



The impact of human capital on the provision of agricultural products in the context of import substitution

El impacto del capital humano en la provisión de productos agrícolas en el contexto de la sustitución de importaciones

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ABSTRACT

Vegetable growing is an important sub-sector of agriculture. The provision of the region's population with vegetable products depends on its successful functioning. Vegetables contain vitamins, minerals, and fiber necessary for humans, which makes them an irreplaceable food product. The authors analyzed the current state of production and consumption of vegetable products in the region and made a forecast of the need for vegetable products until 2035, gave a number of recommendations to fully provide the population of the region with vegetable products. The transition of vegetable growing to a new level of technology development requires improvement, strengthening of human capital in the rural sector. Since in modern conditions the quality and quantity of products produced by the agro-industrial complex depends on the main characteristics of workers, therefore, special attention should be paid to changing the paradigm of agrarian education.

Key words: Vegetable production; consumption; forecast; human capital; education.

RESUMEN

El cultivo de hortalizas es un subsector importante de la agricultura. De su buen funcionamiento depende la provisión de productos vegetales a la población de la región. Las verduras contienen vitaminas, minerales y fibra necesarias para el ser humano, lo que las convierte en un alimento insustituible. Los autores analizaron el estado actual de la producción y el consumo de productos vegetales en la región e hicieron un pronóstico de la necesidad de productos vegetales hasta 2035, dieron una serie de recomendaciones para abastecer completamente a la población de la región con productos vegetales. La

transición de la horticultura a un nuevo nivel de desarrollo tecnológico requiere mejora, fortalecimiento del capital humano en el sector rural. Dado que en las condiciones modernas la calidad y cantidad de los productos producidos por el complejo agroindustrial depende de las principales características de los trabajadores, por lo tanto, se debe prestar especial atención al cambio de paradigma de la educación agraria.

Palabras clave: Producción de hortalizas; consumo; pronóstico; capital humano; educación.

1. INTRODUCTION

The development of human capital and the transition to digital technologies in agriculture are the basis for the sustainable development of vegetable growing in the region and the provision of the population with vegetable products in the required volume and with appropriate quality (Kosenchuk et al., 2019; Pogosyan, 2021). The efficiency of agricultural producers in the vegetable market directly depends on the modern technologies used, and this requires an appropriate level of development of the human capital of workers.

In the broad sense of the word, human capital is understood as a set of human knowledge and skills capable of bringing economic benefits (Gapsalamov et al., 2020; Dunets et al., 2019; Tvaronavičienė et al., 2020; Kislyakov et al., 2021).

N.A. Medvedev and N.I. Proca represent in their works “human capital” as a combination of health, knowledge, skills, experience, communication and psychophysical potentials used in production activities, providing income to a person, organization and society as a whole” (Medvedeva and Proka, 2019).

As the main goal of the study, the authors set themselves the consideration and analysis of the main trends in the development of the agro-industrial complex of the Siberian Federal District.

In accordance with this goal, the object of the study is agriculture in the Siberian Federal District.

2. METHODS

The objects of observation are agricultural producers and consumers of agricultural products. The subject of the research is the location of agricultural production sectors depending on natural and climatic factors. The methodological and theoretical basis was the work of foreign and domestic researchers devoted to the problem of agricultural development, legislative acts of the Russian Federation, decrees and reference materials. The study used methods of statistical analysis, analogy and comparison, causal, graphical and monographic.

3. RESULTS

The effectiveness of human capital in vegetable growing depends on a number of factors: the level of education; experience and state of professional qualifications; motivating employees of agricultural organizations to acquire new knowledge and experience and their application in agriculture. It is important to attract young specialists to work in rural areas, for this it is necessary to develop social infrastructure so that life in rural areas is as comfortable as possible. Otherwise, due to the loss of the attractiveness of the rural way of life, the way of life, human potential will find application in other sectors of the economy. For the economic efficiency of the functioning of vegetable growing in the long term, it is necessary to improve the intellectual and educational potential, taking into account the digitalization of agricultural production (Kuznetsova et al., 2019; Dudukalov et al., 2016).

The formation and development of human capital in vegetable growing should be carried out through the interaction of government bodies, the rural population and owners and employees of agricultural organizations (Rahman, 2017; Gichiev, 2021; Ohlin, 2019). All these measures should contribute to the attractiveness of the rural way of life, the consolidation of workers in rural areas, the improvement of the qualifications of vegetable workers, the use of new technologies, and an increase in production and sales of products.

At present, the issues of improving the food supply of the population of the Siberian Federal District with high-quality, safe and affordable vegetables are urgent (Semenov, 2021; Rahman and Bobkova, 2017; Ivanova, 2021). Nowadays, foreign countries often supply vegetables to the Siberian regions, with the presence of pesticides above the norm, etc. Most of the diseases of people appear due to improper nutrition, including the use of contaminated products. To preserve the health of the country's citizens, it is necessary to provide them with high-quality food and increase the consumption of fresh and processed vegetables (Kuznetsova et al., 2019; Sinenko, 2021; Nikitin and Safonov, 2021).

The Siberian Federal District occupies more than 25 percent of the territory of the Russian Federation, over 11 percent of the country's population lives here. In the Siberian Federal District, the area under vegetable crops is 6.5% of the total area under vegetable crops in the country. The Okrug occupies one of the leading places in the production of basic agricultural products, behind the Central Okrug, which produced 25% of the products, Privolzhsky - 23%, Uralsky - 19%.

Agriculture is an industry, the well-coordinated work of which determines the quality of life and health of the population. In the period preceding the reforms in the industry, large agricultural producers functioned successfully, but today the situation is such that in this sector of the economy, along with organizations, there is a significant number of peasant farms. The structure shows that there is a tendency for a decrease in the number of agricultural organizations in the district, due to an increase in peasant farms. The largest number of peasant farms is located in Omsk - 48%, Irkutsk - 46, Kemerovo regions - 44.2%.

In the current conditions, personal subsidiary plots occupy an important place in providing the population with food (Chuvashlova et al., 2021). To the greatest extent among the regions of the district, personal subsidiary plots were developed in the Republic of Tyva - 17.1%. Despite the fact that a number of difficulties arise in running a personal subsidiary farm, the households of the population fully provide themselves with the necessary foodstuffs themselves. The share of private household plots in the overall structure of agricultural production is negligible, which is associated with low purchase prices and underdevelopment of purchasing points (Table 1).

Table 1. Structure of the supply of agricultural products in the Siberian Federal District,%

Regions	Agricultural organizations			Households of the population			Peasant farms		
	2012	2015	2019	2012	2015	2019	2012	2015	2019
Siberian Federal District	72,2	64,8	63,9	0,6	0,6	0,6	27,2	34,6	35,5
Altai Republic	88,5	85,1	81,9	0,2	0	0	11,3	14,9	18,1
The Republic of Buryatia	86,2	72,8	65,9	0,3	1,8	1,9	13,6	25,4	32,3
Tyva Republic	62,8	29,7	49,2	19,8	59,4	17,1	17,4	10,9	33,8
The Republic of Khakassia	70,3	68,9	59,2	-	-	-	29,7	31,1	40,8
Altai region	69,5	62,4	61,4	0	-	-	30,5	37,6	38,6
Transbaikal region	86,0	86,9	80,2	0,1	1,3	0,7	13,9	11,8	19,1

Krasnoyarsk region	90,1	86,5	84,9	0,3	0,3	0,3	9,5	13,2	14,8
Irkutsk region	63,1	54,5	53,5	0,3	0,6	0,5	36,6	44,9	46,0
Kemerovo region	56,6	53,4	53,8	1,5	3,0	2,0	41,9	43,7	44,2
Novosibirsk region	79,8	72,6	72,0	0,5	0,2	0,2	19,7	27,2	27,2
Omsk region	56,2	51,5	50,4	1,9	1,2	1,5	41,9	47,3	48,0
Tomsk region	79,8	74,2	76,0	0,1	0,2	0,1	20,1	25,6	23,9

Source: Siberian Federal District. 2019. Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region; Agriculture of the Novosibirsk Region in 2019 / Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region)

Small agricultural producers have a significant competitive advantage over large organizations because they have the ability to respond more quickly to the market needs of consumers (Pashina, 2021). The production of the agricultural sector in actual prices over the past 20 years has increased by more than 15 times, but this does not allow judging the stable development of the industry, since high inflation rates significantly reduce the income of agricultural producers. Thus, the financial position of producers can be judged by the index of agricultural production in comparison with the previous year. In 2015-2019, there is a trend towards a decrease in the area under vegetables in open ground in all regions of the Siberian Federal District and in the Russian Federation as a whole (Table 2).

Table 2. Areas occupied by planting vegetables, thousand hectares

Subject	2015	2016	2017	2018	2019	2019 in% to 2015
Siberian Federal District	38,6	37,6	36,3	35,1	33,5	86,8
including Republic: Altai	0,4	0,4	0,4	0,4	0,4	100
Tyva	0,2	0,3	0,2	0,3	0,3	150
Khakassia	1,6	1,5	1,6	1,6	1,5	93,8
Edges: Altai	8,0	7,9	7,2	6,5	6,2	77,5
Krasnoyarsk	6,1	6,2	6,0	6,3	5,8	95,1
Regions: Irkutsk	4,5	4,2	4,2	4,2	3,9	86,7
Kemerovo	5,8	5,7	5,1	4,8	4,7	81
Novosibirsk	4,7	4,4	4,4	4,4	4,3	91,5
Omsk	5,6	5,2	5,5	5,0	4,7	83,9
Tomsk	1,8	1,7	1,7	1,7	1,7	94,4
Russian Federation - total	563,1	551,1	534,6	525,9	517,6	91,9

Source: Siberian Federal District. 2019. Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region; Agriculture of the Novosibirsk Region in 2019 / Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region)

In total, in the region, the percentage of reduction in areas under vegetable crops was 13.2%. The largest reduction is observed in the Altai Territory, namely, by 1.8 thousand hectares over the past five years. The largest area under vegetables is occupied in the Altai and Krasnoyarsk regions. Omsk and Kemerovo regions are in the lead from the regions. The area decreased due to the reduction in the area under vegetables in private households of the population (Table 3). Recently, there has been a decrease in the interest of urban residents and residents of regional settlements in growing vegetables on their own personal plots.

Table 3. The size of the area under vegetables in the Siberian Federal District (in household farms), thousand hectares

Subject	2015	2016	2017	2018	2019	2019 in% to 2015
Total Siberian Federal District	29,92	27,54	26,65	25,79	24,18	75,12
including: Republic: Altai	0,38	0,32	0,3	0,3	0,3	78,95
Tyva Republic	0,18	0,18	0,17	0,17	0,15	83,33
The Republic of Khakassia	1,16	1,05	1,05	1,06	1,02	87,93
Altai region	6,35	5,87	5,52	5,15	4,77	75,12
Krasnoyarsk region	4,84	4,53	4,57	4,71	4,25	87,81
Irkutsk region	3,41	3,19	3,1	3,08	2,83	82,99
Kemerovo region	4,18	4,05	3,77	3,55	3,41	81,58
Novosibirsk region	4,03	3,64	3,56	3,52	3,42	84,86
Omsk region	4,09	3,49	3,41	3,07	2,9	70,9
Tomsk region	1,3	1,22	1,2	1,19	1,14	87,69
Russian Federation - total	375,96	363,29	352,1	345,15	328,69	87,43

Source: Siberian Federal District. 2019. Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region; Agriculture of the Novosibirsk Region in 2019 / Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region)

The area in the Omsk Region and in the Altai Territory decreased to a greater extent, i.e. the area in households decreased by 29.1 and 22.5 percent, respectively, and in the Novosibirsk region by 8.5%. At the same time, in the Novosibirsk region in 2015-2019, there was a positive trend towards an increase in the area under open ground vegetables in agricultural organizations by 36.5% and in peasant farms by 7.1%. In the studied 2019, the area under vegetables in open ground in agricultural organizations in the structure of the entire area under vegetables in the Siberian Federal District was only 12.87%. Over the past five years, these areas have decreased in agricultural organizations by 24.12%. And in agricultural organizations, the direct production of marketable vegetables is carried out, since the households of the population grow most of the vegetables for personal consumption (Table 4).

Table 4. Areas under vegetables in the Russian Federation and in the subjects of the Siberian Federal District (in peasant farms), thousand hectares

Region	2015	2016	2017	2018	2019	2019 in% to 2015
Total Siberian Federal District	3,74	4,38	4,44	4,59	4,7	118,39
Including Republics: Altai	0,02	0,02	0,02	0,02	0,02	100
Tyva	0,02	0,03	0,04	0,06	0,06	300
Khakassia	0,39	0,47	0,48	0,53	0,44	112,82
Edges: Altai	1,04	1,24	0,98	0,88	0,99	95,19
Krasnoyarsk	0,52	0,92	0,74	0,89	1,05	201,92
Regions: Irkutsk	0,41	0,42	0,44	0,59	0,51	124,39
Kemerovo	0,3	0,25	0,31	0,3	0,39	130
Novosibirsk	0,14	0,12	0,14	0,15	0,15	107,14
Omsk	0,74	0,79	1,15	0,99	0,87	117,57
Tomsk	0,16	0,12	0,14	0,18	0,23	143,75
Russian Federation - total	91,14	94,18	87,35	88,9	95,69	104,99

Source: Siberian Federal District. 2019. Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region; Agriculture of the Novosibirsk Region in 2019 / Statistical Book /

Territorial Body of the Federal State Statistics Service for the Novosibirsk Region). The area under open ground vegetables in peasant farms has expanded. In the Siberian Federal District, this increase is more rapid than in Russia as a whole.

In terms of the gross harvest of vegetables, the Siberian Federal District took the 5th place in the Russian Federation, the Southern Federal District remained in the lead, followed by the Volga Federal District, then the Central and North Caucasian Federal Districts. Currently, there has been a decrease in the gross harvest of vegetables in half of the regions of the Siberian Federal District, largely due to a significant decrease in areas. For vegetable crops, 832.9 out of 934.3 thousand tons of gross harvest falls on 6 regions, or 89.15%. Most of the vegetables produced in 2019 were grown in 6 constituent entities of the Siberian Federal District: most in the Novosibirsk region, namely 17.21%, followed by the Krasnoyarsk and Altai regions with 16.9%, Omsk, Kemerovo and Irkutsk regions 15.4, 13.6 and 10.3 percent, respectively (Figure 1).

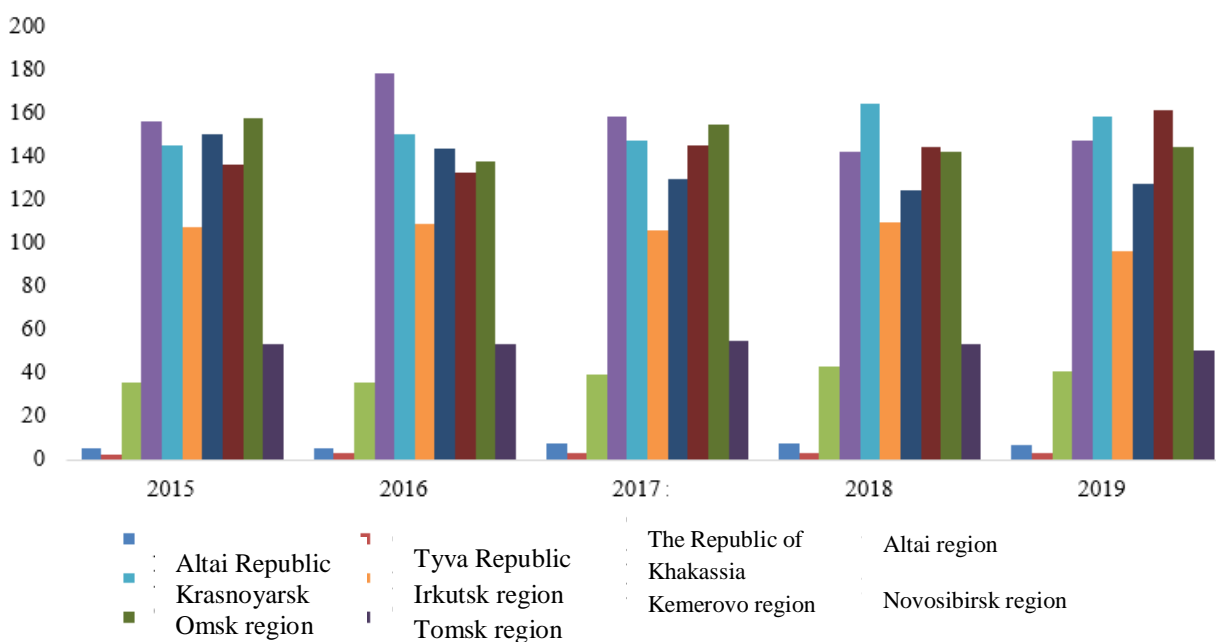


Figure 1. Gross harvest of vegetables in the Siberian Federal District (in farms of all categories), thousand tons

Source: Siberian Federal District. 2019. Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region; Agriculture of the Novosibirsk Region in 2019 / Statistical Book / Territorial Body of the Federal State Statistics Service for the Novosibirsk Region)

Siberian regions are in the zone of risky farming, which affects the cultivation of vegetables. This factor, on the one hand, limits the list of types of vegetables grown in the open field, on the other hand, it does not allow collecting, as in southern countries, several harvests per year. According to Rosstat data for the period from 2015 to 2019, vegetable production in the region decreased by 1.48%. The production of vegetables is associated with high labor costs and this turned out to be a decisive factor for most agricultural organizations and private households of the population to refuse to cultivate vegetables in open ground.

Modern technologies make it possible to grow vegetables all year round, the use of photoculture has made it possible to increase the yield of tomatoes from 60 and more, and of cucumber to 100 and more kilograms per square meter. The construction of modern greenhouse complexes and development is proceeding at an intensive pace in the Novosibirsk region. At the end of 2018, the second stage of the Tolmachevsky shopping center on 8.5 hectares was launched, which made it possible to increase production by 12 thousand tons of fresh vegetables additionally. By the end of 2019, the Novosibirsk Region covers more than half of its needs for protected ground vegetables. This state has been achieved thanks to the activities of such modern greenhouse complexes as Tolmachevsky TC, Novosibirsk TC, Giant Gardens TC, Emelyanovsky TC. In 2020, it is planned to commission the Obskoy greenhouse complex. "Thanks to the activities of modern greenhouse complexes, the production of greenhouse vegetables is increasing in the Altai Territory, Omsk, Kemerovo and Tomsk Regions."

But the rapid growth in the production of greenhouse vegetables in modern fourth and fifth generation greenhouses has not yet made it possible to meet the population's demand for fresh vegetables in the required volume all year round. Also, the types of vegetable crops grown in the open and closed ground of Siberia are limited. The climate of Siberia does not allow growing vegetables in the open field all year round. Large storage losses due to the lack of properly equipped vegetable stores and warehouses, lack of processing of vegetables. Therefore, without the import of fresh and processed vegetables, it is not yet possible to meet the needs of the region's population (Figure 2).

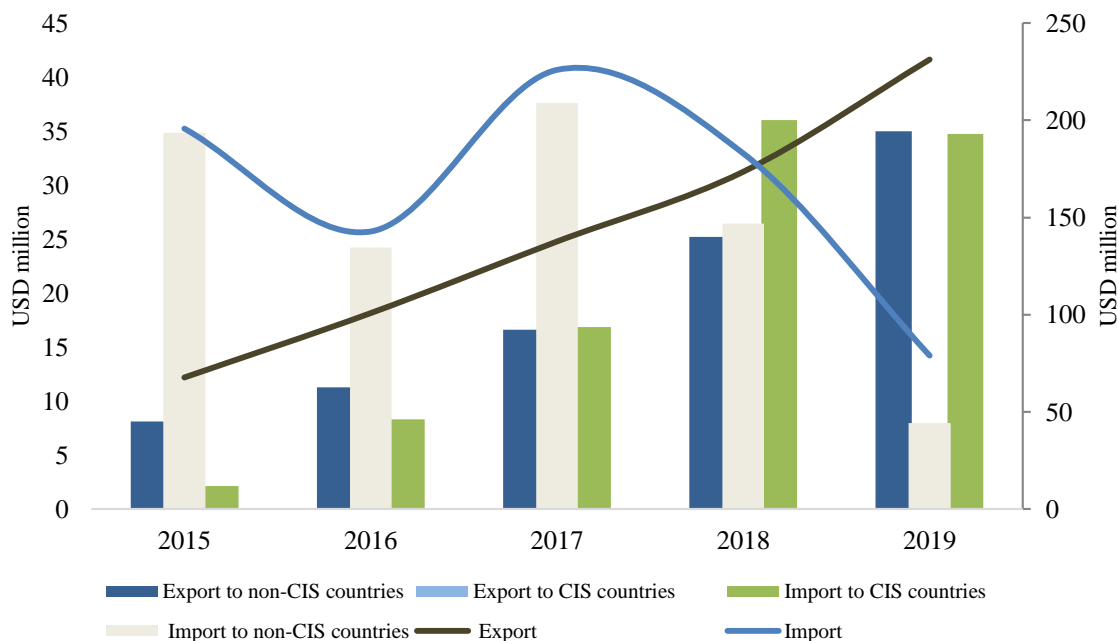


Figure 2. The current state of export and import of vegetables in the Siberian Federal District

Vegetable imports are twice the size of exports in 2019. The largest importing country of vegetable products to the Siberian Federal District is China, deliveries from it in 2019 reached more than 52 percent of the total value of imported products. Among the non-CIS countries, with the largest volume of imported vegetables in 2019, one can single out: China is in first place - 52%, in second place - the Netherlands - 2%. Of the CIS countries, most vegetables are imported from Kazakhstan - 26% and Uzbekistan - 9%.

An important indicator characterizing the economic efficiency of production activities is profitability. In

order to assess the economic efficiency of agriculture, Table 6 examines the profitability of the sold end products of crop and livestock production in the context of the regions of the district. The table shows that the plant growing industry is more efficient 19.8% than livestock, in which the share of profitable organizations is 9.8%. It is noteworthy that in the Trans-Baikal Territory, Irkutsk and Kemerovo Regions, as well as in the Republic of Khakassia, plant growing organizations are unprofitable. This is primarily due to the reduction of agricultural land and the industry's dependence on the "whims" of nature. The most profitable, due to favorable natural and climatic conditions, this industry is in the Altai Territory - 10.5%, the Republic of Buryatia - 12.3% and the Novosibirsk region - 14.9%.

The significant volatility in the profitability of crop production indicates that agriculture is strongly influenced by climatic conditions associated with the district's geographical location. In addition, one of the reasons for the decrease in crop production is a decrease in the fertility of agricultural land, due to the lack of replenishment of nutrients with mineral fertilizers, as well as the lack of plant protection measures. The equipment of the sector with agricultural machinery over the years of reforms has significantly decreased, which leads to an increase in the load on 1 unit of equipment by 2-2.5 times. This leads to an increase in the harvesting time, as a result of which there is a loss of a significant number of agricultural products.

The number of residents of Russia in 2019 increased by 0.14% compared to 2015. As for the Siberian Federal District as a whole, there is a slight decrease in the population by 0.82%. The largest population is in the Krasnoyarsk Territory, almost 2.9 million people. The smallest Altai Republic with 0.2 million people. An insignificant increase in the population within 0.1-2% took place in: Republic of Altai, Novosibirsk and Tomsk regions. For the rest of the subjects, a decrease in the population is observed. As for the norm of consumption of vegetable products, none of the regions in the next few years has reached their normative value (Figure 3).

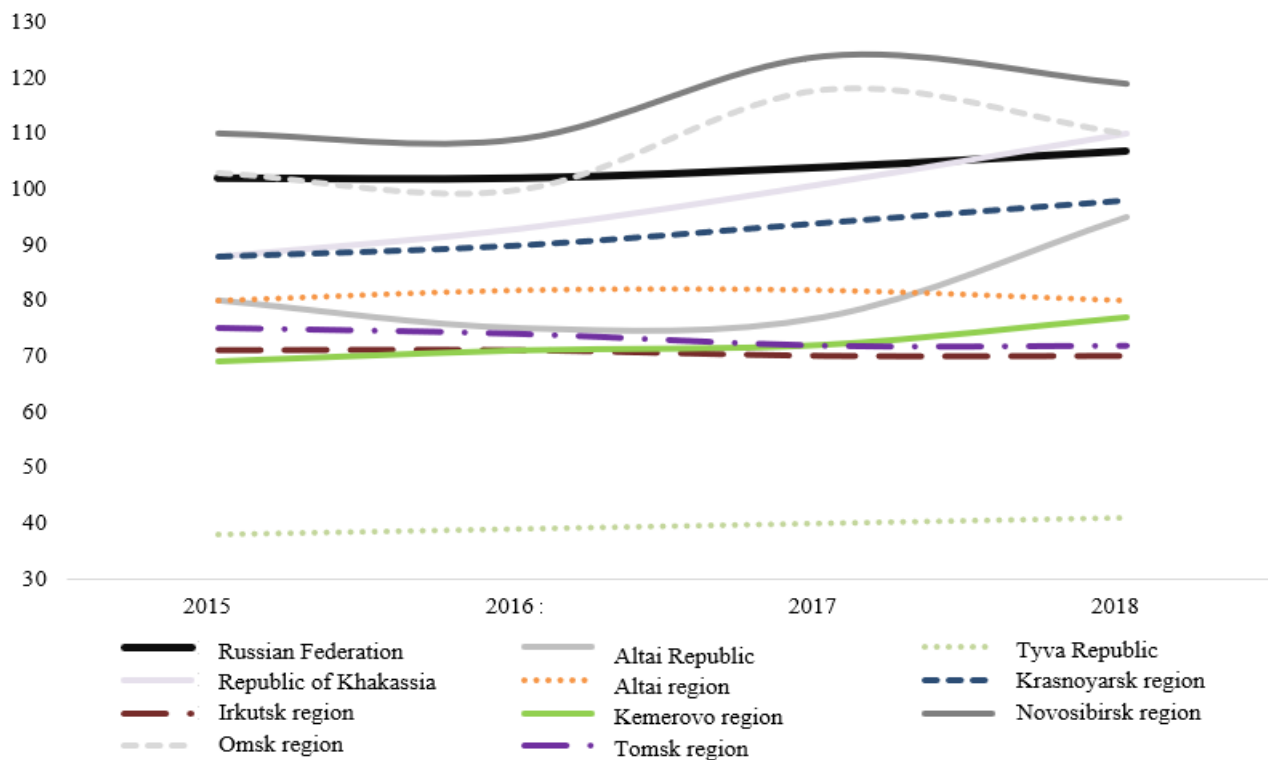


Figure 3. Actual consumption of vegetables and melons per person kg per year

Residents of Siberian regions consume vegetable and melon crops from 15 to 50% less than the recommended norms. In the Siberian Federal District, the population spends 30-70 percent of family income on food. This is much more than in the developed countries of the world, where these costs are not more than 12 percent of family income. Most of the population cannot afford the variety and year-round consumption of fresh vegetables and herbs all year round. The forecast of the required volume of consumption of vegetables in the region has been made. When calculating the needs, the recommended consumption rate for vegetables and melons was used 140 kg / year (Figure 4).

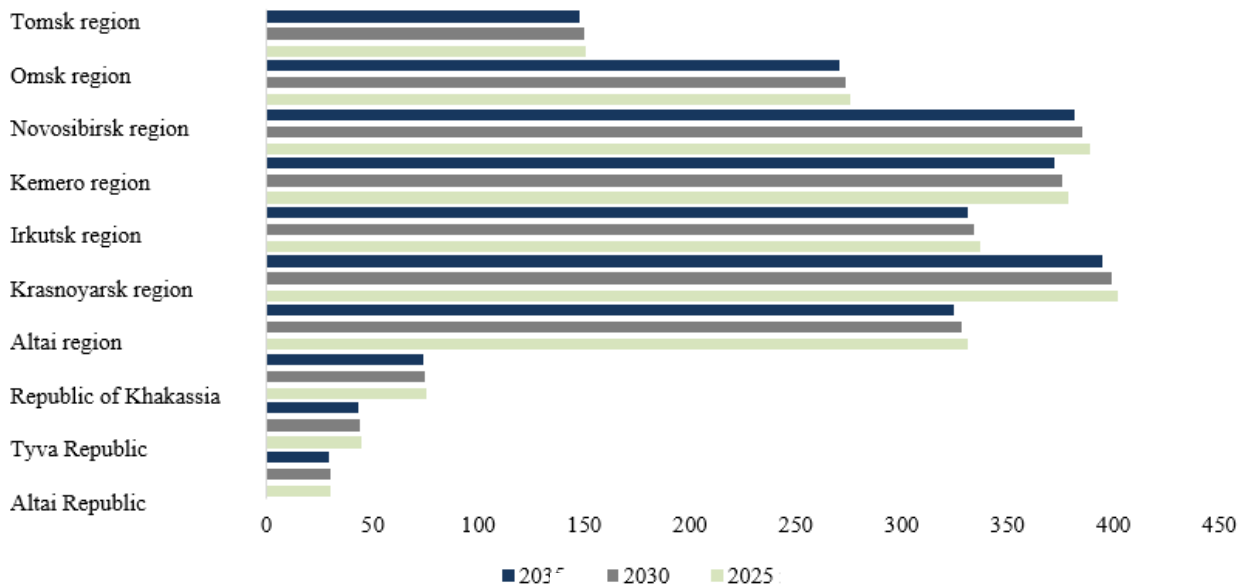


Figure 4. Forecast of consumption of vegetables and melons in the Siberian Federal District, thousand tons.

When forecasting the consumption of vegetables, rational norms of food consumption were taken into account, in accordance with the requirements of a healthy diet, according to order No. 614 of August 19, 2016 of the Ministry of Health of the Russian Federation, based on vegetables and melons 140 kg per person per year (Figure 4).

When calculating the forecast of the population size, the average version of the forecast of the population size of Russia was used, presented on the Rosstat website.

4. CONCLUSION

Summing up, we would like to point out that in order to provide the population with vegetable products, according to medical standards, it is necessary to:

- Develop and implement programs for the social development of rural areas. Agriculture needs qualified personnel. To do this, it is necessary to attract young specialists to agricultural organizations, using support programs, similar to the support programs used for graduates of medical universities, which will support the rural way of life, increase the competitiveness of vegetable products and provide the population of the Siberian Federal District with the required amount of vegetables.

- Strengthen the training of highly qualified personnel for work in the conditions of digitalization of production, transferring agricultural education to a new higher level of training. To increase the availability of higher professional education, expand the system of grants for training and reimbursement of expenses for agricultural organizations for the training of qualified specialists.
- On the terms of public-private partnership, attract investors to the construction of modern sixth generation vegetable complexes. - Revive our own seed production network. The Siberian Federal District should not depend on the supply of foreign seed material. The implementation of this proposal requires government support.
- To increase the production of organic vegetables.
- To carry out specialization and concentration of vegetable growing in large agricultural organizations. This will allow the use of industrial technologies for the cultivation of vegetables.
- Create wholesale markets for the sale of vegetable products by local producers.

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