Accounting for Organizational and Economic Mechanisms in Greenhouse Activities

AKMAL SH. DURMANOV*, FARKHOD Z. KARAKULOV, RIMMA R. YUNUSOVA, OKSANA A. VOROBEVA, NURLAN A. KALDIBAYEV, ANNA M. ARIPOVA
Tashkent State University of Economics,
Department of Corporate Economics and Management
Tashkent,
UZBEKISTAN

Corresponding Author

Abstract: - The article considers a specific area of greenhouse vegetable production, which is an important area of greenhouse farming that significantly affects the availability of plant products and canned vegetables yearly in the Republic of Uzbekistan. In adopting greenhouse vegetable cultivation, certain factors are considered, such as the location of the farm, natural and climatic conditions, and types of farming, that as open field or protected farming. Agriculture is the main pillar of the country's economy. This work aims to study greenhouse vegetable farming adopted in the country. It also aims to study the technological innovation applied in its operation, its structural and functional organization, and the economic benefits derived from it. The study data were obtained from the statistical database of the World Bank. The data were analyzed based on the descriptive statistics of the factors characterizing the organizational and economic mechanisms of agriculture in the Republic of Uzbekistan. The study results show that the main technology adopted in the country for the proper running of greenhouse farming is greenhouse vegetable clusters, and there is a strong correlation between the organizational and economic indicators of the greenhouse vegetable clusters. It is found that the economic yield of the greenhouse vegetable clusters depends on the patterns in which the clusters are organized, such as the availability of labor, as well as transport routes for transporting products. Adopting the appropriate policies for organizing the clusters could lead to sustainable food security for the population of the country, including the development of agricultural infrastructures, such as road networks, crop storage facilities, access to electricity, foreign investments, domestic loans, etc. The work analyzes the production efficiency and current economic status of farms. It also gives recommendations for improving the production of vegetable crops in the greenhouse.

Key-Words: - greenhouse, greenhouse economy, vegetables, soil, organizational mechanisms, enterprise, economic status of the farm, cultivation features, products, greenhouse production, environmental conditions.

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1 Introduction

Agriculture is an important part of the economy of Uzbekistan, and studies need to be done to improve agriculture in the country. Researchers and practitioners are concerned about how innovation in agricultural activities and strategies can contribute to the sustainable development of agriculture. Understanding how new methods of farming can be developed, spread, and organized is very important. One of the innovative methods being adopted by Uzbekistan in its agricultural practices is greenhouse vegetable production, a form of protected agricultural activities or cultivation that has been adopted all over the world contrary to open-field cultivation. Protected cultivation helps to protect crops from adverse weather conditions, such as drought, heavy rains, and excessively warm or cold temperatures and predators; it allows year-round production and the use of an integrated crop production and protection management approach for controlling pests and diseases. Additionally, the cultivation of crops in greenhouses has the potential to address issues related to hunger, food insecurity, and malnutrition. By engaging in greenhouse farming, individuals can find employment opportunities, thereby diminishing rural poverty and fostering business prospects within the horticulture sector, [1]. As per, [2], the adoption and customization of technologies based on climatic conditions and specific crop needs are feasible through protected cultivation. High-tech greenhouses, in turn, yield abundant harvests.

While greenhouse technology offers numerous benefits, its high initial cost poses a significant challenge for farmers who choose to adopt it. Factors such as the availability of capital and trained personnel capable of managing the technology influence the utilization of this agricultural method. Between the 15th and 19th centuries, wood and bamboo were the materials used for constructing greenhouses, which were later replaced with galvanized iron pipes and channels, [3]. This replacement enhanced both the durability and cost of the greenhouse structure. Over time, many scientists and engineers contributed to reducing the cost of the technology. In most cases, this reduction was achieved by using alternative construction materials or by employing innovative environmental control technology, [4].

There are various ways to reduce costs and enhance the efficiency of greenhouse production, with farmers adopting different strategies. However, this study specifically focuses on the greenhouse cluster adopted in the Republic of Uzbekistan. Currently, the development of greenhouse clusters is considered an important area of domestic and foreign policy of the Republic of Uzbekistan. Clusters are an important tool for innovative development and increasing competitiveness. In the 1990s, M. Porter introduced the term “cluster”, focusing on one of its benefits: competitive advantage. Today, many researchers and economists also believe that clusters are a tool for achieving competitive advantage both at the regional and international levels. Cluster exists in all fields, including agriculture, [5], [6]. Greenhouse clusters enable farmers to gain from each other economically through the exchange of information, and use of specified labour markets, and infrastructures, [7].

Due to the numerous advantages of greenhouse crop production, [8], it is now growing rapidly all over the world with an estimated 405 000 ha of greenhouses spread throughout Europe, of which some 105 000 ha are located in the South Eastern European (SEE) countries, [6]. Some countries are leading in the use of agricultural clusters, which would be the basis for the development of greenhouses. According to the European Cluster Observatory, in 2014, there were 2101 clusters in Europe, 11.5% of them being agricultural clusters. Among European countries, Greece, Spain, Bulgaria, and France have the highest number of agricultural clusters.

The United States is one of the founders of economic clusters. This country has developed many industrial clusters, including agro-clusters, the largest of which are located in the states of Louisiana, Washington, and Oklahoma; it also has a wine-making cluster in California, [9], [10], [11]. Also, it is interesting to note that China has experience in agro-based industrial clusters. These clusters combine food and agricultural industries. The main players in the clustering process were the dragon-head companies – large agricultural firms. It is very difficult to give a clear and comprehensive picture of Chinese clusters, but some examples of large agricultural clusters can be given: there is a dairy cluster in the Inner Mongolia region (110 companies, producing approximately 2 million tons of milk per year) and a hop cluster in Xinjiang. It is important to note that China’s agricultural clusters are “company-farmer” cooperation, in which farms operate according to the standards of companies. This helps them to have financial and technical support, boosting their business cooperation. Agricultural clusters dominate regional specialized clusters, which are efficient and have great growth potential. However, they find it difficult to develop new products, because priority is given to improving and maintaining existing rather than new ones, [12].

Despite the advantages of agricultural clusters, an increase in their number complicates the interaction between them. An increased number of greenhouse clusters can weaken the ability of institutional bodies to formulate agricultural laws that will be followed by the greenhouses and can also reduce the sharing of information among the clusters. This in turn can reduce production efficiency and increase the cost of production. To further improve cluster policy, it is important to study internal communications and understand how the greenhouse clusters interact. The main problems in the development of agro-industrial clusters include imperfect methods used in creating and developing agro-clusters, lack of trained staff for the agro-industrial businesses, and the problems of agro-economic science. It is necessary to avoid the gross mistakes made in the last century in Russian agriculture. Agro-industrial sector is greatly dependent on the natural conditions of the region, in which the enterprises and clusters are located, [13], [14]. The purpose of this study is to analyze agricultural clusters of Uzbekistan, specifically greenhouse clusters. It also aims to analyze the current economic status of the farm and give recommendations on how to improve the production of vegetable crops.

2 Materials and Methods

The data used to study the organizational and economic mechanisms in the agriculture of the Republic of Uzbekistan are the statistical database of the World Bank, [15]. The data are analyzed based on economic, demographic, and social indicators. We will examine and compare the economic, social, and environmental indicators historically of the Republic of Uzbekistan with the countries that are leaders in agricultural exports. Besides the statistical base, the World Bank provides information on current projects for improving regional economies. The World Bank database, [16], contains information on projects that the banks fund. Different documents – reports, plans, and prospects are presented in this study, [17].

The descriptive statistics of the factors characterizing the organizational and economic mechanisms of agriculture in the Republic of Uzbekistan are analyzed (Table 1). The nature of the study data is analyzed based under study the statistics review. Logarithms are used for the financial indicators. The construction of econometric models of panel cointegration is utilized to analyze a small sample without a very large time series, [18].

The data were collected by the World Bank and the UN Food and Agriculture Organization, [19].

Table 1. The nature of determinants and data sources of organizational and economic mechanisms of agriculture in the Republic of Uzbekistan

No.	Name of indicator, measurement unit	Observation unit	Period	Database (name, webpage)
1	Agriculture, value added (% of GDP)	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]
2	Arable land (% of area)	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]
3	Forest area (% of area)	Country	15 years (2004–2018)	World Bank [http: //www.worldb ank.org]
4	Access to electricity (% of population)	Country	15 years (2004–2018)	International Energy Agency [https://www.iea.org]
5	Exports of goods and services (% of GDP)	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]
7	Employment in agriculture (% of the employed population)	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]
8	Imports of goods and services (% of GDP)	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]
9	Foreign direct investments, net inflow, at current prices (in US dollars)	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]
10	Broad money (% of GDP)	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]
11	GDP per capita (at 2010 prices)	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]
12	Vegeculture index	Country	15 years (2004–2018)	World Bank [http://www.worldbank.org]

The dependent and independent variables are defined below:

Y – **Agriculture, forestry, and fisheries, value added % of GDP.** Value added is the net output of the agricultural sector after adding all the results and subtracting the intermediate inputs. It is calculated without deducting the depreciation of finished assets or the depletion and degradation of natural resources.

X_1 – **Arable land, % of the total land area.** Arable land includes land labeled by the FAO as land under temporary crops (area under cultivation is counted once), temporary meadows for mowing or pasturage, land under market or vegetable gardens, and land under temporary fallow. Land abandoned as a result of shift cultivation is excluded.

X_2 – **Forest planting area, % of the total land area.** Forest territory is land under natural or planted tree stands at a height of at least 5 meters, regardless of whether they are productive or not. It excludes tree plantations in agricultural production systems (for example, in fruit plantations and agroforestry systems) and trees in urban parks and gardens.

X_3 – **Nitrous oxide emissions in agriculture (**thousand metric tons of CO2 equivalent). Nitrous oxide emissions in agriculture are the emissions that result from the use of fertilizers (synthetic and animal dung), animal waste disposal, agricultural waste burning (non-energetics in situ), and burning of savannahs.

X_4 – **GDP per capita, US dollars.** It is gross domestic product, divided by the average annual population. GDP is the sum of the gross value added of all resident producers, plus any taxes on products and minus any subsidies not included in the price of products. It is calculated without deducting the depreciation of fixed assets or the depletion and degradation of natural resources. The data presented are constant in US dollars for 2010.

X_5 – **Access to electricity, % of the population.** This is the percentage of the population with access to electricity. Electrification data are collected from industry, national research, and international sources.

X_6 – **Export of goods and services, % of GDP.** This represents the cost of all goods and other market services provided to the rest of the world population. These include the cost of goods, freight, insurance, transportation, travel, royalties, license of ion charges, and other services, such as communication, construction, financial, informational, business, personal, and public services. They do not include remuneration and investment income (formerly called factor services) and transfer payments.

X_7 – **Employment in agriculture, % of the population.** This entails involving persons of working age in the production of goods or services for profit making. The persons may be given a particular time to report at work, and the persons might be temporarily absent from work. The agricultural sector consists of all activities related to the fields of agriculture, hunting, forestry, and fishing.

X_8 – **Imports of goods and services, % of GDP.** This reflects the value of all goods and other market services received from the rest of the world population. They include the cost of goods, freight, insurance, transport, travel, royalties, license fees, and other services such as communication services, construction, financial, informational, business, personal, and public services. They do not include remuneration and investment income (previously called factor services) and transfer payments.

X_9 – **Foreign direct investment, US dollars** refers to the flow of direct investment into the reporting economy. This is the sum of equity, reinvestment of profits, and other assets. Direct investment is a category of cross-border investments in which the resident of one economy has control or a significant degree of influence on the management of an enterprise belonging to another economy. The ownership of 10% or more of ordinary shares or voting shares is a criterion for determining the existence of direct investment relationships. The data are presented in US dollars.

X_{10} – **Broad money, US dollars** is the amount of currency not in banks; demand deposits, except for deposits of the central government; saving deposits and deposits in foreign currency in resident sectors, except for the central government; bank and traveler's cheques; and other securities, such as certificates of deposit and commercial papers.

X_{11} –**Domestic loan, US dollars,** provided by the financial sector, includes all loans given to various sectors on a gross basis, except the net loan given to the central government. The financial sector includes monetary authorities and deposit banks, as well as other financial corporations, which possess data. It includes corporations that do not accept transferable deposits, but bear obligations, such as fixed-term and savings deposits. Examples of other financial corporations include financial and leasing companies and lenders, insurance corporations, pension funds, and foreign exchange companies.

X_{12} – **vegetable farming** shows agricultural production for each year relative to the base period from 2004 to 2006. It includes all crops except feed crops. The aggregate indicators by region and income groups for FAO production indices are calculated based on base values in international dollars reduced to the base period 2004–2006. The index can range from 1 to 100.

Let us calculate the main descriptive statistics: number of observations, mean median, standard deviation, asymmetry coefficients, kurtosis and variations, and maximum and minimum values (Table 2), [20].

Table 2. Descriptive Statistics for 2004 and 2018 (N = 15)

	Average	Median	Standard deviation	Asymmetry	Kurtosis	Variation	Minimum	Maximum
Value added (2004)	34.3	31,846	15,52	1.49	1.87	0.45	16.86	76.08
Value added (2018)	30.84	27.4	12.81	0.77	-0.27	0.42	14.28	27.4
Arable land, % (2004)	15,64	12.3	13.7	0.98	-0.028	0.87	0.47	45.9 6
Arable land, % (2018)	19.66	18.64	14.91	0.63	-0.61	0.76	0.44	48.72
Area of saplings,% (2004)	25	25.47	18.84	-0.062	-1.67	0.75	0.31	48
Area of saplings,% (2018)	22.96	22.73	19.12	0.02	-1.75	0.83	0.22	48.22
Nitrous oxide emissions in agriculture (2004)	3337	2174.7	3925	2.26	4.66	1.18	106.8	15448
Nitrous oxide emissions	7230	3446.7	9626.5	2,5	5.65	1.33	359.8	37938
GDP per capita (2004)	6.42	6.33	0.45	0.23	-0.8	0,07	5.72	7.23
GDP per capita (2018)	6.71	6, 58	0.53	0.63	-0.4	0.08	5.96	7.85
Access to electricity, % (2004)	21,2	16.73	18.15	0.95	- 0.1	0.86	0.01	62.26
Access to electricity, % (2018)	35.82	38.55	19.72	0.34	-0, 68	0.55	7.7	75.72
Exports of goods and services (2004)	27.18	25.16	11.78	0.83	0.06	0.43	9.53	51, 73
Exports of goods and services (2018)	27	25.37	9.38	0.4	-0.41	0.35	10.67	44,42
Employment in agriculture (2004)	60,2	58.7	16.8	-0.18	-0.73	0.28	26.8	84
Employment in agriculture (2018)	54	49.4	16.6	0.09	-0.73	0.3	23.5	81.5
Imports of goods and services (200 4)	36.3	34.8	11.78	1.17	1,52	0.32	19.65	67.25
Imports of goods and services (2018)	49.94	46.85	21.98	0.97	1.65	0.44	10.67	106.55
Foreign direct investments (2004)	10.82	1 0.66	1.2	1.16	1.34	0.11	9.3	14

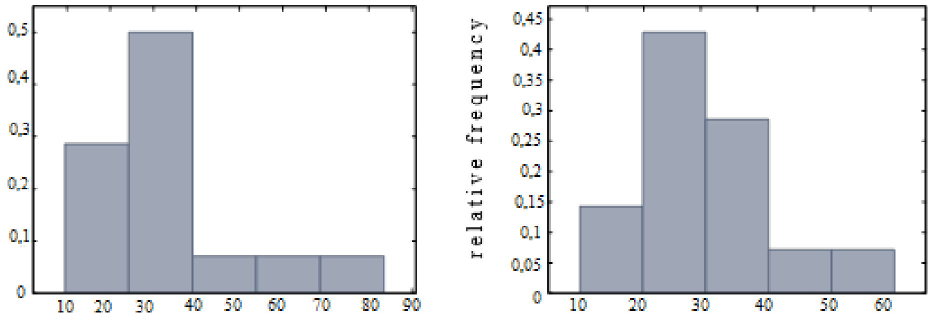

Fig. 1: Distribution by dependent variable for 2004 (left) and 2018 (right) of organizational and economic mechanisms of agriculture in the Republic of Uzbekistan

Data quality improved markedly at the end of the time series in question. The amplitude between the average value and median decreases significantly, which indicates the normality of the distribution. For some indicators, the asymmetry is negative, but the value is close to 0: area of saplings (2004), employment in agriculture (2004), foreign direct investment (2018). The left tail area of the indicators is longer. The kurtosis coefficient exceeds 3 only in the variable “nitrous oxide emissions in agriculture” in 2004 and 2018 and domestic loans in 2004, which can be interpreted as thicker tail areas to extremes (Figure 1), [21].

Compared to 2004, the distribution of the dependent variable (the value added of agricultural products in terms of greenhouse activities in the Republic of Uzbekistan) in 2018 is more even, with the asymmetry coefficient halving to 0.77. This reduction suggests the absence of a heavy right tail. The spread from the minimum to the maximum value decreased by 2 times, [22].

Based on the data obtained, we will analyze the correlation coefficients of the dependent indicator y – agriculture, forestry and fishing, greenhouse farming, and value added (% of GDP) with independent indicators. Changing the dynamics of the relationships helps to identify the patterns used in developing agriculture and greenhouses in the analyzed region. The correlation coefficient indicates whether there is a relationship between the two variables. This indicator measures the power and direction of communication between x_i and y. The value of the correlation coefficient (r) lies in the interval, [23].

The dynamics of the correlation coefficient clearly show there is a weak correlation between value-added and number of domestic loans. Compared to 2004, when a high positive relationship was found between the indicators (the correlation coefficient was 0.89), the relationship became weak quickly and completely disappeared in 2018. The same pattern can be seen in another financial indicator – foreign direct investments. In 2008, the relationship with value-added was noticeably positive (the correlation coefficient was 0.3), but in 2012 the relationship became negative and decreased to moderate indicators (the correlation coefficient was -0.4). The relationship between value-added and broad money (the amount of money outside banks) throughout the entire period was negative and moderate, but in 2012 the relationship significantly weakened, as the other financial indicators. In general, the relationship of the dependent variable with financial indicators was unstable, periodically changing direction. By the end of the time series, it became very weak. The chart shows that all three indicators stopped at the same mark. This phenomenon can be explained by unstable economic situations, but it can be assumed that the weak influence of domestic loans, foreign direct investments, and broad money on value-added reflects the great development of the economy relative to the initial period, [24].

Afforestation, per capita GDP, and access to electricity negatively affect the value added to agriculture. The dynamics of the correlation coefficients of these indicators are almost stable, except for the results of 2004. The pattern is explained by the high costs of improving living standards. The World Organizations solve these problems by providing electricity to the population, increasing GDP, and improving ecological systems. It can be assumed that when the indicators stabilize, the value added of agricultural products will be reduced and the products will be more accessible to the population and other countries, [25].

A review of the level of development of the economic and climatic factors showed the agricultural gap of the Republic of Uzbekistan compared to other regions. It lacks food and vital resources. However, the region has potential if it implements the right policies and has attractive investments. The dynamics of the correlation coefficients between the dependent and independent indicators are quite logical and reflect the specifics of the studied problem of agricultural development in the Republic of Uzbekistan.

3 Results

To assess the parameters of long-term relationships between organizational and economic mechanisms of the greenhouse agriculture of the Republic of Uzbekistan, we use a cointegration ratio containing 7 endogenous variables:

$$y_{it} = a_i + \delta_i t + \beta_1 x_{1it} + \beta_2 x_{2it} + \beta_3 x_{3it} + \beta_4 x_{4it} + \beta_5 x_{5it} + \beta_6 x_{6it} + \beta_7 x_{7it} + \varepsilon_{it}$$

where y_{it}, x_{1it}, and $x_{2it}, \dots x_{mit}$ are the values of the studied indicators of country i in year t; ε_{it} – cointegration errors; a_i – coefficients corresponding to individual effects; $\delta_i t$ – individual trends; β_k – components of the cointegrating vector. The prerequisite for the model is as follows: [26], [27].

1. Panel Least Squares Method (PLSM) is used to evaluate regression;
2. Regression coefficients for all variables are common for all countries in the sample (14 countries);
3. The model tests the hypothesis of individual trends;
4. The hypothesis of permanent individual effects is tested in the model (Table 3)

The model provides estimates of significant determinant coefficients. The coefficients are statistically significant. Thus, an increase in access to electricity by greenhouses in the Republic of Uzbekistan, imported goods, foreign investments, and access to money supply leads to an increase in the share of value added in GDP. This in turn makes the cost of production cheaper. Indicators such as exports, domestic loans, and a growing vegeculture index increase the share of value-added for agricultural products. A test for the absence of permanent individual effects and a test for the absence of individual trends confirm that the model was chosen correctly, [27].

Generally, we can conclude that economic determinants have a greater influence on the value added of greenhouse activities. In other words, the right economic policy of the Republic of Uzbekistan can improve the agricultural sector and solve the country's food shortages. The proven presence of cointegration in the model assumes that the residuals ε_{it}. are stationary. This value with lag 1 is a mechanism for adjusting the equilibrium of a dependent variable from its equilibrium value (Table 4).

Table 3. Long-term relationship between value added of greenhouse agricultural products and dependent variables

Variables	Coefficients	t-statistics	p -value
Access to electricity (% of the population)	-0.28	-2.35	0.01 (***)
Exports of goods and services (% of GDP)	0,07	1.87	0.1 (*)
Imports of goods and services (% of GDP)	-0.05	-2.8	0.01 (***)
Direct foreign investments	-0.9	-2.9	0.01 (***)
Broad money (% of GDP)	-0.12	-1.66	0.1 (*)
Domestic loan	0.29	11.6	0.00 (***)
Vegeculture index	0.12	6	0.00 (***)
	Statistics	Degree of freedom	p – value
Tests for the absence of permanent individual effects:			
χ2-test	44.18	12	0.01 (***)
Tests for the absence of individual trends:			
F – test	27.54	13	0.00 (***)
χ2-test	242, 78	13	0.00 (***)

Table 4. Panel Unit Root Tests

Test	Remnants Statistics	p value
H_0: the row contains a unit root	The individual unit root process	
Im-Pesaran-Shin t-bar (W – statistics)	-4.03	0
Levin-Lin-Chu (*t* *)	-5.56	0
Breitung (*t*- statistic)	-3.27	0
H_0: row does not contain a unit root	Common Unit Root Process	
Hadri (Z- statistics)	-4.59	0

Table 5. Short-term relationship between "agricultural value added and vegeculture index".

Variables	Coefficients	t-statistic	p-value
constant	-1.19	-3.11	0.00 (***)
$\Delta value\ added_{i,t-1}$	-0.15	-2.19	0.00 (***)
$\Delta employment\ in\ agriculture_{i,t-1}$	0.22	1.19	0.23
$\Delta employment\ in\ agriculture_{i,t-2}$	-0.5	-2.56	0.00 (***)
$\Delta GDP_{i,t-1}$	16.48	2.42	0.00 (***)
$ECM_{i,t-1}$	-0.06	-2.56	0.00 (***)

Three of the four tests conducted confirmed the stationarity of the remnants of the model. This confirms the presence of cointegration between the value added of agricultural greenhouse products of the Republic of Uzbekistan and the given determinants. We can state that there are long-term relationships between the dependent value (the value added of agricultural products and independent regressors) and access of the population to electricity, export and import policies, foreign investments, broad money, domestic loans, and crop index.

The results make it possible to use a model for adjusting the equilibrium in both the long- and short-term relationships between the value added of agricultural products and economic and climatic determinants.

The constructed private autocorrelation function indicates the attenuation of private autocorrelation functions (hereinafter, PACF) after the second lag. Therefore, the indicator implies there is a second maximum lag in the model (Table 5), [28].

The hypothesis will be tested using the regressions below:

$$\Delta y_{1it} = \alpha_i^{(\Delta)} + \beta_1^{(\Delta)}\Delta y_{1it-1} + \beta_2^{(\Delta)}\Delta y_{2it-1} + \beta_3^{(\Delta)} y_{3it-1} + \delta_1^{(\Delta)}\mathrm{ECM}_{it-1} + \varepsilon_{it}^{(\Delta)},$$

The assessment of the parameters confirms the existence of a short- and long-term relationship between employment in the agricultural sector, specifically the greenhouses of the Republic of Uzbekistan, GDP level, and value added (% of GDP). An increase in employment with a lag of two years has a statistically significant negative effect of 1% level; it increased value added, whereas GDP has a positive effect at the same level, but with a lag of 1 year. The coefficient of the adjustment mechanism is significant at the 1% level.

The coefficient has a correct negative sign. Based on the model framework used for adjusting the equilibrium, the influence of agricultural workers and GDP on the share of GDP value added, the country can have a rather high level of GDP added value for its equilibrium value with low indicators of GDP and employment in agriculture.

The adjustment mechanism will slow the growth of value added to an equilibrium value, [29]. Also, the equilibrium adjustment mechanism will work in the case of a low share of value added; the adjustment mechanism will increase GDP and employment and will return the dependent variable to the equilibrium trajectory.

Let us construct impulse response functions for shock analysis. In the first years, the shock of the employment indicator acts on the level of value added, and then the shock fades. The effect falls to zero after 3 years. The surge in the level of GDP affects the added value more rapidly, and also after 3 years the shock gradually tends to 0 (Figure 2).

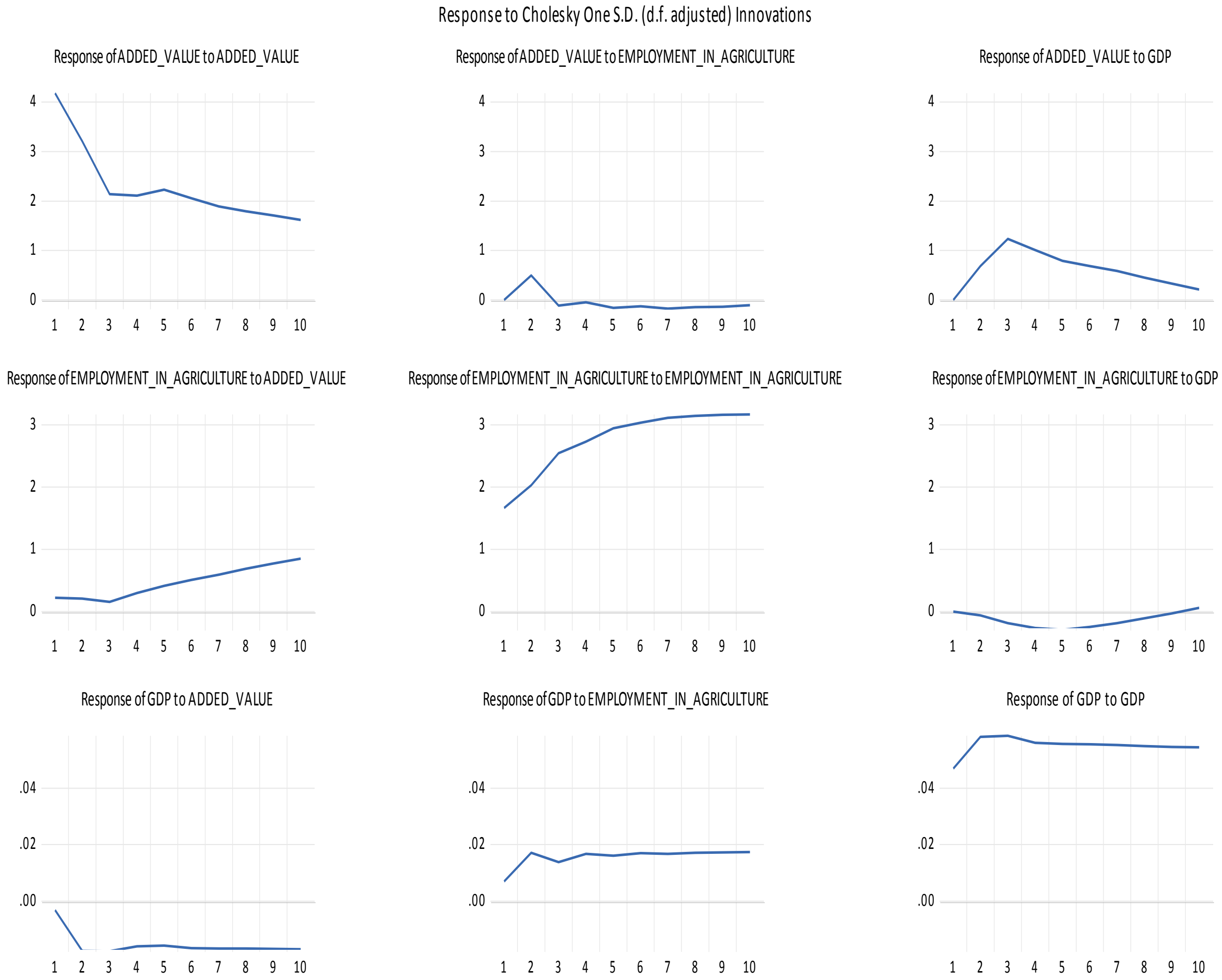

Fig. 2: Impulse response function, value added of greenhouse activities – the vegeculture index of the Republic of Uzbekistan

Source: author's calculations in eviews

Practically, we consider the time series of the Republic of Uzbekistan. It is verified that the series has one level of integration I (1). The Pedroni tests showed the presence of cointegration between the processes. Since the possibility of long-term relationships was proved, we assessed long-term relationships, that is, we built a cointegration relationship and made logical conclusions about the relationship of such an economic indicator characterizing the level of agriculture as value-added.

4 Discussion

It is necessary to consider the global state of food security about the Republic of Uzbekistan for 2013–2018. To this end, we calculate the average values for all indicators relevant to the index. It can be argued that the index has slightly improved the global food security indicators in the Republic of Uzbekistan (a more detailed quantitative assessment of changes in the constituent indicators of the Global Food Security Index is given in Figure 3).

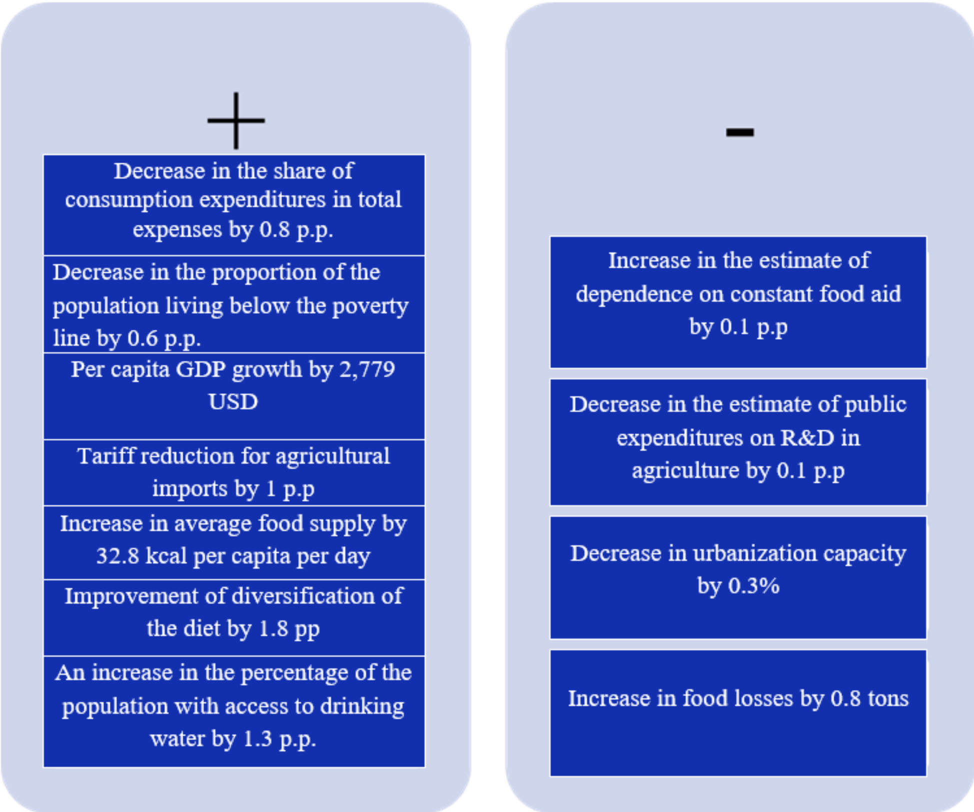

Fig. 3: The main results of the food security global index estimate in the Republic of Uzbekistan for 2013-2018

Slightly more than 70% of the country's agricultural producers included in the index received higher scores in 2018. The improvement indicates a shift to more sustainable food security measures, including the development of agricultural infrastructure (for example, road networks and crop storage facilities) and increased nutritional capacities of the rapidly growing urban population.

Experts point out that at the same time, overall indicators of food quality and safety decreased in Russian regions with a high level of income, due to changes in diet and protein quality. This suggests that while consumers in these regions do not lack food, they do not necessarily consume the healthiest products.

Under these conditions, the organizational and economic mechanisms for the optimal use of greenhouse activities include, first of all, the organization of a vertically integrated process of production and processing of greenhouse products (Figure 4).

Fig. 4: Optimal organization of greenhouse activities
Source: Compiled by the authors

The optimal organization of greenhouse activities, therefore, involves, in addition to its power station, the construction of a fertilizer warehouse, and a disposal site. The application of the approved solution will allow saving costs of storing fertilizers from third parties, as well as saving on overpaying by third parties for utilization and processing of waste.

The organizational and economic aspects of greenhouse activities include the formation of a food chain (Figure 5).

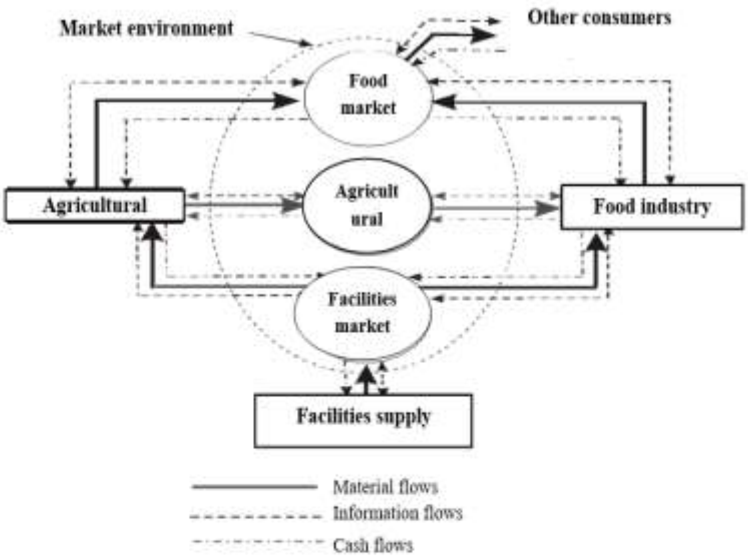

Fig. 5: Food chain in greenhouse activities

The food chain includes suppliers of facilities for the proper functioning of the greenhouse complex; there are supervisory bodies that control the quality of the agricultural products produced and consumers of greenhouse products – organizations in the field of food and marketing of agricultural products. The totality of these economic agents forms the external environment where the greenhouse enterprise functions (Figure 6).

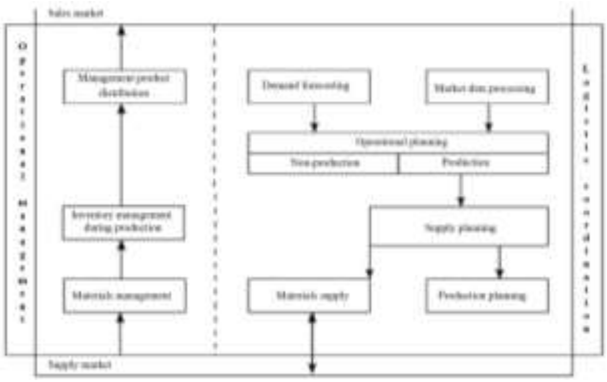

Fig. 6: Organizational and economic aspects of the sale of greenhouse products
Source: Compiled by the authors

The export and import of agricultural goods between nations of the world is one of the factors strengthening global food security. Therefore, an increase in the price of exports and imports of such products, all other things being equal, has a positive effect on food security. In addition, when selling such goods, the leading countries a priori play an important role in managing global food security processes and controlling commodity flows of agricultural products, including through tariff rates. It can also be noted that over the past five years, the situation with global food security in the Republic of Uzbekistan has been stable and is now improving, although not fast. This is due to the lowering of trade barriers, active interstate support of food programs, and efforts of national governments to solve food problems at households, and farms, to develop infrastructure, and to implement a balanced policy on food safety and quality.

5 Conclusion

We can conclude that this study is relevant to the realities of the Republic of Uzbekistan because agriculture is one of the most important sectors of the state, both strategically and in everyday terms. Also, in recent years, the Republic of Uzbekistan has placed great emphasis on the development of rural areas and increasing the competitiveness of the domestic agricultural sector. The development of clusters in this industry is an important part of the innovative development of the country's agro-industrial complex. Thus, studying the network structure made it possible to identify patterns in the organization of agricultural clusters in the country. The purpose of this study is to describe and characterize the intranet structure of agricultural clusters. The results obtained can be used to make recommendations for the development of the industry as a whole and to plan further research on this study.

Taking the peculiarities of organizational and economic mechanisms of the greenhouse activities in the Republic of Uzbekistan, we can use the experience of China in organizing dragon-head agro-complexes to ensure the introduction of advanced technologies in the agricultural sector. At the same time, Russia's experience in the development of agricultural clusters is less preferable for the Republic of Uzbekistan, although countries organize and run agricultural industries similarly. Russian regions rely on domestic-made greenhouse technologies, but China's technologies are recognized as more universal; they consider the agro-climatic features of the Republic of Uzbekistan, and they automate crop cultivation in greenhouses, which results in high yields.

This study mainly compiles and analyzes the network models of several clusters, as well as making comparisons between them. The network models of the clusters made it possible to see their structure, highlight the most powerful actors, and calculate the main mathematical indicators of the network. We highlighted the advantages and limitations of each type of network structure, as well as their features. It was found that agricultural clusters are not numerous in all respects. They are also characterized by a small variety of specializations that sharply reduce their opportunities for development and cooperation. The theoretical recommendations formulated need to be based on the real situation in each cluster.

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