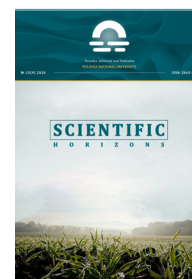


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Farm Size and Technology Implementation: A Comparison between Canada and Ukraine

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Abstract. Many factors play a vital role in the development of agriculture, which include the technology of production, the size of farms in the country and the national policy (including trade policy) in relation to producers of these products. Therefore, the analysis of the above-mentioned factors in Ukraine stays relevant. The purpose of this study was to investigate the situation in the agricultural sector of both countries to form methods of further development of the sector in Ukraine based on the Canadian practices. The leading research method is analysis, thanks to which the agricultural sector was studied. In addition, the comparison method was used in the study of agriculture in Ukraine and Canada. Canada uses the latest methods of growing and tending produce, while in Ukraine there is still manual labour in some enterprises. It was proved that the main reason for this difference in development is the limited ability of Ukrainian companies to attract investment or use credit. The authors concluded that there are fundamental differences in agricultural development in Ukraine and Canada, the reasons for which are explained not only by different geographical, but also by institutional and historical conditions. Meanwhile, the level of agricultural development in Canada is much higher than in Ukraine, showing the need to borrow some principles of the sector. The main ones among them include active attraction of investments, emphasis on technology development, minimal state interference in the sector and others. A more detailed consideration of finding new opportunities to attract investment in the agricultural sector of Ukraine will remain relevant in the future. The article can be useful for studying the specific features of economic development of the agriculture in Canada and Ukraine; for formation of national policy in this sector; for entrepreneurs to make their investment decisions

Keywords: Ukrainian economy, Canadian economy, agricultural products, agricultural sector, export



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INTRODUCTION

The role of agriculture in country's development is enormous. A well-developed agricultural sector allows a country to be not only less dependent on international prices for certain resources, but also to be much more resilient in case of disasters, wars, and cataclysms (Kurdyumov, 2021). Agriculture stays important for achieving the Sustainable Development Goals, in particular Goal 2 – eradicate hunger (Viana *et al.*, 2022; Chen *et al.*, 2022;). However, for some countries, agricultural development is still particularly important for the development of their economies because of the international specialisation of their economies in producing this type of product (Morkunas & Labukas, 2020; Jouan *et al.*, 2020). Among them are developing countries (e.g., India, Ethiopia, Nepal, etc.) and some developed countries (e.g., Australia and Canada). However, such developed countries tend to specialise in resource exports, with agricultural production occupying a small share of foreign trade (Mirzoeva *et al.*, 2021; Fafurida *et al.*, 2019). The reason that the agricultural sector has the potential to grow primarily in developing countries is that agriculture is a good start for such countries to overcome poverty; in addition, it can supply a good foundation for building other sectors (Nugroho, 2021; Sarkar *et al.*, 2018; Kupalova *et al.*, 2021).

Ukraine is one of the countries specialising in agricultural production and exports (Skrypnyk *et al.*, 2021). Although considered to be a country in transition, in fact it can be considered a developing country, especially since most countries have long recognised that Ukraine is a market economy (Heldak *et al.*, 2018). One of the characteristics of the modern Ukrainian economy is its instability. According to H. Chen *et al.* (2022), the riskiness and instability of agriculture is one of the reasons for constant fluctuations within the whole economy: after all, the income of the state in case of its specialisation in agriculture is affected not only by the price of these resources in the foreign market, but also by the yields within the country. However, J.W. Amanullah *et al.* (2019) believed that there are opportunities to stabilise the income of the country and enterprises from agriculture. The main of them are the use of the latest technologies in creating products of the agricultural sector, which allows achieving its sustainable development (Jia, 2019). Thus, it stays particularly important for the Ukrainian state to ensure technological progress in the sector. In addition, K.M.M. Adnan *et al.* is convinced that monitoring the development of farms (including their size) and current trends in farming and trade opportunities for farms, including in foreign trade, plays a significant role. These factors differ from country to country. According to S.S. Kamble *et al.* (2020), the Australian development system with many small households differs a lot from the European system, where large holdings dominate the market. Each system has advantages and disadvantages that will affect agricultural development differently.

In Canadian agriculture the central figure is the producer and their economic and social interests (Morris & Bowen, 2020). Producers form and manage industry unions, producers' associations, and create cooperative verticals of production from agricultural inputs to the final consumer product. The only rule for becoming a farmer in Canada is to have an agricultural education or to have completed an apprenticeship related to working on a family farm (Nugroho, 2021). Thus, Canada, in setting up its single agro-industrial complex as a unified system, is incredibly careful to take advantage of the possibility of government intervention in the industry. It runs strictly within the framework of laws and is a partner for both producers and consumers of products (Viana, 2022). Hence, it is relevant to consider the development of agriculture in Ukraine, how the three factors outlined above affect it. For clarity, the analysis in the study is based on a comparative characteristic with Canada, which also specialises in the export of resources, including agricultural products.

The purpose of this paper was to investigate the agricultural sector to form methods of development of the sector in Ukraine based on the Canadian practices. The object of the study is agriculture in Canada and Ukraine, and their current state. The originality of this paper lies in the fact that in economic science no capacious comparison of agriculture of these two countries is found, although such an analysis will be useful for the formation of future national policy in this area.

MATERIALS AND METHODS

The entire study can be divided into two parts: the first one analyses Canadian agriculture, in particular the level of technology development on local farms, their size, and the characteristics of agricultural trade in the country; the second part analyses related concepts in Ukraine with a parallel comparison with Canada. The paper concludes with a summary of what features of agricultural sector development in Canada Ukraine can apply to local agricultural development. The analysis of the agricultural sector is focused on the period after the collapse of the Soviet Union, due Ukraine gaining independence and thus the emergence of an independent agricultural sector in the country (only briefly mentioning features of the pre-Soviet period). However, most attention is paid to the period of the last 10-15 years, especially in statistical studies, because at this time the last trends of the branch development are formed, which are characterised by enlargement of farms and reduction of their numbers.

The analysis of agricultural development in Canada is based on foreign sources, while the studies of Ukrainian authors were used to describe the situation in Ukraine. The main source of statistical information, namely the analysis of exports of both countries, their products of the agricultural sector, was the TradeMap (2022a)

Internet resource, which provides detailed information about the countries' foreign trade by year in terms of goods, services and countries, which makes the analysis of foreign economic activity particularly effective. However, the types of products on this resource are divided into categories, which sometimes complicates the analysis. Thus, in researching Canadian foreign trade, the authors had to exclude an item in the resource that reads "Wood and wood products; charcoal". The problem is that while the extraction and sale of wood is related to agriculture, the sale of wood products and charcoal is not. Thus, the paper decided not to include this category, as it significantly distorted the agricultural sector output figures. Thus, the countries' foreign trade figures approximate the real picture, which, however, can be considered quite plausible, which is also confirmed by the data obtained from the analysis of information from other sources. In addition, some data was too big to be described in the tables or was not fully highlighted on the website. Such categories in the table are marked accordingly. Another important source

of statistical information was the website of the State Statistics Service of Ukraine (Derzhstat, 2022). It was used to analyse the size of farms in the country.

RESULTS AND DISCUSSION

Main priorities in Canadian agricultural sector policy can be formulated as follows: creating conditions that will ensure producers' income; protecting producers' interests; saturating domestic market for products; and maximising exporters' profits from selling products on foreign markets. The government is trying to secure farmers' activities so that they are conducted within a framework of sustainable development and constant change, reflecting a rapid response to any changes affecting the industry. This should help the industry to better cope with changes in the climate and leads to greater diversification of the sector through the constant transformation of the products grown.

It is important to look at Canada's foreign trade in agricultural products. The evolution of the agricultural sector's share of the country's total exports is shown in Fig. 1.

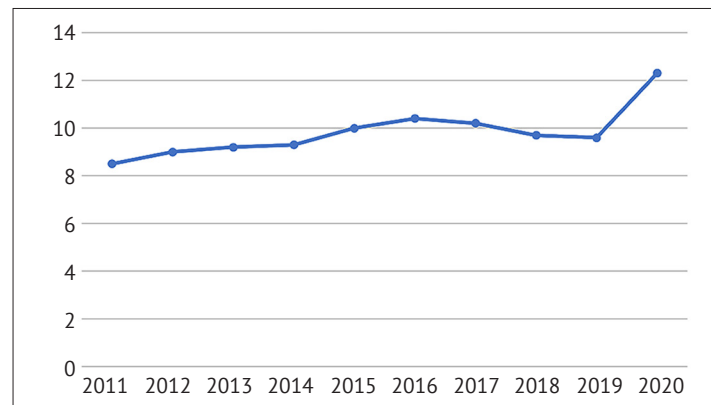


Figure 1. Share of agriculture in Canada's exports from 2011 to 2020, %

Source: TradeMap (2022a)

According to Figure 1, there is a clear upward trend in the share of agricultural products in Canadian exports. This also indirectly indicates the increasing role of the sector in country's economy. The evolution of

the main types of agricultural products that are exported is showed in Table 1. To fully investigate the dynamics of the share of agriculture in the country's exports, the authors chose a decade (from 2011 to 2020).

Table 1. Ratio of exports of selected agricultural products to total agricultural exports of the country from 2011 to 2020, %

Years	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cereals	21.58	18.57	19.67	20.11	17.87	13.92	14.74	16.47	15.69	16.50
Seeds and fruits	20.94	20.70	17.83	17.55	16.56	17.77	18.46	17.38	13.07	16.03
Meat co-products	14.64	11.35	11.17	12.07	11.19	11.63	11.77	11.71	13.08	13.20
Fish co-products	11.32	9.13	9.03	8.81	9.72	10.37	10.36	11.00	11.46	10.97
Vegetables	11.23	7.82	10.42	10.22	11.89	11.96	10.55	9.36	10.19	11.69
Other	11.51	32.43	31.88	31.24	32.76	34.35	34.12	34.08	36.51	31.60

Source: TradeMap (2022a)

Table 1 shows that the share of the first two main categories in agricultural exports is gradually decreasing, while that of meat is gradually increasing. Moreover, the share of export products other than the first five (category “Other”) is also gradually increasing. All these factors point to a gradual diversification of agriculture, which has been mentioned before.

Studies show that in Ukraine, as in Canada, the average farm size has gradually increased over time (Graubner & Ostapchuk, 2017). According to the State Statistics Service of Ukraine (Derzhstat, 2022) the average

farm size in 2018 was approximately 351.84 ha, in 2019 – 366.22, in 2020 – 385.83. The number of small enterprises is gradually decreasing (there was a particularly large decline in 2020 due to the COVID-19 crisis), while the number of large companies is mostly increasing. It is also important to note that individual enterprises in Ukraine are particularly large (over 10.000 ha), as shown in several studies (Graubner & Ostapchuk, 2017). It is also relevant to consider Ukraine's foreign trade. Figure 2 shows the dynamics of the share of agriculture in the country's exports from 2011 to 2020.

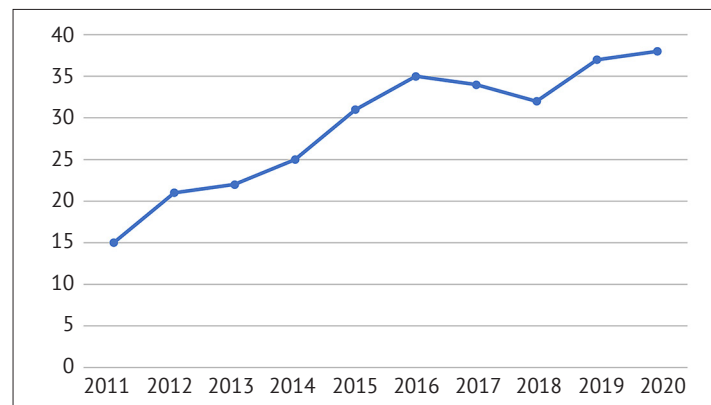


Figure 2. Share of agriculture in Ukraine's exports from 2011 to 2020, %

Source: TradeMap (2022b)

Figure 2 shows that the share of the agricultural sector in Ukraine has increased significantly over the last 15 years – almost fivefold. This reflects the increasing specialisation of the country in the international arena as an exporter of resources. It is also related to

the gradual recovery of the sector due to the problems that arose after the collapse of the Soviet Union, associated with changes in the state system and forms of power. Changes in exports by agricultural sector are provided in Table 2 below.

Table 1. Ratio of exports of selected agricultural products to total agricultural exports of the country from 2011 to 2020, %

Years	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Cereals	35.15	47.33	46.29	48.02	50.29	47.85	44.25	47.10	51.44	50.36
Animal or vegetable fats	33.01	28.32	25.48	28.06	27.39	31.22	31.39	29.25	25.27	30.80
Oilseeds and oil-bearing fruits	13.94	11.91	14.88	12.39	12.25	12.09	14.02	12.71	13.69	9.85
Meat and edible meat co-products	1.92	2.14	2.53	2.80	3.13	3.05	3.62	4.20	3.80	3.49
Dairy products	6.84	4.16	5.03	4.22	3.21	2.60	3.37	3.13	2.42	2.28
Other	9.14	6.14	5.79	4.51	3.73	3.18	3.36	3.60	3.37	3.22

Source: TradeMap (2022b)

The authors established that in terms of Ukrainian agricultural exports, cereals (apparently wheat of different varieties) and the products related to vegetable oil (apparently sunflower oil) dominate considerably. These two categories account for more than 80% of all agricultural exports in 2020, which is a dangerous factor for the economy as it significantly increases its exposure to the prices of these products. Furthermore, the trend towards specialisation appears to be continuing – this is proved by the fact that the rest of the

sector's exports are taking a smaller share each year and by the gradual increase in the weight of agricultural products in the country's exports. In Canada, the opposite is true with increasing diversification of the country's agricultural exports. The product composition of agricultural exports in both countries is quite similar. Therefore, in the first five of the export commodities three are converging: cereals, meat, and oilseeds. However, as mentioned above, the agriculture of both countries is still different from each other.

S. Kozlovskiy *et al.* (2018) studied the introduction of technologies and the attraction of investments in the agricultural sector of Ukraine. The researchers found that the problems in the technological environment are related to the fact that Ukrainian enterprises mostly fall behind foreign enterprises in introducing innovative technologies; most farms, especially small ones, use outdated machinery and often even manual labour. The data of the presented study confirm the results of the work by L.B. Gnatyshyn (2018) on the use of the technological potential of Ukrainian enterprises. L.B. Gnatyshyn (2018) proved that the excessive cost of borrowing is associated with high interest rates on loans in Ukraine; high rates will also be demanded by foreign investors despite the high attractiveness of agriculture in the country in general. According to V. Onegina & Y. Vitkovskiy (2021), the main problem with the actions of the state and the agricultural holdings themselves has been their focus on short-term goals rather than long-term ones.

According to O. Kuzmenko *et al.* (2020), the introduction of innovative technologies into production allows for lower variable costs in exchange for higher fixed costs (which is particularly helpful given that farmers mostly have exceptionally low fixed costs, and in some cases none). Innovation in the country's agricultural sector over time leads to the creation of new jobs in the industry (Loizou *et al.*, 2019; Patyka *et al.*, 2021). The authors of this study confirm this statement because it was investigated that to increase the efficiency of farms, they need more information to make their decisions, more research, and more diagnostics, which also requires added funds. The technologies that are being introduced to large farms to increase their efficiency include the creation of large databases with all relevant information (on individual plots on the farm, on crops, nutrients, etc.); automatic control technologies; use of drones; remote sensing, etc. Absolutely all types of farms are gradually changing from wheat to canola (a Canadian variety of rapeseed and suet) (Brown *et al.*, 2020).

The development of nanotechnology is enabling new agrochemical elements and new delivery mechanisms to improve crop yields and promises to reduce the use of pesticides (Sekhon, 2014). According to L. Pronko *et al.* (2020), nanotechnology can be used for precision farming, to increase crop yields without compromising soil, water resources, improving long-term nutrient uptake by soil microorganisms. There are also technologies related to microbiota that can protect production from heterogeneous stresses (Berg, 2009). They can be used to transfer genes, DNA or to treat produce to increase food storage. In turn, C. Parisi *et al.* (2015) believes that with the help of nanotechnology, Canadian farms significantly increase their competitiveness compared to farms in other countries.

Soil degradation is one of the biggest problems that Canadian scientists have been working on (Awada

et al., 2014). To reduce the effects of soil erosion, the government tried to implement measures whereby a certain crop (e.g., wheat) was planted in the first year and nothing was planted at all in the second year. However, practice has shown that this approach did not prevent land degradation. Therefore, modern Canadian agronomists are working on new methods to combat this problem. According to W. Morris & R. Bowen (2020), the most popular tillage method stays No-till, i.e., zero-tillage, in which seeds and fertilisers are applied to the soil in one time (in one operation), allowing less soil disturbance, and its surface is covered with specially shredded plant residues – mulch. This allows for efficient harvesting every year (instead of having to take breaks to plant every 2 or 3 years), which significantly increases farmers' income (Hamel and Saindon, 2017). The adoption of no-till technology has increased the size of cropped area on the prairies from 8% to 59% between 1991 and 2011 (Brown *et al.*, 2020). Technological innovations carried out by Canadian agronomists also allow new crop species and hybrids to be grown in harsh climates.

It is predicted that the next 60 years will see an increase in temperature in Canada, which could significantly affect agriculture through droughts and severe storms, resulting in lower yields (Stalhammar & Thoren, 2019). Such changes are forcing farmers to adapt to them at an accelerated pace, enlisting the help of specialists from various fields. To respond effectively to the incoming changes in climate, Federal ministry of agriculture and agri-food of Canada is constantly working with researchers in academia and industry organisations to find innovative and transformative solutions to this problem. An added challenge is also the fact that Canada is a large country by area, which complicates adaptation processes, which must vary according to soil type and natural conditions (Sarkar *et al.*, 2018).

In Ukraine agriculture also plays a vital role in economic development, even more than in Canada. During the Soviet era, Ukraine was one of the main suppliers of agricultural products for all union republics. After the collapse of the Soviet Union, the sector began to rank second in importance after metallurgy, and after 2014 it became country's main supplier again (Bakulina *et al.*, 2019). In the 1990s, the country had many small enterprises, which appeared from the privatisation of collective and state farms. Their functioning in the fragile and unstable post-Soviet economy was difficult, but over time some enterprises were allowed to merge, leading to the formation of agricultural holdings (Jiang & Chen, 2020; Suder & Kahraman, 2018). This had a mixed effect on the development of country at that time. However, it is worth recognising that without farm consolidation in today's economy, the existence of such enterprises is virtually impossible. Therefore, this process was and still is unavoidable and became an objective reaction to the existing conditions of the agrarian market (Dub, 2017; Burachek & Mikhailenko, 2018).

Hence, compared to Canada, Ukraine has significant problems in introducing technology into the agricultural production. This applies even to machinery, not to mention nanotechnology, which is rapidly gaining popularity in Canada. As mentioned above, the main reason is the excessive cost of funds for Ukrainian enterprises. This reduces the production capacity of the country and its competitiveness on the market. A possible short-term solution to the problem is the government's subsidising of loans for enterprises. Nevertheless, in the long term, it is necessary to attract foreign investment into the industry, for which existing problems destabilising the economic situation in the country, especially corruption, need to be addressed. Another option for attracting investment is the creation of a more favourable investment climate by the state, which may involve lower tax rates, simplification of the investment process, and other methods.

CONCLUSIONS

The study analysed the agricultural sector in Canada and Ukraine and compared them. In general, the agricultural

sector itself differs in both countries: Canadian one is more diversified by type, while the Ukrainian one is very concentrated (primarily on cereals and vegetable oil). It is difficult to say whether Ukraine should move towards diversification in the current unstable conditions of the country's existence. Nevertheless, it is worth remembering that such a high dependence of exports on one type of resource could become a significant danger in case of crisis situations (a drop in commodity prices or environmental disasters).

In terms of technological development, Canada is ahead of Ukraine. Thus, improving the investment climate in the country by combating general economic instability and corruption and providing cheaper credit, especially for small and medium-sized farms, could be helpful. Overall, Ukraine should adopt the Canadian practices in the creation of future national policy in this sector. The main points on which emphasis should be made are attracting investment, increasing the use of the latest technologies in the sector, and reducing the country's role in regulating the sector, especially the land market.

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Величина фермерського господарства та впровадження технологій: порівняння між Канадою та Україною

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Анотація. У розвитку сільського господарства життєво важливу роль відіграють багато чинників, до яких належать технологія виробництва, розмір господарств в країні та національна політика (зокрема, торговельна політика) по відношенню до виробників цієї продукції. Тому аналіз вищезазначених факторів в Україні залишається актуальним. Метою даного дослідження було вивчення ситуації в аграрному секторі обох країн для формування методів подальшого розвитку сектору в Україні на основі канадського досвіду. Провідним методом дослідження є аналіз, завдяки якому було вивчено аграрний сектор. Крім того, при дослідженні сільського господарства України та Канади використовувався метод порівняння. У Канаді використовуються новітні методи вирощування та догляду за продукцією, в той час як в Україні на деяких підприємствах все ще зберігається ручна праця. Доведено, що основною причиною такої різниці в розвитку є обмежені можливості українських підприємств залучати інвестиції або користуватися кредитами. Автори дійшли висновку, що існують фундаментальні відмінності у розвитку сільського господарства в Україні та Канаді, причини яких пояснюються не лише різними географічними, а й інституційними та історичними умовами. Водночас, рівень розвитку сільського господарства в Канаді значно вищий, ніж в Україні, що свідчить про необхідність запозичення деяких принципів функціонування галузі. Основними серед них є активне залучення інвестицій, акцент на розвиток технологій, мінімальне втручання держави в сектор та інші. Більш детальний розгляд питання пошуку нових можливостей залучення інвестицій в аграрний сектор України залишатиметься актуальним і надалі. Стаття може бути корисною для вивчення особливостей економічного розвитку сільського господарства Канади та України; для формування національної політики в цьому секторі; підприємцям для прийняття інвестиційних рішень

Ключові слова: економіка України, економіка Канади, сільськогосподарська продукція, аграрний сектор, експорт
