: nadya-reznik@ukr.net, ORCID: <https://orcid.org/0000-0001-9588-5929>

²Ph.D. (Economics), Associated Professor of the Department of Economics and Management, Carpathian Institute of Entrepreneurship, Open International University of Human Development «Ukraine», Khust, Ukraine, e-mail: dolynskiy74@gmail.com, ORCID: <https://orcid.org/0000-0002-6565-1264>

³Ph.D. (Economics), Associated Professor of journalism and advertising department, State university of trade and economics, Kyiv, Ukraine, e-mail: a.savchuk@knu.edu.ua, ORCID: <https://orcid.org/0000-0002-6960-6452>

Abstract. *The article is devoted to the coverage of Israel's experience in the field of agrarian and rural development and justification possible directions of implementation in Ukraine of Israeli positive practices. Consider the experience of the development of agriculture in Israel in the context of prospects for cooperation with Ukraine. To analyse the prerequisites for intensive development of the Israeli agro-industrial sector. To determine the achievements of Israeli agriculture. To highlight the current state of bilateral economic relations between Ukraine and Israel in the agrarian sphere and to determine promising areas of cooperation. Comparative-descriptive, historical-analytical, relevant, extrapolation. The article uses general scientific methods of induction and deduction. The first involves a transition in the process of cognition from individual knowledge to general knowledge, from the accumulated by the process of learning reliable individual facts before establishing certain regularities of the historical process, formulation of laws, which, in turn, contribute to the knowledge of individual phenomena, facts, processes, i.e. serve the basis of deduction – the transition from the general to the individual. Thus, the deductive method greatly facilitates and accelerates the process of historical research and provides an image of a certain historical phenomenon in the background general historical processes. The article helps us to consider experience of development of agriculture of Israel in context of perspectives of cooperation with Ukraine; to analyze premises of intense development of agro-industrial sector of Israel; to define achievements of agriculture of Israel; to show contemporary condition of economic relations between Ukraine and Israel in agrarian sphere and to define perspective directions of cooperation. On the basis of theoretical generalizations, scientific and applied approaches to ensuring the self-reproduction of rural development have been developed, its main principles have been defined, the observance of which ensures the achievement of the goals of sustainable development, guarantees the preservation of rural areas, rural lifestyles and rural traditions along with increasing efficiency of agricultural production.*

Keywords: *farming; rural development; sustainable development; agricultural production; cooperation; kibbutz; export; newest techniques; imports; agricultural products; agro-food sector.*

JEL Classification: Q 00, Q 01, Q 17, R 11

Formulas: 0; **fig.:** 0; **tabl.1;** **bibl.:** 28

Introduction. The article is devoted to studying the Israel experience in the agrarian and rural development and offering possible directions for implementing Israel positive practices in Ukraine. The scientific and applied approaches to the

provision of self-reproduction of rural development have been developed, its fundamental principles have been determined on the basis of theoretical summarizing. Its observance ensures the achievement of sustainable development goals, the preservation of the countryside, rural lifestyle, rural traditions and the increases of the agricultural efficiency.

Literature review. The analysis of literary sources on the implementation of foreign innovations in agriculture shows that a significant number of scientists studied this problem, namely: Shai Dotan, A. I. Gordiychuk, V. A. Ivanov, Ayal Kimhi, V. V. Kyrychenko, V. V. Lavruk, Yossi Offer, Alon Tal., O. I. Yankovska and others. However, taking into account the significant achievements of scientists, there is a need to further search for effective ways of implementing foreign experience in introducing innovations into the activities of domestic agricultural enterprises.

Aims. Consider the experience of the development of agriculture in Israel in the context of prospects for cooperation with Ukraine. To analyse the prerequisites for intensive development of the Israeli agro-industrial sector. To determine the achievements of Israeli agriculture. To highlight the current state of bilateral economic relations between Ukraine and Israel in the agrarian sphere and to determine promising areas of cooperation.

Methods. Comparative-descriptive, historical-analytical, relevant, extrapolation. The article uses general scientific methods of induction and deduction. The first involves a transition in the process of cognition from individual knowledge to general knowledge, from the accumulated by the process of learning reliable individual facts before establishing certain regularities of the historical process, formulation of laws, which, in turn, contribute to the knowledge of individual phenomena, facts, processes, i.e. serve the basis of deduction – the transition from the general to the individual. Thus, the deductive method greatly facilitates and accelerates the process of historical research and provides an image of a certain historical phenomenon in the background general historical processes.

Results. Israel has made significant progress in the development of its agro-industrial complex. Today, this country is a powerful exporter of fresh produce and a world leader in the field of agricultural technology, despite of the fact that Israel's geography is not optimal for farming. More than half of the country's area is desert and the climate and lack of water are not conducive to farming [1]. At the same time such factors only stimulated the rapid development of intensive agriculture based on the latest technologies. Historically, the idea of developing an agrarian economy was a priority for the Jewish population of Palestine. Although Israel has become an agrarian country, agriculture has been given special attention in the strategy of economic development for several decades. Only the rapid formation of Ukraine's post-industrial economy deprived the agrarian sphere of priority. The fall in the share of the agricultural sector was accompanied by a significant increase in the production of agricultural products, its intensification and deepening of export specialization. Israel's agriculture is built mainly on the principle of creating joint social entities that were formed at the beginning of the 20th century. Kibbutzim (from the word «group» in Hebrew) are the largest formations, the members of which jointly own the means of

production and share economic, social and cultural achievements depending on its needs [2]. The first kibbutz, «deganiya», was founded by Jewish settlers in 1910, 38 years before the birth of the state of Israel. Jewish immigrants had at best a weak idea of agriculture: in Russia and other countries of Eastern Europe, where the first Zionist settlers came from, they were not allowed to own land at all. A firm principle of Zionist ideology was that the Jews would not achieve sovereignty until they learned how to work the land, as there were many socialists among the settlers, who opposed private farming in favor of communal ownership of the land, its cultivation and communal life in general. That is, it was in Israeli kibbutzim that a slightly modified communist slogan «From each according to his abilities, to each according to his needs according to the level of development of the collective economy» was implemented in practice. Another types of formation are «moshavs», which are built according to the principle of family farms united into a community, where the owners of land plots are jointly engaged in the production and sale of produced products. 80% of the country's agricultural products are produced in kibbutzim and moshavs. It is worth noting that over the past few decades, the structure has changed significantly, primarily in favor of modern agro-industrial complexes and a departure from the traditional equal distribution of economic gains. Currently, the largest income of Israeli kibbutzim does not come from agricultural production, but from other types of activities. There is also an intensive transition from common to private ownership [3]. Only 20% of Israel's land in natural conditions is suitable for agriculture. Today, agricultural products make up only 1.3% of the country's GDP and 4.2% of goods exports. It is interesting that almost 2.9 billion dollars or 2.2% of total exports is the export of agricultural technologies, scientific developments and services. Only 2% of Israel's workforce (about 65,000 workers) is employed in agriculture, while the country provides 95% of its own needs, importing only grain, oilseeds, meat, coffee, cocoa and sugar. It is considered that agriculture is efficient and highly productive if one farmer engaged in it, produces products necessary for the life of 30-50 people.

In Israel, one agricultural producer feeds 115 people, in the USA – 75 people. In Ukraine today one farmer feeds about 15 people. After Israel gained independence in 1948, the total area of cultivated land increased by 2.6 times to approximately 450,000 hectares and the area of irrigated fields increased by 8 times, reaching 254,000 hectares.

During the same period, the number of agricultural settlements increased from 400 to 900. 58% of the 450,000 hectares of agricultural land is used for the cultivation of vegetables, fruits and other crops, 19% – for citrus, 23% is used for growing flowers, this percentage also includes fisheries, etc. 130,000 hectares are used as pastures for livestock. Land in Israel is divided into privately owned and public land according to the Land Law [4].

More than 90% of all lands in Ukraine are owned by the state. The private sector includes land within settlements, sold by the state to the population and commercial companies for the construction of housing and commercial buildings. An electronic database (Land Registry) has been created in Israel, in which all owners, tenants and users of land plots are registered. Any actions related to the transfer of ownership, lease and use of a land plot become legal only if there is an entry in the Land Registry about

the ownership of the land. Land plots are provided by the state for long-term use (49 years) with further extension on a paid basis. The cost of renting a plot depends on its location and purpose. The most advanced technologies are widely implemented in Israeli agriculture. Resources are used very efficiently. The deserts are drained, the All-Israel Aqueduct is built, which supplies water from the north of the country (mainly from Lake Kinneret) to the arid southern regions.

The main agricultural crops are grain, vegetables (tomatoes, zucchini, cucumbers, peppers), fruits (apples, peaches, cherries, bananas, dates, melons, watermelons, citrus fruits, mangoes, avocados, kiwi), cotton and flowers. In recent years, more and more attention has been paid to the ecological aspects of agriculture, in particular to reducing the use of chemicals for pest control. Alternative techniques and methods, ecologically clean processing of agricultural waste, etc. are widely used. Arab farms located on the territory of Israel work together with the Jewish sector. Its main activities are growing vegetables, fruits and livestock (sheep, goats) [5].

Peasants in Israel are extremely respected, which is connected with their pioneering role in the formation and development of the young state. The state provides massive multi-level support to kibbutzim and farmers: loans at 10% per annum for 20 years, allocates quotas and pays 2/3 of the cost of water. Serious help is provided by the instruction service (Shaham) of the Ministry of Agriculture and Rural Development. Each agricultural producer has the right to 100 hours of consultations by specialists in technology and economics, and 70% of the cost of these consultations is paid by the state and 30% by the farmers themselves. A variety of coaching methods are used: individual consultations, one-day seminars, courses, seasonal meetings, telephone consultations, computer analysis, etc. A system for stimulating the introduction of new technologies and innovations has been developed in Israel [6].

The state subsidizes farmers up to 40% of the cost of purchasing and implementing new technologies. So, a farmer who built a modern greenhouse (the cost can be about 500,000 dollars) and put it into operation receives 30% of its value as a gift from the state (a third of the loan is repaid). In agricultural production, the marketing approach prevails, the entire system of post-harvest processing is subordinate to it: sorting, gas treatment, packaging, cooling, etc. The results of this policy are annual growth of agricultural production of 10%, and during the last decade the volume has increased by 2.5 times. Today, the annual needs of the domestic market of Israel in the mentioned products amount to 11.4 kg of consumption per capita [7].

The secret of the success of the country's agriculture lies in the close cooperation of farmers, in the development and implementation of improved methods in all branches of agriculture as well as in the use of technical innovations, modern irrigation technology and the latest agro-technical equipment. The achievements of Israeli genetics and biotechnology became widely known. For example, there are saucer-shaped zucchini, black watermelon, red banana, green and brown cotton. Almost everywhere in Israel, agriculture is connected with irrigation systems. However, conventional sprinkler installations are rarely found, for example, in waste water disposal. In contrast, thin black hoses of drip irrigation can be seen almost everywhere: on banana, date and grape plantations, when growing vegetables and flowers, even on

green roadside strips. Due to this technology, water loss is reduced by 20%, and with automated management, it is even more significant. Israeli scientists and engineers in close cooperation with the peasants have achieved a leading position in the world in this field [26].

Drip irrigation technology has recently been hailed as Israel's most important discovery since the founding of the state. Aquaculture in Israel accounts for 2.9% of total agricultural production. About 100 million m³ of water is used annually for the consuming industry. Fish production in farms ranges from 0.5 kg per one m³ of water of outdoor ponds till 20 kg per one m³ of indoor ponds [8].

It is worth noting that farms which use the bio-filtration system for indoor ponds reach a production level by 60 kg per m³ of water. Given the scarcity of natural water resources, many fish farms are located on the coasts of the Mediterranean and Red Seas for the cultivation of marine species of fish using the circulation of water from the sea delivery and vice versa. Production in such farms has increased from 900 tons in the 90s of the last century to 3,000 tons today. Israel's success in the field of aquaculture is clearly demonstrated by the fact that the country took third place in the world in terms of sturgeon caviar exports. In addition to fish for food, cultivation of decorative, exotic fish has become widely developed. The annual turnover of trade is about 8 million dollars [9].

Cooperation between Ukraine and Israel in the agro-industrial sector is developing successfully. Israel was among the top 20 countries with which Ukraine had the largest trade in agricultural products (15th place), ranked 11th in terms of exports and 61st in terms of imports. The share of Israel in the export of agricultural goods in 2020 was 2.7% and in the import – 0.2%. In 2020, the turnover of agricultural products between Ukraine and Israel reached to 403.8 million dollars, which is by 7 million dollars more than in 2019. Ukraine exported \$263.2 million worth of grain and cereals to Israel, \$58.4 million worth of fodder, \$41.2 million worth of oil seeds (mainly sunflower) and fruits, \$10.1 million worth of flour and cereals million dollars, natural oils – for 5 million dollars. Israel delivered significantly less agricultural products to Ukraine, only for 8.3 million dollars. These are mainly fruits, nuts and peels – for 2.5 million dollars; vegetables, plants and root crops – 1.5 million dollars; juices – 1.4 million dollars. Only in recent years have several meetings of the ministers of agriculture of Ukraine and of Israel, representative business forums on agrarian topics [10].

Table 1. Volumes of trade in agricultural products between Ukraine and Israel for 2018-2020 (million US dollars)

	2018	2019	2019/2018	2019	2020	2020/2019
Merchandise turnover	532,6	474,7	-10,9%	396,3	403,8	+1,9
Export	510,4	443,8	-15%	377,4	395,5	+4,8%
Imports	22,2	30,9	+39,1%	18,9	8,3	-55,9%
Balance	488,2	412,9	-15,4%	358,5	387,2	+8%

Source: compiled by the author on the basis [11]

Almost 80 Ukrainian businessmen organized a visit to Israel to familiarize themselves with the experience in rural economy. Ukrainian specialists were interested in the latest technologies for increasing milk yield, the latest irrigation systems, the introduction of computer technologies in the management of agricultural processes, improvement of processing and storage of grown products, etc. In turn, their Israeli colleagues got acquainted with the agro-industrial potential of Ukraine, the prospects of investments in Ukrainian agriculture [12].

In recent years, Ukrainian experts have regularly participated in multi-disciplinary research programs organized by the Israeli side. It is especially worth noting the cooperation with the Center for the Development of International Cooperation of the Ministry of Foreign Affairs of Israel «MASHAV». The center actively cooperates with Ukrainian organizations, experts and scientists in the field of agriculture, conducted constant consultations and training courses for agricultural circles of Ukraine.

On May 26, 2021, the round table «Agreement on free trade between Ukraine and Israel: features, opportunities, business perspective» was held. The event was attended by representatives of the Ministry of Economy, the American Chamber of Commerce in Ukraine, the Israeli-American Chamber of Commerce, and the Israel-Ukraine Chamber of Commerce and Industry. The conclusion of this agreement became a kind of advertisement for the strengthening of bilateral trade and business relations between Ukraine and Israel. Ukraine had a fairly significant export of agricultural products to Israel, and the agreement created additional opportunities for the development of this cooperation. But the most important emphasis should have been not so much on increasing direct trade, but on increasing production cooperation and increasing trade opportunities in other markets. With the beginning of the war in Ukraine any cooperation in this direction does not yet seem possible [13].

At one time, Golda Meir, a prominent Israeli woman, politician, statesman, visionary of the Jewish people, said: «Moses led our people for 40 years and brought them to a single place in the Middle East where there is no oil or gas». The witty phrase perfectly reflects not only the geographical or geopolitical situation, but also the climatic one: it seems that a person cannot live normally on this land, it is impossible to run a farm here, let alone a farm. It is impossible to grow fruits or vegetables, the soil is polluted, it is bad, infertile (remember what the Lebanese oak is, the only autochthonous tree of the Near Harvest), there is little precipitation, and it is so hot that even in October it is difficult to breathe [14].

However, the 70-year existence of the state of Israel eloquently proves that the impossible is actually possible. Even under such conditions and such a tiny territory, it is realistic to build an agro-industrial complex that will fully meet the food needs of several million people. Farms are everywhere here – on land below sea level, above and even in the sea.

The main companions of local economic life – drought and hail – have always been and always will be. As local farmers joke, there are no unbelievers among them. Belief in God, in oneself, and in the fact that without technology there will be no progress, helps Israeli farmers to move forward and prosper.

In Israel, they are convinced that everywhere in their country has its own climatic differences; the areas of the land are very different. Great professionalism is to realize this. Just a few meters from a small group of trees – and we see a completely different land. Each area of soil needs different treatment – different amounts of fertilizers, pesticides, and moisture. Sometimes too much fertilizer or irrigation slows down the fruit's growth rate [15].

Agriculture does not play a significant role in Israel's economy. The share of agro-industrial complex in the total structure of the country's GDP is now only 2.6%, and the area of cultivated arable land is only 360,000 hectares. And the number of people employed in agriculture totals 17,000 people with a population of 8.6 million. After all, if the Ukrainians conduct their agriculture in the conditions of a moderate continental climate, the Israelis in the conditions of the subtropical Mediterranean. Despite of such significant differences, Israeli farmers can suggest some interesting technological solutions to their Ukrainian colleagues.

From the point of view of farming, Israel does not have the best natural conditions. The country is located in the Middle East near the eastern coast of the Mediterranean Sea, characterized by steppe and desert zones with significant fluctuations in day and night air temperatures, low relative humidity, cloudless, hot and dry weather. Average annual precipitation in this region does not exceed 500 mm per year, given that most of the territory (60%) is classified as arid and desert. Such natural conditions practically make farming impossible without irrigation. The problem of lack of water for agricultural needs is solved through the widespread introduction of innovative solutions for the use of wastewater and the use of the latest technologies and equipment for irrigation needs [16].

Israeli farmers are supporters of the intensification of agricultural production. If in China one farmer feeds five people, then in Israel – 115 people at once. They achieve an increase in labor productivity in the agricultural sector due to the automation of production. Of course, incentives from the state cannot be dispensed with here. In Israel, very few people live in rural areas, due to which there is a shortage of workers in the agricultural sector. Therefore, farmers have to hire foreign workers every year, because there are not enough of their own. However, you can hire only within a strictly limited quota. If a farmer bought equipment that made it possible to automate the process of soil cultivation and harvesting, then workers were «taken» from the farmer within the quota. Not every farmer can afford expensive equipment, so the government offered to cover 40% of such costs. It would be more profitable and cheaper for farmers to keep foreign hired workers. But farmers took a risk and bought equipment even on credit. We are talking, for example, about robots for picking strawberries. Or about machines for «shaking» almonds or apples [17].

The Israelis got a glimpse of this technology from the Americans, who in the 70s presented their machine for «shaking» apples. They adapted such a machine to weather conditions, but they calculate the optimal amplitude and frequency of tree oscillations independently. In the early days, it happened that the «shaking» machines simply uprooted trees. Harvesting of grapes also takes place with the help of harvesters. One such machine costs 200,000 euros, but on the other hand, it pays for itself in 3 years

and allows you to replace 100 workers at once. It is interesting that the Israelis copied their grape harvesters from Soviet models that worked in Moldova. In 2015, 2.2 million tons of vegetables and fruits worth 701 million dollars were collected from trees in tunnels and on suspensions. Such products are grown on 45 thousand hectares of «open ground», and 16 thousand hectares – in greenhouses or simply under cover. Some crops can only be grown in «closed ground» due to adverse weather conditions [18].

For understanding: 7 out of 11 climate zones pass through Israel at once. There are places where at the same time one hand can be burned in the sun, and the other hand will be soaked by the rain at the same time. However, no more than 500 mm of precipitation falls every year. Therefore, the interaction of the farmer and the consultant of the Ministry of Agriculture, who can suggest the best solutions for growing vegetables or fruits, is extremely necessary here. For example, strawberries in Israel used to be grown exclusively in «open ground», but they were massively affected by fungus. Farmers tried to fight it with poisons, but after that the fruits could not be used at all. So they switched to growing strawberries in so-called «tunnels» – drip irrigation systems are used to plant strawberries, and all this is under a polyethylene cover. Thus, the temperature for crops is created lower than that outside. Melons, cucumbers and tomatoes are also grown under polyethylene covering. In this case, it is necessary so that the desert sun does not burn the planting. At the same time, tomatoes are generally grown on mineral wool, which is impregnated with a fertilizer substrate. But farmers use bumblebees to pollinate vegetable crops, specially placing bumblebees in greenhouses, at the rate of 4 hives per 2,000 square meters. Of course, they also experimented with artificial insemination, but bumblebees turned out to be more effective. In «closed ground» farmers have by four times higher yields than in «open ground» [19]. Therefore, they selectively harvest tomatoes once every two to three weeks and cucumbers once a week. 250-300 tons of cucumbers are harvested from one hectare. For several years now, farmers have been experimenting with «hanging» cultivation of bananas and strawberries. That is, the root system of plants remains in the soil, but its stems are tied to sufficiently tall stems, so the fruits ripen already at a height of about two meters from the ground. This is done in order to give the fruits the optimal air temperature for ripening. The «hanging» height of the fruits may vary depending on the air temperature. Of course, the height of «hanging» is calculated not «on the knee», but with the help of the «phytomonitor» device. If the device shows that the stem of the plant has not grown even by a micron during the day, it means that you need to change the height of the «hanging» or the volume of watering the plants.

Difficult weather conditions in Israel create problems for animal husbandry as well. According to government regulations, a farmer must produce the same amount of milk throughout the year. Of course, in the summer, the milk production of cows drops significantly because of the heat. But this is of little concern to inspectors from the Ministry of Agriculture, who fine farmers for violating regulations. It is clear that it was necessary to find a way to «cool» the cows. But installing air conditioners in cowsheds would be very expensive. Then they decided to install water sprinklers in the cowsheds. However, the cows ran away from the sprinklers. Then they put «shower booths» for cows next to the feeders and it paid off. The cows stopped running away

from the «shower», and thus it was possible to achieve a drop in the temperature in the cowsheds by 2 degrees immediately and for the farmers to keep the standard of milk delivery at the proper level.

One of the main forms of business in modern Israel is the kibbutz, where the means of production belong to the collective and important decisions are made at general meetings. Currently, about a third of the country's agricultural products are produced in kibbutzim. Using the example of some Israeli kibbutzim, we will try to show their management experience. Kibbutz «Afikim» has 400 dairy cows, each of which milks 11,700 liters of milk per year. The farm is known for the development and production of automated herd management systems under the AfiMilk brand – a modern tool that allows more efficient use of resources, increasing the efficiency and profitability of the farm [20].

Livestock farms do not have its own veterinarians and artificial insemination operators. In Israel, there are special companies that provide appropriate services, which, by the way, are not cheap. Calves are kept for only two months after birth, and then sold to farms that grow them. Kibbutz «Afikim» also develops organic crop production. Vegetables are grown both in open and closed soil, 600 hectares are occupied by grain crops. Among the main pests of wheat are mice, which cannot be exterminated with the help of chemicals. Therefore, they decided to «call» for the help of owls. Special houses are made for these birds in the field, in which they live. Owls feed on mice, successfully protecting crops from them. To destroy aphids on vegetables, wasps of a certain species are bred. Kibbutz «Geva» keeps 350 dairy cows with an average annual milk yield of 12,500 liters. The farm is served by only 9 workers, including the manager. The animal husbandry system is intensive, feed for animals is bought. Everything that has been said is also true for Israel's largest dairy farm in Kibbutz «Ifaat»: 1,150 dairy cows with an average annual productivity of 11,500 liters are kept here. The milking process at the farm takes place almost around the clock. Fodder is imported. Due to automation and computerization, at any moment it is possible to obtain data about this or that animal, its physiological state, diseases, etc. All this makes work easier. At the same time, animals can withstand intensive exploitation for no more than three lactations [21].

However, there is no shortage of milk in the country, so it makes no sense to increase production on farms all the time. On the contrary, there are quotas for producers in Israel. If the farm produces more milk than is stipulated by the quota, it will not be paid for the surplus of delivered products. In Israel, there are practically no natural pollinators of agricultural crops, so bees are used here primarily not to obtain honey, but to pollinate cultivated plants. On bee farms, these insects are bred and sold to farms engaged in crop production. The experience of the Netafim company, which occupies a leading position in the world in the production of drip irrigation systems, greenhouses and the development of large-scale irrigation projects, is interesting. When you get to Israel, you are struck by the fact that different trees, bushes and flowers grow in the middle of the desert. All this is possible due to irrigation systems. For example, when planting a date palm, first of all, a pit is dug for it, to which irrigation pipes are laid, then fertile soil is poured, the plant is planted, covered with

earth and irrigation is also arranged on the surface. Israeli greenhouses make a strange impression, because they are built practically in the middle of the desert. Various crops are grown here, so as tomatoes, peppers, basil, etc. Drip irrigation is connected to each plant. The management of the irrigation system is computerized, due to which the intensity of watering is regulated, the necessary amount of trace elements is automatically added to the water for the plants. In general, fresh water in Israel is treated carefully, because there is not enough of it. Therefore, seawater desalination systems are used, and treated wastewater is used in the economy. They are trying to reduce the negative impact of agriculture on the environment. For example, they developed a film that completely decomposes in the environment during one cycle of plant growth [28].

An interesting fact is how the use of chemical plant protection agents is avoided. So, basil is planted on an area covered with a film, and the culture is grown for 3-4 years. After that, the film is removed, and the sun scorches the earth so that no pathogens of plant diseases, pests or weeds remain on it. After the land has been under the sun for a month, crops can be grown on it again. And on date palm plantations, weeds are fought with the help of... donkeys. The area planted with trees is fenced with an electric herder and animals are released there, which eat all the weeds.

So, we have collected 10 facts about agriculture in Israel [22]:

1. 76% of Israel's agricultural exports go to the EU.

This fact speaks of the high quality and safety of Israeli food products. The main region for growing export products is the Arabah desert.

2. Israeli farmers know how to change the taste characteristics of vegetables and fruits.

They can both enhance the taste of the fruit and make it more neutral. It is worth noting that a similar effect is achieved by breeding new varieties of plants by crossing existing ones.

3. Vegetables are sorted using photo equipment and computers.

Each fruit is photographed 32 times on the conveyor belt. From the obtained images, the computer generates a three-dimensional model of the fetus, determining its size, maturity and the presence of damage.

Based on the collected data, vegetables and fruits are automatically sorted. That is why Israeli strawberries are «one in one» on supermarket shelves.

4. Almonds and dates are not collected by hand, but with the help of a special harvester.

Harvesting is done by shaking the trunk with a combine harvester. This method not only does not harm the tree, but also strengthens its root system.

The assembly process takes an average of 30-60 seconds, unlike manual assembly, which takes several tens of minutes.

5. The state subsidizes farmers up to 40% of the cost of purchasing and implementing new technologies.

Software, irrigation systems, innovative harvesting equipment – all this is cheaper for Israeli farmers due to government subsidies.

6. In Israel, losses during grape harvest are extremely low.

The use of special harvesters allows to reduce losses from 10% (with manual harvesting) to 1-1.5%.

7. Milk yield is increased by dousing cows with cold water.

Today, Israel has the highest level of milk production from one cow in the world – an average of 12.5 tons per year.

For example, in Germany this indicator is about 8.5-9 tons per year, in the USA it is about 10 tons per year.

8. The egg-laying of chickens is increased with the help of colorful toys.

In order to eradicate cannibalism, colorful toys were hung in front of the hens in the chicken coops.

Thus, when chickens want to «let off steam», they do not peck at its nest neighbors, but at these toys. Thus, it was possible to significantly reduce the mortality rate in chicken coops.

9. In Israel, the process of combating insects is much more global and systemic than in other countries.

They don't even call it a fight. It is rather a systemic insect management that is included in the plant protection system.

Aniseed, basil and other oils and pheromones are sprayed in greenhouses and fields with the aim to exterminate and control insects.

10. The shelf life of potatoes is extended by treating additional buds with essential oils [23].

Additional tuber buds are treated with mint, eucalyptus and other essential oils, which prevents potato germination and, accordingly, extends its shelf life. This work is not performed by people, but by special programmed devices.

The Ukrainian Horticulture-Business Development Project (UHBDP) was an interesting experience of multilateral (Ukraine-Canada-Israel) cooperation in the field of agriculture within the framework of technical assistance projects, the purpose of which was to provide assistance to Ukrainian farms producing fruit and vegetables products by increasing their potential as producers and finding highly profitable sales markets for them [24]. The project worked in the southern regions of Ukraine (Zaporizhia, Kherson, Mykolaiv and Odesa) and was designed to support 30,000 small/medium farmers and small enterprises producing fruit and vegetable products. As a result, it was expected that small farmers with the assistance of UHBDP, would collectively increase their sales to 50,000 metric tons of fruit and vegetable products worth \$40 million per year by the end of the project. Funding for this project (almost 20 million Canadian dollars) was provided by the Canadian Department of Foreign Affairs, Trade and Development (DFATD) and the Mennonite Economic Development Association (MEDA). The Center for International Cooperation of the Ministry of Foreign Affairs of Israel «MASHAV» acted as a partner in the implementation of the project. The grant assistance of this project was aimed at providing equipment, conducting training, as well as practical and methodical assistance in establishing effective agricultural management for farmers and household owners (with the involvement of Israeli and Canadian specialists) [25]. Such a credit mechanism to support small and medium-sized farmers was created, which is aimed at facilitating

access to financing, so that farmers themselves can make investments in the development of their own business. Local agricultural educational institutions were assisted in the development of new courses on efficient and environmentally sustainable management of small farms operating in the field of fruit and vegetable production. A similar project in 2015 gave the following result – for one dollar of investment the farm received three dollars of income [26].

Discussion. The fact that Israel have managed to create a strong, prosperous, innovative and highly competitive economy, even in the face of permanent military conflict, in the face of an arid climate and a lack of water resources, proves once again that determination and perseverance can be decisive factors. And here Israel's experience is invaluable for Ukraine [27]. This example clearly shows that despite Russia's external aggression and other economic challenges that Ukraine has faced, we can still achieve success if we clearly define our priorities and follow them [28].

Therefore, our intentions are clear — we strive to develop and deepen cooperation with the State of Israel. Today, We can say without a doubt that over the past year, we have made a significant breakthrough in bilateral relations in several directions.

Conclusion. Thus, Israel is one of the world leaders in the innovative development of agriculture. Before the war, Ukraine, having a significant natural potential, was approaching the world leaders in the production of agricultural products, in particular, sunflower oil, poultry meat, and other agricultural products. The agreement on free trade between Ukraine and Israel was supposed to ensure the diversification of Ukrainian exports. Taking into account that Israel has traditionally been a net importer of Ukrainian agricultural products, in particular, wheat, fodder crops, sugar, oil crops, a joint decision was reached on the maximum reduction of import duty rates on the part of Israel, access to its market of goods and the expansion of the list of Ukrainian products, which was exported to the crane. However, currently, Ukrainian-Israeli cooperation in the agricultural sphere is not limited to trade transactions. After all, Israel's success is largely related to many years of research in the field of agro-technological innovations. Acquaintance with these technologies, its implementation in agro-industrial production, attraction of Israeli investments in reconstruction after the war will provide an opportunity to take a significant step in reforming the agricultural sector of our country. Obviously, the combination of the capabilities of Ukraine and Israel will make it possible to significantly restore the agro-industrial potential, restore the position of our countries in the world market of agricultural products.

The success of Israel's agro-food sector is due to close cooperation between farmers and science. The results of scientific research and development are instantly sent to the fields for practical testing and the problems that arise are transferred to scientists to find solutions. As a result, farmers receive the latest farming methods, crop cultivation, irrigation technologies and innovative agricultural equipment. The main share of scientific research and development in agriculture falls on the Organization of Agricultural Research under the Ministry of Agriculture of Israel. Most research institutes dealing with agricultural issues maintain close connections with the United Nations Food and Agriculture Organization, thereby ensuring a constant exchange of

information with other countries. The combination of the achievements of applied science and targeted government support created favorable conditions for Israeli farmers to modernize equipment and technologies and helped to adapt to changing geopolitical, market and climatic conditions, which created a solid foundation for the sustainable development of the industry.

Generalized principles of rural revival are successfully implemented in Israel, have confirmation in many EU countries and prove its effectiveness. None of the defined instruments cannot be implemented without state support. In this case, it is not only financial support (although it is important and difficult to be overestimated, especially for Ukraine), but also institutional, regulatory, informational and organizational, etc. The Ukrainian and Israeli prerequisites for agricultural production and rural development are significantly different, but the innovative approaches on which the development of the Mediterranean country is based, the knowledge-intensiveness of all production processes, the ways of revitalizing rural localities can be useful for bringing Ukrainian agricultural production to a new modern level and ensuring balanced social-oriented economic development of rural areas.

Author contributions. The authors contributed equally.

Disclosure statement. The authors do not have any conflict of interest.

References:

1. Agricultural news agency (2018), «Innovations in the desert: how and why Israel has become the cradle of agricultural startups». [Online], available at: <https://agravery.com/uk/posts/show/innovacii-u-pusteli-ak-i-comu-izrailstav-koliskou-agrostartapiv> (Accessed 5 Feb 2021).
2. Ministry of Agriculture and Rural Development of the State of Israel. Israel's Agriculture. P. 4. URL: http://www.moag.gov.il/agri/files/Israel's_Agriculture_Booklet.pdf
3. Israeli agricultural innovations will keep the world fed. [Online], available at: <https://www.israel21c.org/israeli-agricultural-innovations-will-keep-the-world-fed/>
4. Israeli inventions for greener farming. [Online], available at: <https://www.israel21c.org/8-israeli-inventions-for-greener-farming/>
5. How Israeli Agriculture Technology is Changing The World For The Better. [Online], available at: <https://sareltours.com/article/israeli-agriculture-technology-tour>.
6. Alon Tal. Israeli Agricultural Innovation: Assessing the Potential to Assist Smallholders. [Online], available at: file:///C:/Users/Nadiia/Downloads/israeli_agricultural_innovation_assessing_the_potential_to_assist_smallholders.pdf.
7. Israeli companies offer solutions for global wheat crisis. [Online], available at: <https://www.al-monitor.com/originals/2022/05/israeli-companies-offer-solutions-global-wheat-crisis>.
8. Israel's key role in the foodtech revolution. [Online], available at: <https://www.calcalistech.com/ctechnews/article/bky9sovn9>.
9. Alon Tal. To Make a Desert Bloom: The Israeli Agricultural Adventure and the Quest for Sustainability. *Agricultural History*, Vol. 81, No. 2 (Spring, 2007), pp. 228-257. [Online], available at: [https://social-sciences.tau.ac.il/sites/socsci.tau.ac.il/files/media_server/social/public/CV/alontal/24\)%20To%20Make%20a%20Desert%20Bloom%20-%20The%20Israeli%20Agriculture%20Adventure%20and%20the%20Quest%20for%20Sustainability,%20Agricultural%20History,%202007.pdf](https://social-sciences.tau.ac.il/sites/socsci.tau.ac.il/files/media_server/social/public/CV/alontal/24)%20To%20Make%20a%20Desert%20Bloom%20-%20The%20Israeli%20Agriculture%20Adventure%20and%20the%20Quest%20for%20Sustainability,%20Agricultural%20History,%202007.pdf).
10. Food Insecurity in Israel. Presentation by Prof. Ayal Kimhi at the Cornell Atkinson Center for Sustainability Workshop on Food Security Strategies for a Changing World, April 7-8, 2022, Ithaca, NY, USA. [Online], available at: <https://www.youtube.com/watch?v=mH0I6YMx1uQ>.
11. Ayal Kimhi (2016). Presentation «The Importance of Agriculture to Rural Revitalization: The Case of Israel».
12. Kyrychenko V. V. (2008). Market models of implementation of breeding innovations / V. V. Kyrychenko, V. M. Tymchuk // *Herald of Agrarian Science*. 2008. P. 62–64.

13. Lavruk V. V. (2010). Innovative product in agriculture as the result of the innovation process / V. V. Lavruk // *Effective economy*. No. 5. P. 22–25.
14. Yankovska O. I. (2012). Features of innovations in agriculture / O. I. Yankovska // *Economy of the 21st century: challenges and problems*. No. 4. P. 30–33.
15. Hordiychuk A. I. (2010). Innovative development of agricultural industries and the effectiveness of their functioning / A. I. Gordiychuk // *Scientific Bulletin National University of Bioresources and Nature Management of Ukraine*. No. 6. P. 44–46.
16. Ivanov V. A. (2008). Methodological foundations of innovative development agro-industrial complex / V. A. Ivanov // *Economic and social changes: facts, trends, forecast*. No. 2 (2). P. 50–59.
17. Yuliia Chornous, Nadiia Reznik, Artem Samodin, Hanna Nikitina Dudikova (2020). Techniques of procedural actions performance in green room environment: comparative analysis of European and Ukrainian practices. *International Journal of Advanced Science and Technology*. 29(6s), 1109–1115. URL: <http://sersc.org/journals/index.php/IJAST/article/view/9200>.
18. Reznik, N. P. (2010). Justification of the use of leasing in the agricultural sector as an effective mechanism for attracting investments / N. P. Reznik // *Herald of UDU*. No. 29. P.150–156.
19. N. Reznik, S. Yablochnikov, M. Kuptsov, O. Omelchenko, A.F. Hatsko, O.M Sakovska. (2019). Modelling of informational counteraction between objects in economy // *International Journal of Engineering and Advanced Technology*. 8(6). P. 3797–3802. <https://doi.org/10.35940/ijeat.F9394.088619>.
20. Nadiia P. Reznik, Y.Yu. Demyan, Ya.I. Tokar, S.K. Gupta, A.D Ostapchuk. (2019). Mechanism of investment maintenance for the sustainable development of the agricultural sphere // *International Journal of Engineering and Advanced Technology*. 8(11). P. 112–116.
21. Reznik N.P. (2017). Corporate social responsibility: essential theoretical aspects. *Journal of European Economy*. Volume 13, № 3. P. 296–303. <http://jeej.wunu.edu.ua/index.php/ukjee/article/view/756>.
22. Reznik N.P. (2011). Features of leasing investment in agriculture. *Bulletin of Agricultural Science*. Issue 11. P. 72–73.
23. Reznik N.P. (2004). Innovative activity is a factor in improving production efficiency. *Economics: problems of theory and practice*. Volume 198. Dnepropetrovsk. P. 979–985.
24. Yossi Offer (2016) Presentation «Innovation & economic development of rural areas – approach and tools».
25. Ayal Kimhi (2016). Presentation «The Importance of Agriculture to Rural Revitalization: The Case of Israel».
26. Shai Dotan (2016). Presentation «Agrotourism. Promoting rural development».
27. Reznik N.P., Dolynskiy S.V., Voloshchuk N.Y. (2020). Retrospective analysis of basic risk as a part of futures trading in Ukraine. *International Journal of Scientific and Technology Research*. <http://www.scopus.com/inward/record.url?eid=2-s2.0-85078765334&partnerID=MN8TOARS>.
28. Reznik N.P., Popov V.M., Podprietnii V.V., Popova S.P. (2020). Financial support for the development of joint territorial communities. *Test Engineering and Management*. <http://www.scopus.com/inward/record.url?eid=2-s2.0-85082999646&partnerID=MN8TOARS>

Received: November 10, 2022

Approved: December 22, 2022