Asia Agricultural Market: Methodology for Complete Use of Economic Resources through Supply Chain Optimization

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***Abstract*— Agriculture remains the main sector of the Central Asia economy. The level of involvement in global production networks significantly affects the economic growth of Asian countries. The main objective of the article is to assess the opportunities for implementation of economic resources in the Asia agricultural market through supply chain optimization. After the systematization of secondary information, the study analyzes the agriculture value added, the Logistics Performance Index (LPI), and its interrelationships with economic development. This research uses statistics from open data sources as a foundation for descriptive analysis of Asian agricultural sector. The LPI, gross domestic product (GDP) per capita and the agriculture value added indicators are used to evaluate the results. The current research indicates that an effective supply chain is of great importance to agricultural sector development. However, the successful implementation of a supply chain into the agricultural sector continues to be problematic. Consequently, the issues of integration, infrastructure development, and information management require a solution.**

***Keywords*—** *agricultural market, Asia, supply chain, agriculture, development*

1. Introduction

The current world population is growing rapidly, and in the near future, it is expected to reach 9 billion. The pressure on the existing agricultural supply chains is increased by many challenges. Among them are plot size decrease, ever-increasing demand on natural resources and environmental issues. Agricultural systems require complete reorganization from the traditional methods to precision or smart farming techniques to overcome these obstacles. The lack of industrialization, management inadequacy, information inaccuracy, and general inefficiency are setting significant challenges to agri-food supply chains. The proposed solutions to overcome these challenges should not only consider the way the food is produced but also take care of societal, environmental and economic concerns.

The economic importance of the Asia region is growing annually. People are becoming wealthier and the role of local politicians in the world increases.
Moreover, Asian economic prospects vary considerably across countries. Over the past few years, Asian countries have increased their participation in existing economic relations and in establishing new relations [1]. Companies focus on designing a strong collaborative supply chain for successful competition in the global market. Efficient cooperation with supply chain partners requires organizations to share valuable information in real-time.
The market economy of Eastern Europe and Asia is gradually approaching the level and quality characteristics of member countries of the Organization for Economic Co-operation and Development (OECD). The world economy's transition to a qualitatively new stage of globalization after the global crisis of 2008 – 2009, is characterized by a number of changed qualitative and quantitative features showing that the rates of world trade are outpacing domestic production. Many researchers note that logistic principles implementation in the practice of managing supply chains is a promising tool for increasing the level of logistical integration between countries and optimizing the logistics activities of all supply chain participants [2, 7, 9].

2. Literature review

The concept of supply chain management (SCM) in agriculture is a relatively recent approach in agribusiness management literature. Despite the fact that the supply chain itself has been around for several decades, many new approaches to analyze agri-food networks' organization and dynamics have recently emerged. In [1] were aimed to study critical factors affecting SCM in agriculture by combining surveys from various agribusiness areas. Furthermore, researchers also examined the relationships and associations to increase SCM efficiency in agriculture. The Internet of Things (IoT), blockchain, and Big Data technologies continue to be potential tools for sustainable supply chains acquiring in agriculture. In [2] proposed an application framework for

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practitioners involved in the agri-food supply chain that identifies the supply chain's visibility and resources as the main driving force in data analytics.

Kamble and Gunasekaran [3] distinguished and established relationships between the enablers of Blockchain Technology (BT) adoption in agriculture supply chains (ASC). Thirteen enablers were identified and validated by the experts to apply a combined Interpretive Structural Modelling (ISM) to envision the complex causal relationships between the BT enablers [3]. The findings from the study [3] suggested that traceability was the most significant reason for BT implementation in ASC, followed by auditability, immutability, and provenance.

Closed-loop agri-food supply chains have a high potential to reduce environmental and economic costs resulting from food waste disposal. In [4] illuminated an alternative to the traditional supply chain of bread based on the principles of a circular economy. In [5] attempted to explore problems faced by Indian agriculture in food security such as inadequate infrastructure and inefficient supply chain. In [6] reviewed the impact of agricultural land use in five countries of Central Asia during 2008–2013 through the analysis of 362 articles. Central Asia is geopolitically and strategically important due to its location. The Central Asian countries form a trade link between China, the Middle East, and Europe. Thus, agriculture is among the major economic sectors in the Central Asian countries, accounting for 10 to 45% of national GDP, employing from 20 to 50% of the labor force.

After the World War II, the Asian agricultural market changed. Supply chains in the agricultural sector have become more diverse [7]. SCM for Sustainable Food Networks provides an up-to-date and interdisciplinary framework for designing and operating sustainable supply chains for agri-food products [8, 9]. Kazakhstan with its considerable export potential in the wheat, beef and dairy sectors is a key player in the world agricultural markets [10, 11]. In [6] mention that research on land use in Central Asia received strong attention on an international scale. Thus, the number of publications exceeded the global average. Further literature analysis confirms it. In [12] evaluate the efficient use of agricultural land. In [13] review the irrigation systems' efficiency. In [14] present a resource management approach, by identifying linkages between water resources, energy production, and agriculture.

Efficient and fair ASC can be initiated from stable networks and relationships between suppliers, manufacturers, processors, traders, and retailers. Considering that logistics has many directions, measuring and summarizing indicators is a challenge for many countries. Normally, the information on the implementation of customs clearance, data processing at the port, and transport logistics is available. Hence, the examination of time and costs associated with these processes forms the basis of the initial indicators system. However, considering the existing structural differences, a problem of data collection into a single international set is arising. Another problem in the integral estimation is that many essential criteria such as transparency, quality or reliability cannot be assessed using only data on the time and cost. This poses many challenges to the economic development level of Asian countries, taking into account productivity estimates along the entire supply chain.

2.1. Problem Statement

Agricultural In recent years many studies have been done in the field of SCM for various production areas. Although this approach remains interesting, it suffers from an insufficient consideration given to the SCM in agriculture. Agricultural production is still poorly reviewed. Moreover, previous works failed to give a structural analysis of the agri-food industry. Approximately 30-35% of the total food produced is wasted because of insufficient infrastructure and ineffectual supply chains. Central Asian countries, such as Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan, are located in the heart of the Eurasian continent and define trade relations between the Middle East and Europe. Thus, the agricultural sector in this region plays a strategically important role in the world economy and the economy of Central Asia. Along with the thorough understanding of the drivers for land use changes, including climate change, water conflicts, and resource degradation, a comprehensive knowledge base regarding the impacts of agricultural land use on economic and social dimensions of sustainable development is essential.

The use of the supply chain potential provides new opportunities to access the world markets and the agricultural sector development in Asia. This paper is aimed to conduct a descriptive analysis of parameters such as the agriculture value added, the LPI, and the relationship with economic development indicators.

3. Methods and materials

This study uses statistics from open sources [15, 16, 17, 18] as well as research results and world ratings from the public domain for 2010-2019, as a foundation for descriptive analysis of the Asian countries' economic condition and potential. In the analysis, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, and Thailand are compared. The capabilities of the Microsoft Excel spreadsheet processor are used to carry out statistical analysis of data in several steps.

In the World Development Indicators database [18] all represented countries with populations of more than 30.000 are classified, enabling aggregation, categorization, and comparison of statistical data. The

World Bank divides the world's economies into four income groups — high, upper-middle, lower-middle, and low. Each country's income is measured using gross national income (GNI) per capita, in U.S. dollars. Economies are divided into IDA, IBRD, and Blend countries based on the operational policies of the World Bank. International Development Association (IDA) countries are those with low per capita incomes that lack the financial ability to borrow from the International Bank for Reconstruction and Development (IBRD). Blend countries are eligible for IDA loans but are also eligible for IBRD loans because they are financially creditworthy. The current study examines Europe, Central Asia, the IDA and IBRD countries of the Asian region.

The development of a country is measured with income per capita and gross domestic product per capita, while the general state of the economy is estimated by the rate of GDP growth. Consequently, if the real GDP is increasing, the economy is efficient. GDP is equal to the sum of the gross value added of all resident institutional units engaged in production, plus any taxes on products and minus any subsidies on products. Value added is the value of the gross output of producers less the value of intermediate goods and services consumed in production. Value added by industry is normally measured at basic prices.

Agriculture value added is the net output of the agricultural sector, including forestry, hunting and fishing, and cultivation of crops and livestock production, after adding up all outputs and subtracting intermediate inputs. Deductions for depreciation of fabricated assets, depletion, and degradation of natural resources are not included in the calculation.

The LPI measures the effectiveness of the logistics services supply throughout the chain [19]. Since logistics has a large number of various dimensions, the process of measuring and summarizing indicators is a challenge for many countries. A consolidated performance index is used to represent the logistics sector's effectiveness. This index combines data on the main components of efficiency into a single value [19]. The LPI is constructed from the six indicators using principal component analysis (PCA), a standard statistical technique used to reduce the dimensionality of a dataset. The weights are chosen to maximize the percentage of variation in the LPI's original six indicators.

4. Results

The analysis was performed on the following six countries of Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, and Thailand. The assessment was carried out according to the GDP per capita, LPI and the level of value added in agriculture.

GDP is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Figure 1 presents data on annual percentage growth in GDP at market prices.

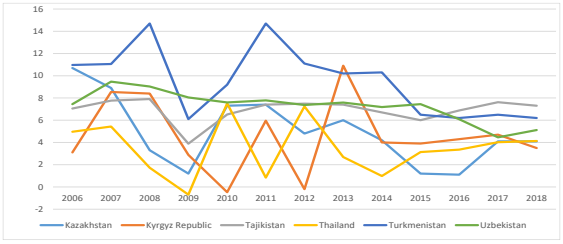

Figure 1. Problems associated with the application of flexible methods to manage supply chains in agricultural business.

According to the analysis, almost all examined countries show high GDP growth rates. Even though Thailand is slightly lagging behind, in general, the economic conditions of the reviewed countries can be described as positive. However, it should be noted that all the indicators exceed the average rates.

In the framework of the current study, research on the percentage of GDP in agriculture value added is made on data from OECD and The World Bank [16, 18]. Figure 2 presents data as of 2018. Agriculture value added in Tajikistan in 2018 was reported at 19.2%. Over the past 33 years, the maximum and minimum values for Tajikistan were 36.69% in 1995 and 18.55% in 2009, respectively. Agriculture value added in Kazakhstan in 2018 was reported to stand at 4.40%. In 26 years, a maximum value reached 23.34 in 1992 and a minimum of 4.29 in 2012. The value added in agriculture in Uzbekistan in 2018 was 28.79%. The maximum value during the last 31 years was 37.09% in 1991, and a minimum was 18.63% in 2009. In the Kyrgyz Republic, the minimum value during the last 30 years was 11.65% in 2018 and a maximum of 46.32% in 1996. The latest value for Tajikistan from 2018 is 19.2%, and fluctuations over the past 33 years were of 18.55% in 2009 and 36.69% in 1995. In 2018, the share of agriculture in Thailand's gross domestic product was 8.12%. The maximum value over the 58 years was 36.44% in 1960, and a minimum of 8.03% in 1993. The latest value added in the agricultural sector as percent of GDP for Turkmenistan from 2015 is 9.3%. The maximum value during the 28 years was 33.33% in 1990, and a minimum of 8.30% in 2014.

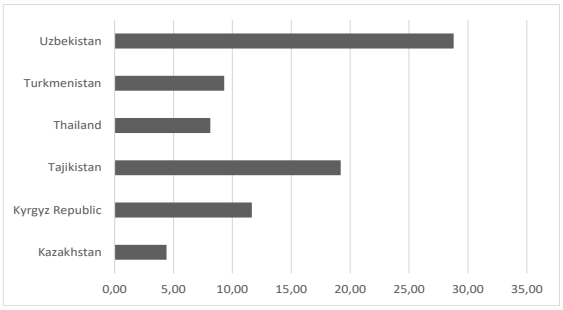

Figure 2. Agriculture, value added (% of GDP), taken from World Bank Open Data [18]

The logistics performance index of the countries should be defined for a more accurate analysis of opportunities opened to completely utilize economic resources in the Asian agricultural market. The LPI is an interactive benchmarking tool created to help countries identify the challenges and opportunities they face in trade logistics and what they can do to improve [19]. The LPI allows for comparisons across 160 countries. The LPI index is formed by interviewing operators in local logistics centers, which allows receiving estimated information about the logistics relationships with various countries. The estimates obtained through the surveys are supplemented by quantitative data, which are collected by measuring the efficiency of the supply chain key elements. Figure 3 presents LPI data for the countries examined in the research.

The components analyzed in LPI (World Bank [19]) are selected according to studies conducted by logistics specialists. These components include:

• efficiency of customs and border management clearance;
• quality of trade and transport infrastructure;
• ease of arranging competitively priced shipments;
• competence and quality of logistics services—trucking, forwarding, and customs brokerage;
• ability to track and trace consignments;
• frequency with which shipments reach consignees within scheduled or expected delivery times;

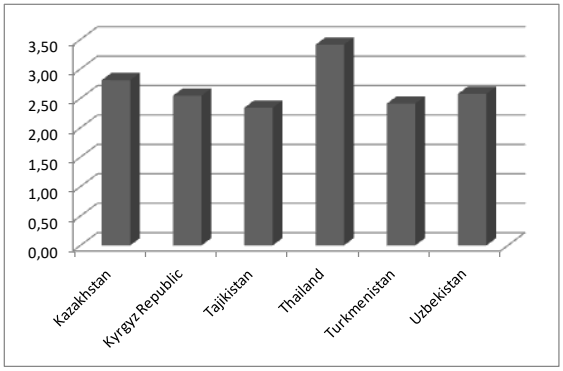

Figure 3. Central Asian countries' LPI, reproduced from World Bank Open Data [19]

Figure 4 presents the Kazakhstan's LPI components. The diagram analysis reveals that the best score on timeliness is 3.53 with a total index level of 2.81. The rest of the LPI components are quite low, which explains the 71st place in the global ranking. Thailand ranked 32nd out of 160 nations in the ranking on LPI. Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan occupy the 108th, 134th, 126th, and 99th positions.

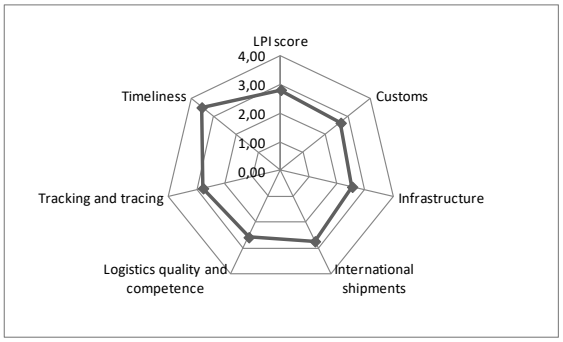

Figure 4. Kazakhstan's LPI components, reproduced from World Bank Open Data [19]

The analysis reveals that despite the rather high rates of GDP growth and added value in agriculture, the countries examined are not ready for integration into the global logistics system. Consequently, their opportunities for economic growth are highly limited. The effective supply chain is of great importance for agricultural sector development, however, its management remains problematic. For this reason, the issues of integration, infrastructure development, and information management require a solution.

5. Discussion

The global value chain (GVC) concept has become popular as a prerequisite for the successful development of Asian countries' economies. Nowadays, the use of emerging technologies in agriculture supply chains is increasing [2]. These technologies are driving the agricultural supply chain towards a digital supply chain environment.

The vast amount of data generated from transactions in agricultural supply chains delivers more accurate market information and data for supply chain actors and the public sector. As a result, these data can be used to inform production and marketing decisions or to prove a farmer's track record to access credit and strengthen the enabling environment with better informed policies [20]. In [1] provide an insight into various research models for a better understanding of logistics, networks, and relationships in agricultural supply chains.

Furthermore, Guidance for Responsible Agricultural Supply Chains is developed by OECD [15] to help enterprises observing existing standards for responsible business carrying along agricultural supply chains. These standards include the OECD Guidelines for Multinational Enterprises, the Principles for Responsible Investment in Agriculture and Food Systems, and the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security. Observing these standards helps enterprises mitigate their adverse impacts and contribute to sustainable development.

The critical issues at the agricultural supply chain subsystem are examined to integrate them efficiently and effectively [4, 5]. In [5] concludes that an efficient supply chain plays a very important role in the

development and is a contemporary issue for agriculture. Therefore, the government and the corporates must address the issue of integration, infrastructure development, and information management to achieve the objective of a feasible agricultural sector which will lead to food security for all.

In [6] note, that Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan are situated in the heart of the Eurasian continent. Upon entering into membership in the Shanghai Cooperation Organization, the Central Asian region has been viewed as a new route of the multilateral partnership between the political powers of Russia and China. Thus, this region plays a strategically important role in the world economy. All five countries became independent from the Soviet Union in 1991, and they share a culture and a way of life that incorporate elements from both the East and the West. To date, agriculture remains an important sector in the economy of Central Asia, contributing 5.2% of the GDP in Kazakhstan, 7.5% in Turkmenistan, 18.5% in Uzbekistan, 20.8% in Kyrgyzstan, and 23.3% in Tajikistan [6].

Based on unique farm-level data covering all production systems, [10] offer new insights into the constraints that hamper Kazakhstan's further economic growth and its integration into the global food trade. The studies [9, 11, 14] were also devoted to the analysis of the agro-industrial complex of Kazakhstan, and features of the supply chain implementation. Some authors suggested achieving long-term sustainability in terms of agricultural land use in Central Asia by switching from growing low-return crops on irrigated dry lands to a less water-intensive crop production system [6]. The primary objective of this paper is to review the current international literature on agricultural land use in Central Asia and its relevance to sustainable development. Thus, to use economic resources more thoroughly, substantial attention should be paid to supply chain optimization. An analysis of the international LPI scores shows that infrastructure in the Central Asian region is poorly developed. Furthermore, the quality and organization of the logistics processes are quite low. The reasons mentioned remain a significant problem for the development of the agricultural potential in the countries examined.

6. Conclusions

Agriculture continues to be the main sector of the Central Asia economy. Consequently, the sustainable use of agricultural land is essential for economic growth, human well-being, social justice, and the environment. The economic importance of the Asia region is growing annually. People are becoming wealthier and the role of local politicians in the world increases. Along with it, the level of involvement in global production networks significantly affects the economic growth of Asian countries. Thus, proper supply chain management allows maintaining a competitive advantage in the markets. The present findings will be of use to practitioners when developing strategies to ensure the success of value chains as a complex system.

In modern conditions of the socio-economic development, the SCM in Kazakhstan is among the most prioritized areas. The LPI ranks countries on six dimensions of trade, including customs performance, infrastructure quality, and timeliness of shipments. The index consists of qualitative and quantitative indicators and allows evaluating the effectiveness of supply chains. The LPI measures performance along the logistics supply chain within a country and offers two different perspectives: international and domestic. The results reveal rather low ranks of the considered countries. However, several countries in the region made sufficient progress towards SCM optimization in the agricultural sector. For this reason, to increase economic potential and opportunities for further development, Asian countries should prioritize the improvement and integration of logistics service into the global supply chain system.

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