BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

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MANAGEMENT OF SUCCESSFUL TECHNOLOGY TRANSFER IN AGRICULTURE: THE CASE OF KAZAKHSTAN

Abstract

Progress of agriculture is becoming increasingly reliant on the successful application of technology. However, many developing countries depend on technology transfer from other countries to be utilized in large and complex projects in agriculture. This study intends to identify strategic directions for successful technology transfer in developing countries' agriculture with Kazakhstan as a case study. A SWOT analysis was conducted using Internal Factor Evaluation, External Factor Evaluation, Strategic Position and Action Evaluation, and Quantitative Strategic Planning matrices as analytical methods, based on primary data from interviews and secondary data from reports. With a weight of 52%, opportunities prevail in external factors, with emerging good geographical position, land area latitude, and participation in economic integrations as the most significant ones. On the other hand, internal factors such as emerging low skills in agricultural innovation, insufficient resources in agriculture, old technologies and worn-out equipment, and lack of mechanisms for effective adaptation of foreign technologies to local conditions are indicated as weaknesses, with the percentage of 82%. This study includes twenty-six strategies that were specially designed for technology transfer, and nine of them are considered the most relevant in overcoming internal weaknesses by exploiting external opportunities. Promoting agriculture in an innovative direction, expanding the resource base necessary for technology transfer, and increasing sources of funding for the transfer of technology and the R&D expenditures in agriculture make a top 3 of these strategies. These results will be of interest for policymakers in decision-making on technology transfer in agriculture.

Keywords international technology transfer, management, agriculture, innovation, SWOT analysis, strategy

JEL Classification O13, O32, Q16

Received on: 24th of April, 2021
Accepted on: 11th of September, 2021
Published on: 28th of September, 2021

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Conflict of interest statement:
Author(s) reported no conflict of interest

INTRODUCTION

Faster development of the infrastructures, economy, and standard of living is a concern for many developing countries. However, these countries lack the required capacities to undertake large or complex innovative projects. International technology transfer can be an expedited way of reducing technological gaps between countries (Nelson, 1990). Especially in fast-growing Asian countries, technology transfer from other countries continues to be a key driver of industrialization and economic growth (Waroonkun & Stewart, 2008; Joshi et al., 2018). The diffusion of technology contributes to change that fuels the economy with increased productivity (Mamat & Roslan, 2012).

However, international technology transfer is a very complex process involving several entities (Bozeman, 2000). Not only a good understanding of the process is required, but managers also should have an understanding of the potential problems in the pathway for a successful transfer of technology. To address those problems, management needs to devise clear strategies and successful implementation of these strategies (Keller & Chinta, 1990). To formulate those strategies,

http://dx.doi.org/10.21511/ppm.19(3).2021.40

it matters to identify key factors that can work either as facilitators or inhibitors in sector-wide technology transfer projects in developing countries (Iyer & Banerjee, 2018).

The agricultural sector is a key piece for the development of Kazakhstan's economy. Innovative processes and new technology are required to compete with developed countries. Technologies in agriculture in Kazakhstan became obsolete after the collapse of the USSR, and foreign technologies have become more expensive for ordinary farmers. It is necessary to properly manage the technology transfer and know which factors may play a crucial role in that process for the effective implementation of complex innovative processes in the agriculture of Kazakhstan.

1. LITERATURE REVIEW

An uninterrupted supply of food and goods to consumers is provided in the agriculture of developing countries (Pawlak & Kołodziejczak, 2020). Nevertheless, at present, because of the lack of technological equipment, agriculture in developing countries cannot compete with that of developed countries. Many developing and newly industrialized countries lack the technical capabilities to implement large and complex infrastructure projects (Romijn, 2001). Agriculture in developing countries like Kazakhstan also faces similar challenges (Tulemetova et al., 2019). To solve the aforementioned problems, foreign countries often use international technology transfer (ITT). The topic of ITT has spurred great interest among academic researchers and policymakers. According to these policymakers and researchers, technology transfer (TT) is defined in many different ways, regarding the discipline of the research, but also related to the purpose of the study (Bozeman, 2000). Previous research explained TT in three different aspects: international political dimensions, commercial transactions, and issues of operational relevance. These three aspects are very important for the selection and adaptation of new technologies (Reddy & Zhao, 1990).

However, successful technology transfer depends on a variety of influencing factors. These factors are considered from different points of view, depending on the areas of activity and the dependence of the development of countries. Technology transfer is a complex process; consequently, the study of TT has many different influencing factors.

Khan et al. (2017) identified 17 barriers affecting TT using general interpretive structural modeling. Important barriers affecting TT, such as lack of top management support, lack of awareness, lack of human resources, lack of communication, cultural barriers, new technologies, investment, excessive government intervention and regulation, inadequate information and technological systems, limited forecasting and planning, lack of infrastructure, resistance to change, lack of R&D and individual capabilities, lack of demand, lack of trust among partners, organizational risk and country risk were discussed. It was also argued that this hierarchy of barriers provides valuable information when making decisions and formulating strategies for the acquisition and development of technologies.

Thus, Iyer and Banerjee (2018) note that the priority facilitators and inhibitors for the TT in developing economies were considered through transfer environment, learning environment, transferee, and transferor characteristics. Such classification is found in the models of many researchers of TT (Bozeman, 2000; Lee et al., 2018; Mohamed et al., 2012; Waroonkun & Stewart, 2008). Especially in the process of technology transfer, the relationship between transferee and transferor plays a crucial role. Malik (2002) argued that lack of trust and knowledge sharing reluctance between transferee and transferor reduces the effectiveness of the TT process; moreover, it is an important management tool. Conversely, effective communication, prior TT experience, willingness to transfer, knowledge base, and motivation facilitate the TT process.

Such disagreement between the two parties is largely dependent on the cultural differences or personality traits of the participants (Nguyen & Aoyama, 2015). As a result, according to Gibson and Smilor (1991), the barrier syndrome "not invented here" appears. The reason for that is

not everyone is willing to take responsibility for technology transfer. After this study, Sung and Gibson (2000) tested 16 factors at the Microelectronics and Computer Technology Corporation again. The results showed that four key factors, such as communication, distance, ambiguity, and motivation, are particularly important in TT. Given that, managers can accelerate their work by recognizing affecting facilitators and barriers in the TT process (Gibson & Smilor, 1991). These differences in groups can be regulated via cooperative norms. Cooperative norms improve teamwork and are an integral part of successful technology transfer (Devapriya & Ganesan, 2002).

In addition to internal factors, external factors like economic and political factors also influence success in ITT. According to Cho and Shenkoya (2020), one of the important factors influencing TT is the economic factor. In their view, economic factors such as the rate of inflation, the exchange rate of the currency, and foreign direct investment motivate both the transferor and transferee to choose a TT partner. Derakhshani (1984) concluded that resources are a significant economic factor in the success of ITT. Thang and Quang (2005) confirm that future decisions on technology transfer depend on constraints and resource requirements. The resource limit was divided into several parts. The first type of resource constraint was related to the number of staff and lack of qualified personnel. This type is the result of a close relationship between organizational resources. The second type of resource restriction is associated with financial restrictions. In addition to emphasizing these constraints, Thang and Quang (2005) gives some proposition to resource requirements. According to propositions, the newer and more complex the technology is, the greater resource commitments require the process of technology transfer. As a result of this study, the transfer mode with a high resource commitment will help to carry out an effective transfer. Moreover, the financial support for agricultural enterprises facilitates the introduction of technologies (Lipych et al., 2017). For developing countries, resource support comes mainly from the state. Therefore, in the transfer of technology, political factors, the influence of the state has a major role (Bozeman, 2000; Sung, 2009; Mohamed et al., 2012).

Wegren (2019) believes that public policy has an impact on many factors affecting the agricultural sector. The SWOT analysis (strengths, weaknesses, opportunities, and threats) carried out shows that the government is a central actor for the agricultural sector of post-Soviet countries, which provides financial resources. Compared to what Wegren et al. (2019) wrote about the SWOT analysis of the Russian agricultural sector, this study's SWOT analysis showed that in addition to state influence, foreign countries are very important for agricultural development. The development of agriculture can be accelerated by attracting foreign investors, introducing new technologies from developed countries. In addition to these barriers, the transfer of agricultural technology is hindered by various edaphic, climatic, economic, and political factors. One solution to this situation is that indirect technology transfer can take place in other regions that have been used by adapting to local conditions (Evenson, 1994).

In conclusion, it can be said that the studies on TT barriers are broader than those on facilitators. In addition, the literature review indicates the importance of using technology for innovative development of the agricultural sector, as well as the need to identify factors affecting technology transfer in this sector of the economy, taking into account national characteristics, to effectively manage this process by both farmers and government agencies. Consideration of all these factors affecting technology transfer makes it possible to identify strategic ways of successful technology transfer to agriculture in Kazakhstan.

2. AIMS AND METHODOLOGY

The purpose of this study is to reveal factors affecting technology transfer in the agricultural sector and to identify strategic directions for successful technology transfer to agriculture in developing countries, using Kazakhstan as an example.

Situational SWOT analysis of the process of technology transfer to the agricultural sector of Kazakhstan was conducted to assess the TT to the

http://dx.doi.org/10.21511/ppm.19(3).2021.40

agricultural sector in Kazakhstan and to identify the factors affecting its effective functioning. Selection and evaluation of the TT strategy were carried out in three stages (Satpayeva, 2017):

1) through the Internal Factors Assessment (IFE) Matrix and the External Factors (EFE) Matrix, the internal and external environments of the TT to the agricultural sector were analyzed, the information obtained identified its strengths and weaknesses (internal factors), and threats (external factors). IFE and EFE matrices were created based on literature review, statistical analysis of data from the Ministry of Agriculture of Kazakhstan, and interviews of experts;

2) through the SWOT analysis, its strengths and weaknesses, opportunities, and threats were evaluated. The possible TT strategies were developed for the agricultural sector;

3) through Strategic Position and Action Evaluation (SPACE) Matrix and Quantitative Strategic Planning (QSP) Matrix, priority strategic recommendations were offered and identified for technology transfer to the agricultural sector of Kazakhstan.

All ratings were weighted in the course of a questionnaire survey of experts engaged in research on TT in the agricultural sector. The information base of the study is primary and secondary data. For collecting primary data there were conducted interviews. The target population was 16 participants involved in the TT process, including 8 foreign specialists. The conversation was attended by such foreign experts as professors of Ohio State University, Director of the Italian company Euro Chorus Consulting, vice-president of the International Fund for Sustainable Peace and Development, Russian economist, Chairman of the Board of the National Agrarian Research and Educational Center and professors working in the field of agricultural science. As the TT is carried out between the two parties, it was very important to get opinions of foreign experts. The base of secondary data was reports of the Ministry of Agriculture of Kazakhstan and literature on TT to the agricultural sector.

3. RESULTS

SWOT analysis is an effective tool for identifying opportunities and challenges in the agricultural sector and identifying ways forward, as it provides more detailed information about strategic planning (Azarenkova et al., 2019). SWOT analysis is often used to assess the strengths, weaknesses, opportunities, and threats of agriculture (Dyson, 2004; Ali et al., 2021). To better illustrate the components, the SWOT is based on the grouping of the main components: 1 – economic forces, 2 – environmental, ecological, cultural, and social forces, 3 – legal, governmental, and political forces, 4 – technological forces, and 5 – competitive forces (Hashemi et al., 2011).

The EFE matrix is a strategic management tool used to visualize and prioritize the opportunities and threats that can be faced in the formation and development of a country's TT (Table 1). The purpose of studying environmental factors is to use opportunities and avoid threats. The creation of the EFE matrix showed threats due to the influence of the external environment.

Table 1 shows the list of opportunities and threats of TT to the agricultural sector of Kazakhstan, where economic factors are predominant. The most important opportunities are the country's location, the latitude of land area, and participation in economic integrations. The most important threats include the country's raw materials focus, high level of interest rate of leasing, and bureaucracy. At the same time, the growth of urbanization and the lack of legal coverage in the context of TT are hindering the development of TT.

The IFE matrix is a strategic management tool used to assess strengths and weaknesses. An IFE matrix has been build to assess the internal environment that affects the TT to the agricultural sector of Kazakhstan (Table 2).

Table 2 shows the strengths and weaknesses of the TT in the agricultural sector of Kazakhstan. It shows that among the internal factors, weaknesses have a predominant influence. In particular, the following internal factors have a significant impact on the development of the TT in the agricultural sector of Kazakhstan: a small number of qualified specialists, the lack of mechanisms

Table 1. EFE matrix of technology transfer to the agricultural sector of Kazakhstan

External factor	Weight[1]	Rating[2]	Score[3]
Opportunity			
1. Location of the country in a good geographical position, which gives priority to logistics	0.08	4	0.32
2. Latitude of land area	0.08	4	0.32
3. Participation in economic integration organizations (Eurasian Economic Union (EEU), World Trade Organization (WTO), Green Bridge Union, Silk Road Economic Belt (SREB), etc.)	0.08	4	0.32
4. Tax reduction for farmers	0.05	3	0.15
5. Increased sources of agricultural financing (support from QazAgro Corporation, subsidies, Asian Development Bank (ADB) allocations, leasing, etc.)	0.04	4	0.16
6. Increased capacity to transfer foreign innovation technologies to agriculture	0.04	3	0.12
7. Development of new industries (formation of new technological direction, development of knowledge-intensive industries and creative industries, development of "green" and low-carbon technologies, etc.)	0.04	4	0.16
8. The possibility of increasing the volume of all types of agricultural production in response to population growth and changing nutritional patterns	0.05	4	0.2
9. Growing demand for food in neighboring countries (Commonwealth of Independent States (CIS), Central Asia, China)	0.06	5	0.3
Total	0.52		2.05
Threat			
1. Decrease in the level of support and protection of patents, decrease in the number of valid patents	0.05	1	0.05
2. Insufficient legal space for technology transfer	0.07	1	0.07
3. Insufficient state support for agriculture	0.07	1	0.07
4. Bureaucracy	0.08	1	0.08
5. Increasing the economy's focus on commodities	0.04	1	0.05
6. The growth of the urban process	0.05	1	0.05
7. Further decline in oil prices, devaluation of the national currency	0.06	1	0.06
8. High leasing interest rate to improve technical equipment	0.06	1	0.06
Total	0.48		0.48
Total	1		2.53

Notes: 1. The weight ranges from 0 to 1 for each factor. The weight assigned to this factor indicates its relative importance. Zero means that the factor is irrelevant, while one indicates that the factor is very influential. The total sum of the weights must be one. 2. The rating is determined on a scale of 1 to 4 for each factor. The rating reflects whether the factor is a serious threat (1), a minor threat (2), a minor opportunity (3), or a major opportunity (4). 3. The weighted score is the product of the weight and rating of the corresponding factor.

Table 2. Analysis of the internal environment of technology transfer in the agricultural sector of Kazakhstan

Internal factor	Weight[1]	Rating[2]	Score[3]
Strength			
1. Production of natural products in agriculture	0.04	4	0.16
2. A wide range of climatic zones with favorable conditions for increasing the number of crops	0.03	4	0.12
3. Mass digitalization of the agro-industrial complex	0.03	3	0.09
4. Improving roads in rural areas	0.03	3	0.09
5. Increased interest of farmers in the development of new technologies	0.06	4	0.24
Total	0.19		0.7
Weakness			
1. Availability of old technologies and large quantities of worn-out equipment in agriculture	0.05	1	0.05
2. Low skills in agricultural innovation	0.06	1	0.06
3. High cost of technology	0.04	1	0.04
4. Insufficient knowledge of a foreign language by specialists	0.03	2	0.06
5. Low qualification of farmers and domestic transfer authorities in technology transfer	0.04	1	0.04
6. Lack of mechanisms for effective adaptation of foreign technologies to local conditions	0.05	1	0.05
7. Problems in agriculture of technology transfer to agriculture, lack of research on the technology introduced	0.04	1	0.04
8. Low level of attractiveness of agriculture to foreign investors	0.04	1	0.04

http://dx.doi.org/10.21511/ppm.19(3).2021.40

Table 2 (cont.). Analysis of the internal environment of technology transfer in the agricultural sector of Kazakhstan

Internal factor	Weight[1]	Rating[2]	Score[3]
9. Greater documentality of the technology transfer to agriculture	0.04	1	0.04
10. The duration of the registration period when implementing technology	0.04	1	0.04
11. Undeveloped technology transfer channels	0.04	1	0.04
12. Low channels for the dissemination of information about the technology	0.04	1	0.04
13. A small number of venture funds, technology commercialization, and transfer centers, and technology brokers	0.04	1	0.04
14. Limited opportunities for the dissemination of science and technology among farmers	0.04	1	0.04
15. Low level of implementation of research and development work	0.03	1	0.03
16. Small number of cooperatives	0.01	1	0.01
17. The inability to establish high cooperation with foreign partners in the technology transfer	0.05	1	0.05
18. Low volume of agricultural exports	0.03	1	0.03
19. Insufficient material, technical, information, and human resources in agriculture	0.06	1	0.06
20. Low level of insurance system in agriculture	0.03	1	0.03
21. Non-compliance of manufactured products with international standards	0.02	2	0.04
Total	0.82		0.87
Total	1		1.57

Notes: 1. The weight ranges from 0 to 1 for each factor. The weight assigned to this factor indicates its relative importance. Zero means that the factor is irrelevant, while one indicates that the factor is very influential. The total sum of the weights must be one. 2. The rating is determined on a scale of 1 to 4 for each factor, showing whether the factor is a major weakness (1), minor weakness (2), minor strength (3), or major strength (4); 3. The weighted score is the product of the weight and rating of the corresponding factor.

for effective adaptation of foreign technologies to local conditions; insufficient material, technical, information and human resources in agriculture; limited opportunities for the dissemination of science and technology among farmers; undeveloped technology transfer channels; a small number of venture funds, centers for commercialization and TT, technology brokers.

Based on the EFE and IFE matrixes the following significant external and internal factors influencing TT to the agricultural sector of Kazakhstan were identified:

- opportunities: location of the country in a good geographical position, which gives priority to logistics; latitude of land area; participation in economic integration organizations (EEU, WTO, Green Bridge Union, SREB, etc.), growing demand for food in neighboring countries (CIS, Central Asia, China) and tax reduction for farmers;
- threats: bureaucracy; insufficient legal space for technology transfer; insufficient state support for agriculture; further decline in oil prices, devaluation of the national currency and high leasing interest rate to improve technical equipment;
- strengths: increased interest of farmers in the development of new technologies and production of natural products in agriculture;
- weaknesses: low skills in agricultural innovation; insufficient material, technical, information, and human resources in agriculture; availability of old technologies and large quantities of worn-out equipment in agriculture; lack of mechanisms for effective adaptation of foreign technologies to local conditions; inability to establish high cooperation with foreign partners in the technology transfer.

The SWOT analysis made it possible to build a matrix of strategic planning, which is a management tool and is used to select the type of strategy to be taken at this stage, taking into account all internal and external factors (Ommani, 2011). The SWOT matrix facilitates the selection of the appropriate strategic direction and draws attention to the dynamics of the internal and external environment, which is very valuable in terms of using this analysis for strategic purposes (Table 3).

SWOT analysis allows to diagnose the strengths and weaknesses, opportunities and threats of technology transfer, as well as develop strategic directions. Through SWOT analysis, possible var-

Table 3. SWOT analysis of technology transfer to the agricultural sector of Kazakhstan

Strengths	Weaknesses
S1. Production of natural products in agriculture;	W1. Availability of old technologies and large quantities of worn-out equipment in agriculture;
S2. A wide range of climatic zones with favorable conditions for increasing the number of crops;	W2. Low skills in agricultural innovation;
S3. Conducting mass digitalization of the agro-industrial complex;	W3. High cost of technology;
S4. Improving roads in rural areas;	W4. Insufficient knowledge of a foreign language by specialists;
S5. Increased interest of farmers in the development of new technologies.	W5. Low qualification of farmers and domestic transfer authorities in technology transfer;
	W6. Lack of mechanisms for effective adaptation of foreign technologies to local conditions;
	W7. Problems in agriculture of technology transfer to agriculture, lack of research on the technology introduced;
	W8. Low level of attractiveness of agriculture to foreign investors;
	W9. Greater documentality of the technology transfer to agriculture;
	W10. The duration of registration period when implementing of technology;
	W11. Undeveloped technology transfer channels;
	W12. Poor channels for the dissemination of information about the technology;
	W13. A small number of venture funds, technology commercialization and transfer centers, and technology brokers;
	W14. Limited opportunities for the dissemination of science and technology among farmers;
	W15. Low level of implementation of research and development work;
	W16. A small number of cooperatives;
	W17. The inability to establish high cooperation with foreign partners in the technology transfer;
	W18. Low volume of agricultural exports;
	W19. Insufficient material, technical, information, and human resources in agriculture;
	W20. Low level of insurance system in agriculture;
	W21. Non-compliance of manufactured products with international standards.
Opportunities	**Threats**
O1. Location of the country in a good geographical position, which gives priority to logistics;	T1. Decrease in the level of support and protection of patents, decrease in the number of valid patents;
O2. Latitude of land area;	T2. Insufficient legal space for technology transfer;
O3. Participation in economic integration organizations (EEU, WTO, Green Bridge Union, SREB, etc.)	T3. Insufficient state support for agriculture;
O4. Tax reduction for farmers;	T4. Bureaucracy;
O5. Increased sources of agricultural financing (support from QazAgro Corporation, subsidies, ADB allocations, leasing, etc.);	T5. Increasing the economy's focus on commodities;
O6. Increased capacity to transfer foreign innovation technologies to agriculture;	T6. The growth of the urban process;
O7. Development of new industries (formation of new technological direction, development of knowledge-intensive industries and creative industries, development of "green" and low-carbon technologies, etc.);	T7. Further decline in oil prices, devaluation of the national currency;
O8. The possibility of increasing the volume of all types of agricultural production in response to population growth and changing nutritional patterns;	T8. High leasing interest rate to improve technical equipment.
O9. Growing demand for food in neighboring countries(CIS, Central Asia, China).	

http://dx.doi.org/10.21511/ppm.19(3).2021.40

iants of strategic recommendations were proposed that will increase the sustainability of agriculture and its innovative development based on TT:

1) SO Strategy shows which strengths should be used from the opportunities in the external environment;

2) ST strategy shows how to use strengths to avoid and overcome threats;

3) WO strategy shows what weaknesses can be overcome by the capabilities of the external environment;

4) WT strategy shows how to strengthen weaknesses to avoid threats.

Table 4. SWOT matrix of technology transfer to the agricultural sector of Kazakhstan

SO Strategies:	WO Strategies:
SO1. (S4, O1, O3, O6, O9)	WO1. (W1, W2, W5, W7, W10, W11, W12, W13, W19, O5, O6, O7, O9)
SO2. (S1, S2, O1, O3, O6, O8)	WO2. (W2, W3, W5, W7, W15, W17, W19, O5, O6, O7)
SO3. (S5, O3, O6, O7, O9)	WO3. (W1, W2, W5, W7, W9, W10, W14, W15, W19, W20, W21, O4, O5)
SO4. (S3, O6, O7)	WO4. (W5, W7, W9, W13, W15, W17, W18, W19, O3, O6, O9) WO5. (W11, W12, W13, O6)
SO5. (S3, S5, O3, O6, O7	WO6. (W8, W9, W10, W21, O1, O2, O3, O4, O6, O9)
	WO7. (W5, W11, W15, W17, O3 ,O6, O7, O9)
	WO8. (W1, W5, W15, W19, O4, O9)
	WO9. (W2, W6, W7, W8, W13, W19, W20, W21, O3, O6, O7, O9)
ST Strategies:	**WT Strategies:**
ST1. (S1, S2, S3, T6)	WT1. (W1, W2, W3, W5, W7, W8, W13, W14, W15, W19, T1, T2, T3, T4)
ST2. (S3, T1, T7, T8)	WT2. (W2, W5, W6, W7, W14, W15, W19, T2, T3, T4, T5, T6, T7, T8)
ST3. (S1, S2, T5)	WT3. (W1, W2, W6, W7, W9, W10, W11, W13, W14, W17, W19, W21, T5, T7, T8)
ST4. (S5, T2, T3)	WT4. (W1, W2, W3, W5, W6, W7, W8, W9, W10, W11, W12, W13, W14, W15, W19, W21, T1, T3, T4, T5, T6, T7)
ST5. (S3, S4, T2, T3, T4, T8)	
ST6. (S1, S3, S4, S5, T3, T5, T8)	
ST7. (S5, T2, T3, T4, T5, T7)	
S8. (S1, S2, S5, T2, T3, T8)	

According to the results of the built SWOT matrix, the following areas of TT are proposed to the agricultural sector of Kazakhstan:

1) to implement these opportunities, it is proposed to make maximum use of the existing strengths of technology transfer to the agricultural sector of Kazakhstan:

SO1. Creating a convenient logistics system for technology transfer to agriculture;

SO2. Transfer of technologies that increase the production of natural organic products;

SO3. Strengthening the foreign Union in the direction of technology transfer;

SO4. Development of Information Technology Communications in agriculture;

SO5. Introduction study abroad program for students of agricultural universities.

2) opportunities of the external environment to overcome weaknesses:

WO1. Implementation of measures to promote agriculture in an innovative direction;

WO2. Professional development of specialists in agriculture;

WO3. Increasing sources of funding from the state for the transfer of technology to agriculture and increasing the volume of R&D expenditures in agriculture.

WO4. Increasing mechanisms for effective adaptation of foreign technologies to local

conditions and expanding channels for transferring new technologies to agriculture;

WO5. Step-by-step, high-quality implementation of the technology transfer process;

WO6. Stimulating foreign direct investment in agriculture;

WO7. Creation of technology transfer centers that transfer technologies to agriculture;

WO8. Expanding the resource base necessary for technology transfer to agriculture;

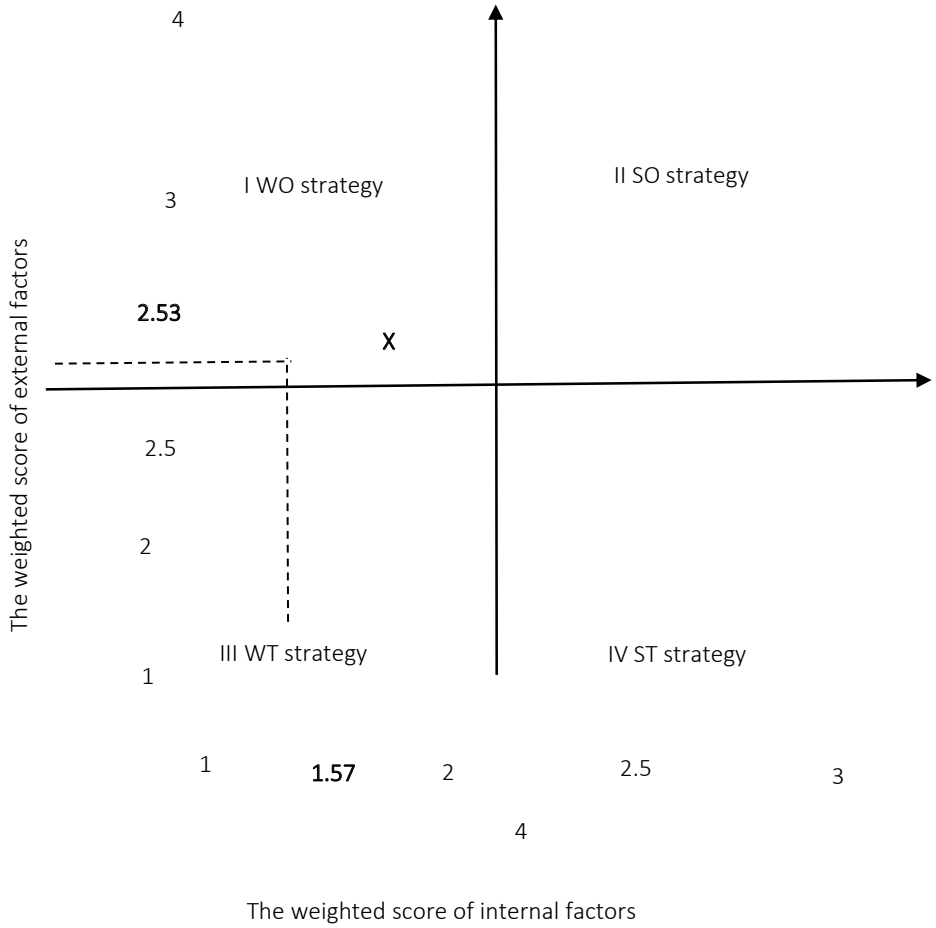

Figure 1. SPACE matrix of technology transfer to the agricultural sector of Kazakhstan

WO9. Development of the insurance system in agriculture and bringing agricultural products into line with international standards.

3) areas of use of strengths to prevent and overcome threats:

ST1. Reducing the urbanization process;

ST2. Development of the intangible asset support system;

ST3. Increasing ways to save natural resources;

ST 4. Development of the legal framework of technology transfer;

ST 5. Implementation of measures to restrict bureaucracy;

ST 6. Expanding the system of subsidies from the state;

ST 7. Implementation of measures to strengthen the national currency;

ST 8. Conclusion of leasing lending agreements available to farmers.

4) ways to reduce weaknesses to avoid threats:

WT1. Increase of state tools to support innovation in the agricultural sector;

WT2. Implementation of the "four spiral" system of elements of the production and technological infrastructure of the innovation system;

WT3. Involvement of multinational companies in the agricultural sector;

WT4. Development of a methodology for monitoring, analyzing, evaluating, and predicting the process of TT to agriculture;

http://dx.doi.org/10.21511/ppm.19(3).2021.40

Based on the SWOT matrix, there are 26 strategic directions for technology transfer to the agricultural sector in Kazakhstan. The considered strategies play an important role in attracting technologies to the agricultural sector of Kazakhstan. Further, the graphical SPACE method determines, the most appropriate strategy in the current situation. To select the most relevant ones, the SPACE matrix was built (Figure 1).

According to Figure 1, today, taking into account all internal and external factors affecting the transfer of technologies to the agricultural sector of Kazakhstan, the priority direction of its development is the implementation of WO strategies.

A QSP matrix was constructed from among the selected WO-strategies to objectively select the best possible strategy for the development of technology transfer to the agricultural sector in Kazakhstan (Appendix A).

According to the QSP matrix, special attention should be paid to the following priority areas of the TT strategy for the agricultural sector of Kazakhstan (in descending order of priority):

1) implementation of measures to promote agriculture in an innovative direction;

2) expansion of the resource base necessary for TT to agriculture;

3) increasing sources of state funding for the TT to agriculture and increasing the volume of R&D expenditures in agriculture;

4) increasing mechanisms for effective adaptation of foreign technologies to local conditions and expanding channels for transferring new technologies to agriculture;

5) advanced skills of specialists in agriculture;

6) creation of TT centers for TT to agriculture;

7) promotion of foreign direct investment to agriculture;

8) step-by-step, qualitative implementation of the TT process;

9) development of a system for the identification of agricultural products by international standards and insurance in agriculture.

Thus, the transfer of technologies to the agricultural sector of Kazakhstan is influenced by both external and internal factors. At the same time, among the external factors, the factors that determine the opportunities have a strong influence, while among the internal factors – the factors that determine the weaknesses of this process. Based on the identified factors, 26 strategic directions for the development of technology transfer in the agricultural sector of Kazakhstan were developed, of which 9 strategies are relevant, where opportunities of the external environment to overcome weaknesses. At the same time, the highest priority is the implementation of measures to promote agriculture in an innovative direction, which once again confirms the importance of technology transfer to the agricultural sector for its sustainable and innovative development in developing countries.

CONCLUSION

Successful technology transfer can significantly affect country's economic development in technical and financial terms, and if technology transfer is unsuccessful, it harms the economy. For this reason, managers need to be aware of the factors affecting technology transfer as well as take them into account in decision-making. The adoption of a strategy for the successful technology transfer to the agricultural sector is a possible item on the policy agenda of developing countries, including Kazakhstan.

Therefore, the aim of the current study was achieved. Key factors are identified and priority strategic areas for attracting technology in the agricultural sector of Kazakhstan were developed. So, based on the conducted analysis, the following conclusions were obtained.

Firstly, economic factors are of predominant importance for technology transfer in the agricultural sector of Kazakhstan, while from the external environment it is possible to note the predominant influence of factors that provide opportunities for effective transfer and development of technologies. Important opportunities include the country's location in a good geographical location that gives priority to logistics; the breadth of the land area; the presence of economic integration organizations; the growing demand for food in neighboring countries and lower taxes for farmers. The most important threats include bureaucracy; insufficient legal space for technology transfer; and insufficient government support for agriculture; further decline in oil prices; devaluation of the national currency; and a high-interest rate on leasing to improve technical equipment.

Secondly, technology transfer in the agricultural sector of Kazakhstan is characterized by a high impact of its weaknesses. The main weaknesses include low skills in agricultural innovation; insufficient material, information, and human resources in agriculture; the presence of old technologies and a large number of worn-out equipment in agriculture; the lack of mechanisms for effectively adapting foreign technologies to local conditions; and the inability to establish close cooperation with foreign partners in the field of technology transfer. At the same time, the increased interest of farmers in the development of new technologies and the production of natural products in agriculture are the most important strengths.

Thirdly, the priorities for the development of technology transfer in the agricultural sector of Kazakhstan are the following strategic actions, which are arranged in descending order of priorities: implementation of measures to promote agriculture in an innovative direction; expansion of the resource base necessary for TT in agriculture; increase in sources of state funding for TT in agriculture and increase in R&D spending in agriculture; improving mechanisms for the effective adaptation of foreign technologies to local conditions and expanding channels for the transfer of new technologies to agriculture; improving the skills of agriculture specialists; creating TT centers for TT in agriculture; stimulating foreign direct investment in agriculture; gradual, high-quality implementation of the TT process; developing a system for identifying agricultural products according to international standards and insurance in agriculture.

The scientific results obtained during the study can be subjective. However, due to the lack of a methodological and statistical base for high-quality monitoring, analysis, evaluation, and forecasting of TT to the agricultural sector of Kazakhstan, the development of such a plan is important to determine the state of TT to the agricultural sector of Kazakhstan and priority directions for its development. In conclusion, this study provides new and useful knowledge for both academics and practitioners who are interested in the field of technology transfer to the agriculture sector. The limitations to be taken into consideration in this study are the collection of data from different sources and the increase in the number of respondents.

AUTHOR CONTRIBUTIONS

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http://dx.doi.org/10.21511/ppm.19(3).2021.40

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http://dx.doi.org/10.21511/ppm.19(3).2021.40

APPENDIX A

Table A1. QSP matrix of technology transfer to the agricultural sector of Kazakhstan

Factor	Weight	WO1		WO2		WO3		WO4		WO5		WO6		WO7		WO8		WO9	
		AS[1]	FAS[2]	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS	AS	FAS
O1	0.08	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32
O2	0.08	4	0.32	4	0.32	4	0.32	4	0.32	3	0.24	3	0.24	3	0.24	4	0.32	3	0.24
O3	0.08	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32
O4	0.05	3	0.15	3	0.15	3	0.15	3	0.15	1	0.05	1	0.05	2	0.1	2	0.1	2	0.1
O5	0.04	4	0.16	3	0.12	4	0.16	4	0.16	3	0.12	3	0.12	4	0.16	4	0.16	4	0.16
O6	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
O7	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
O8	0.05	3	0.15	2	0.1	3	0.15	2	0.1	1	0.05	1	0.05	2	0.1	3	0.15	2	0.1
O9	0.06	3	0.18	3	0.18	2	0.12	3	0.18	2	0.12	2	0.12	3	0.18	3	0.18	3	0.18
T1	0.05	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2
T2	0.07	3	0.21	2	0.14	4	0.28	3	0.21	3	0.21	3	0.21	3	0.21	3	0.21	2	0.14
T3	0.07	4	0.28	4	0.28	4	0.28	4	0.28	4	0.28	4	0.28	4	0.28	4	0.28	4	0.28
T4	0.08	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32	4	0.32
T5	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
T6	0.05	4	0.2	4	0.2	4	0.2	3	0.15	3	0.15	3	0.15	3	0.15	3	0.15	3	0.15
T7	0.06	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24
T8	0.06	3	0.18	3	0.18	3	0.18	3	0.18	2	0.12	2	0.12	3	0.18	3	0.18	2	0.12
S1	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
S2	0.03	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12
S3	0.03	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12
S4	0.03	4	0.12	3	0.09	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12
S5	0.06	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24
W1	0.05	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	3	0.15	4	0.2	4	0.2
W2	0.06	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	4	0.24	3	0.18	4	0.24	4	0.24
W3	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
W4	0.03	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	3	0.09	4	0.12	4	0.12
W5	0.04	4	0.16	3	0.12	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
W6	0.05	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2
W7	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
W8	0.04	4	0.16	4	0.16	4	0.16	4	0.16	3	0.12	3	0.12	3	0.12	4	0.16	3	0.12
W9	0.04	4	0.16	4	0.16	3	0.12	4	0.16	4	0.16	4	0.16	3	0.12	4	0.16	2	0.08
W10	0.04	4	0.16	4	0.16	2	0.08	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	2	0.08
W11	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	3	0.12
W12	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
W13	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
W14	0.04	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16	4	0.16
W15	0.03	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	4	0.12	3	0.09	4	0.12	4	0.12
W16	0.01	3	0.03	3	0.03	4	0.04	3	0.03	2	0.02	2	0.02	4	0.04	4	0.04	2	0.02
W17	0.05	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2	4	0.2
W18	0.03	4	0.12	4	0.12	4	0.12	3	0.09	3	0.09	2	0.06	3	0.09	4	0.12	3	0.09
W19	0.06	4	0.24	4	0.24	4	0.24	4	0.24	3	0.18	4	0.24	3	0.18	4	0.24	4	0.24
W20	0.03	3	0.09	4	0.12	4	0.12	4	0.12	3	0.09	3	0.09	3	0.09	4	0.12	3	0.09
W21	0.02	4	0.08	4	0.08	4	0.08	4	0.08	4	0.08	4	0.08	4	0.08	4	0.08	4	0.08
Total			7.71		7.51		7.64		7.61		7.08		7.11		7.15		7.65		7.07
Priority			1		5		3		4		8		7		6		2		9

Notes: 1. AS – Attractiveness Score; 2. FAS – Final Attractiveness Score.