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Liquid Biofuels Sustainable Development Analysis

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Abstract

The ecological footprint of Hungary is close to the European average and we expect further growth. The projects of the Széchenyi 2020 program and the Hungarian Multinational Oil and Gas Company (MOL) promote the development of the green economy provide significant subsidies. The depletion of petroleum-derived fuel and environmental concern has promoted to look over the biofuel as an alternative fuel source. However, the production of biofuels is an expensive process. The rapid spread of biofuels created an agricultural expansion, contributing to rising water demands; however, that was already a serious international problem. The competition for agricultural areas has an impact of price increment because the excessive rate of energy crops can replace not only the same kinds of food crops but other (for example fodder) varieties. In our evaluation, the third generation of biofuels seems the ultimate solution for us in the following 25-30 years' period.

Keywords: biofuel, environment, sustainable development

Introduction

Global climate change is possibly the most prevalent issue that reaches frequently even the average citizen through the media and the involved foundations. A few

emphasized areas are the relationship between emission and global warming, how biofuels deplete the ozone layer less than fossil fuels and what interrelations are between biofuels and the evolving unbalanced ecosystems. There is an enormous pollution caused by the use of fuels. On the other hand, there are sulfur and nitrogen oxides leaking into the atmosphere, which are directly responsible for the increase of the number of respiratory illnesses, acid rain, soil and freshwater acidification, and metropolitan smog (Popp et al., 2016).

It is a common practice everywhere to use the "well-to-wheel" approach. This means that carbon dioxide emissions are monitored in the total life cycle, thus we are able to measure the actual effectiveness (Chudy-Laskowska, 2020). The first-generation biofuels emit 35-50% less greenhouse gas than conventional fuels in the total life cycle (www.olade.org). According to the EC yearly report of 2017, in the case of the widespread of second-generation biofuels, a 90% GHG saving is possible. In most developed economies, increasing fuel consumption is largely responsible for greenhouse gas emissions, consequently, for the greenhouse effect (Késmárki-Gally, 2008; Karácsony, 2013). The greenhouse effect is a naturally occurring process that aids in heating the Earth's surface and atmosphere. It results from the fact that certain atmospheric gases, such as carbon dioxide, water vapor, and methane, are able to change the energy balance of the planet by absorbing long-wave radiation emitted from the Earth's surface. (Farndon, 2018)

Eurostat estimates that in the European Union 28% of CO_2 emissions are related to the transport sector, of which 84% is for road transport. In the 1990-1998 period, the carbon dioxide emissions grew by 18% in the EU, while between 1990 and 2020 this rate was already 40%. Under the Kyoto Protocol, Hungary undertook a reduction of 6% in greenhouse gases compared to the average of the 1985-1987 period. That time, the Hungarian emission was 111 million tons of carbon dioxide equivalent, while in 2020 this figure was only 97.2 million tons carbon equivalent. Biofuels are still not the cheapest way to reduce the amount of greenhouse gases; however, in the medium-term they seem to be the only option that is possible to make a significant reduction of GHG emissions in the transport sector (Sipos et al.,

2007). As comparison between CO_2 emissions of gasoline and bioethanol, gasoline produces about 2.44 CO_2 kg/l, while ethanol releases 1.94 kg/l, which means it reduces CO_2 emissions by 21%. In case of ethanol, the carbon dioxide and other greenhouse gases' reduction is also influenced by several factors: for instance the production effectiveness of the technology, the environmentally friendly production process, utilization of by-products, the energy supply of the refinery, and one of the most important: the quantity and source of energy consumed during production (Magda, 2014).

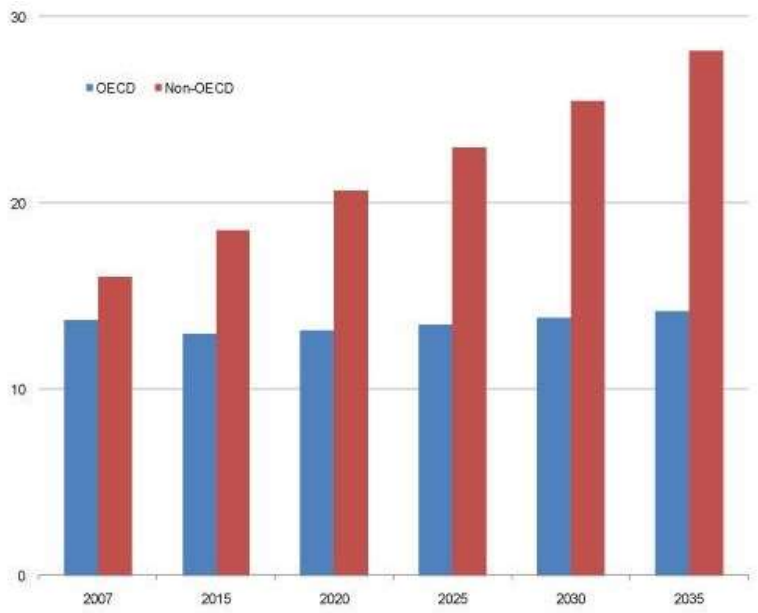

Figure 1. World energy-related CO_2 emissions, 2007-2035
Source: EIA, 2020

Most of the greenhouse gases are produced by burning coal; it generates 80% more CO_2 than the utilization of gas and 20% more CO_2 than utilization of oil - for producing the same amount of energy. The first indicator of CO_2 emissions growth can be placed in time at the beginning of the industrial revolution. Measurements show (for example, an examination of the Antarctic ice), that in the past 160,000 years the concentration of atmospheric CO_2 was nearly constant, then in the early 1800s it began to increase rapidly. Today, the initial value is 25% higher (www.ipcc.ch) Currently, the developed countries are responsible for 50% of CO_2

emissions, while half of the emission is caused by the United States solely. Unfortunately, in developing countries, mainly China and India, the industrialization will result in an extreme increase in CO_2 emissions in the future, and they even might take over the leading role from the USA by 2020.

Beyond these issues, we also have to mention other, less well-known but the same important factors of environmental effects. The rapid spread of biofuels created an agricultural expansion, contributing to rising water demands; however, that was already a serious international problem.

Researchers estimate that the demand for water will be 40% higher than the supply in many regions within 20 years. (www.mckinsey.com) This means that worldwide about one of three people will receive half the amount of water than it would be sufficient for their basic needs. The lack of water can cause a decrease in sanitation, epidemic threat, decreasing life expectancy, the decline in general health.

Literature Review

Sustainable development has become one of today's key issues. According to the UN Sustainable Development Framework, there must be four dimensions differentiated, these are environmental, economic, social, and institutional. The environmental aspect concerns the condition of water, land, atmosphere, other natural resources, and waste. The economical one investigates micro and macro economical interrelations and international affairs. The social dimension consists of demographic, health, education etc. indicatives. The last, institutional part includes the organs and their information flow, regulations, and legal background.

Biofuel, any fuel that is derived from biomass—that is, plant or algae material or animal waste. Since such feedstock material can be replenished readily, biofuel is considered to be a source of renewable energy, unlike fossil fuels such as petroleum, coal, and natural gas (Selin, 2018).

The depletion of petroleum-derived fuel and environmental concern has promoted to look over the biofuel as an alternative fuel source (Popp et al., 2018). But a

complete substitution of petroleum-derived fuels by biofuel is impossible from the production capacity and engine compatibility point of view. (Hassan, 2013).

Biofuels also supply environmental benefits but, depending on how they are manufactured, can also have serious environmental drawbacks (Lehmann, 2018). The crop types, agricultural practices, land and labor costs, plant sizes, processing technologies and government policies in different regions considerably vary ethanol production costs and prices by region (Demirbas, 2011).

However, the process of conversion, or chemical transformation, could be very expensive. and not worth-while to use for an economical large-scale commercial supply of biofuels. Hence, there is still a need for much research to be done for an effective, economical and efficient conversion process (Nigam-Singh, 2011).

In energy generating the alternative energy sources made up 7.2% of the Hungarian electricity production (IEA 2020). Consumers of the alternative energy sources prioritized biomass, geothermal- and solar energy (Table 1.). Hungary`s gross energy consumption in 2017 was 3000 ktons, consisting of 80% biomass usage (Hernandez et al. 2017).

	Consumption			Domestic facilities	Availability	Investment	Payback time	Barriers to use
	Electricity	Heat production	Fuel					
Biomass / Biogas	X	X	X	Favourable agricultural conditions, few energy forest	It depends on agricultural production and is therefore seasonal	Processing plant, operating units	Very soon	It can be detrimental to food production

Wind energy	X			Northwest Hungary is favourable,	Weather dependent	Construction & Network Integration, Land Use	7-8 years	Integration into a centralized electricity grid is problematic
Geothermic energy	X	X		Excellent conditions, especially in the Danube-Tisza Intermediary	Anytime	Installation, relatively high cost	Electricity: 5-8 years, heat generation: 2 years	Relatively high capital requirements
Solar energy	X	X		Favourable conditions: number of sunny hours per year: 1900-2300 hours / year	Weather dependent	Installation, relatively high cost	Photovoltaic application: 12-17 years, solar thermal energy: 6 years	Costly installation, long-term return on investment
Hydropower	X			Adverse hydrographic situation	Area and hydrographic dependent	Power plant construction, network integration (very high capital	8-15 years	Nature conservation problems, unfavourable conditions

						requirements)		

Table 1. Comparing renewable energy sources, self made.
Source: energiaklub.hu, 2019

Another challenging aspect of biofuel production is how it is changing the structure of food production and how it leads to a changing structure and volume of agricultural and food trade in different regions (Vásáry et al, 2013)

Methodology

In our research we conducted primary and secondary analysis, using regional science research methodology tools. In the frame of cluster analysis, we asked different questions about the energy structure of the country for each age group. There are great differences between age groups because younger generations see bioenergy sources of the future, meanwhile, middle-aged people are considering liquid biofuels power and older people traditional hydrocarbon-based technology to be a reliable source of energy.

The Q method can be useful for exploring individual opinions and differences of opinion, as well as for describing different opinion groups (Coogan, J., Herrington, N., 2011.). The advantage of a focus group is that we get to know each other's opinions independently, so we do not have to worry that the opinions of lower-level executives in the organizational hierarchy are not as pronounced when they are different from those of higher-level executives. The Q method uses correlations and so-called inverse factor analysis. In this method, factor formation is not done through statements, as is customary in social statistical procedures, but through individual Q-orders (filled-in Q-tables for each respondent) to create groups of individuals. Thus, I also determine the correlations between persons' Q-orderings in pairs. A factor, that is to say, an opinion group that will be based on that person who filled out the above table in a similar way and can, therefore, be considered as an opinion group.

Findings and Discussion

Studies on international agricultural markets estimated that new cultivable land will be required to satisfy future demand for food and feed. Increased productivity is expected on current arable land as well – the so-called "intensification" – due to the fast growth of the food and feed demand. Biofuels produced from crops will add extra demand for crops like wheat, sunflower, corn, and rapeseed. This will increase prices for these products (as well as for land) and lead to two impacts: intensification of agricultural production and conversion of forests and grasslands to arable land.

This process is called land use change/ indirect land use change, as the official description says "Indirect land use change (ILUC) occurs when land formerly used for a food crop is turned over to the production of biofuels. As a result, cultivation of the displaced food crop is often transferred to a location where land prices and the costs associated with agriculture are lower – this can be on grasslands and forested land. This is of concern because the deforestation and cultivation of virgin or semi-virgin land releases high levels of carbon previously held in soil and plants into the atmosphere. Subsequent use of nitrogen fertilizers on poorer soils would also lead to emissions of N2O from the soil." (ec.europa.eu)

In the EU, the growing demand for ethanol production is satisfied by involving abandoned lands in the plantation of inputs. The European Commission also deals with this issue. In order to reduce greenhouse gas emissions, the exclusion of biofuels cannot be an option because currently there is a target for biofuel production, that must be fulfilled by EU member countries. We can neither expect that nothing happens in the case of indirect land-use, because it would be hardly acceptable politically.

The utilization of tillable agrarian fields for biomass and conversion of forests into other agricultural lands have multiple negative influences, just to mention a few: global increase in food prices, creating unbalance in ecosystems, etc.

Table 2 and 3. demonstrate the different types of land use and the land use matrix.

Table 2. Types of land-use

Category	Comment
Forest	Follows the definition used by FRA 2005 (FAO 2006a). Includes all types of forests, but not tree formations under non-forest land use, such as agroforestry systems, urban parks, etc. Data can be drawn directly from FRA 2005.
Woodland/Grassland	Woodland and grasslands refer to land that have a vegetation cover other than forests, but that are generally not under intensive land use. The most common land use in this category would be different forms of pasture. FAOSTAT was used to obtain statistics for this category, under the assumption that the FAOSTAT category "Permanent pasture" is equivalent.
Agricultural crops	Refers to all areas where temporary or permanent agricultural crops are grown. FAOSTAT was used to obtain statistics, using the category "Arable and permanent crops".
Urban area	Should generally refer to all types of built-up areas including infrastructure. However, the data source (Láng, 2008) refers only to cities as such, and focuses on cities with more than 100,000 inhabitants.
Other land / water	Includes everything not covered by the above categories, e.g. deserts, polar areas, unvegetated and uninhabited land, wetlands that do not fall under above categories and inland water. No authoritative global data source for area trends was found for the components of this category.

Source: Designed by authors' own compilation

Table 3. Land-use change matrix

FROM/TO	Forest	Woodland	Agricultural crops	Urban area	Other
Forest	X				
Woodland		x			
Agricultural crops			x		
Urban area				x	
Other					x

Source: Designed by authors

Economical dimension of sustainable development

The production of biofuels is an expensive process. Calculations stipulate that in case of biodiesel an $80 / barrel and in case of bioethanol a $100-120 / barrel is a sustainable price level. The long-term oil price expectations remain below the sevalues. By comparison, the bioethanol produced by sugar cane in Brazil is sustainable even on the $45-50 / barrel price level. The technology of first-generation biofuel production – whether biodiesel or bioethanol –is a developed, mature technology, which means that there is no longer expected a significant cost reduction.

The competition for agricultural areas has an impact of price increment because the excessive rate of energy crops can replace not only the same kinds of food crops but other (for example fodder) varieties. The direct effect of this phenomenon is a significant price increase in the food industry.

The OECD-FAO Agricultural Outlook 2007-2018 emphasized the sensitive biofuel issue in connection with the food industry as well. The energy crop cultivation is responsible for the demand increment of grain and oilseed prices. The consequence is the price increase, which is proven with the most basic possible theorem of economics: the Marshallian Cross. The food prices are forecasted to

grow with 20-50% by 2018. Another misconception of common thinking is that people believe that the biofuel industry has a huge labour need that creates jobs and might have a serious impact on the country. We do not have Hungarian estimations, but it is likely that the large, mechanized agricultural production of single crops does not have large number of live-work requirements. The few largest biofuel refineries with sometimes foreign (Norwegian, American, etc.) investors create work possibility for only a few thousand citizens and it is common that they are not searching for top engineers and scientists, but cleaners and back-office workers, who they will not provide continuous training. In Hungary, the excise tax exemption for bio component does not exist since July 2017; it was replaced by a 4.4% rate of blending obligation. Anyone who fails to comply with this obligation must pay a higher excise tax of 8 € /litre. In addition, the Environment and Energy Operational Program supports the establishment of ethanol plants with 2.7 billion HUF, while the establishment of biodiesel plants is not supported.

Business environment in Hungary

The support functions of the state were already discussed when the regulations and the incentive taxation system were defined. As it became clear previously, the extent of state involvement cannot be extended above the mentioned factors in the issue of renewables, thus this section is intended to focus on the private investment environment.

The question is whether this environment is attractive enough to gather private investors into renewable energy business, so this industry could be able to grow besides the low level of state engagement.

In order to tell, if the Hungarian environment is optimal for investment in renewable energy, the key elements of the country's competitiveness must be investigated.

An ideal starting point for the analysis of the environment for investment might be the different indices of competitiveness. The World Competitiveness Yearbook compiles its yearly edition on the basis of 329 different indicative measures of the participating countries.

The measures examine all the sectors; thus, the final score reveals the complex status of the subject country; economic and political indicators, but the environment and the everyday life contribute to the final order creation of the competition. The World Competitiveness Yearbook 2020 found Singapore, Hong Kong, and the USA the three most competitive countries, while the rank of Hungary was 42 (in 2019 we were the 45th), just behind Italy and Peru.

Obviously, this ranking is not enough to describe the Hungarian business environment, but still, it gives a basic picture regarding the opinion of experts about Hungary. For example, if my company wanted to acquire market share, I would definitely check this compilation just to have basic approach towards the country.

The also acknowledged World Economic Forum (WEF) published their yearly competitiveness report called The Global Competitiveness Report 2017-2018. They also claim to base their opinion about several sources.

Based on the study, the five most inhibiting factors of the business and investment environment in Hungary are the following:

1. Tax rates
2. Tax regulations
3. Access to financing
4. Corruption
5. Political instability

Three factors were chosen, which are directly related to the liquid biofuel production in Hungary. To understand the business potential of private investments in renewable energy sector, we need to go through the connected factors one by one.

Tax rates and tax regulations

It may sound banal hearing again, but the Hungarian regulations of taxation are too complicated, the rates are too high, and due to the false regulations, the tax burden if distributed unevenly in the different levels of society. This cloudy tax system and the high tax rates have a direct impact on the competitiveness of a country, and seriously deteriorate the investment environment – according to the survey created by the European Commission, called "Taxation trends in the European Union". The document stipulated that in comparison to the EU, the tax rates regarding work and consumption are very high, while the tax rates regarding property and wealth are low. The Commission's survey shows that Hungary is characterized by high indirect taxes (VAT, excise duties and consumption taxes) compared to the GDP, and social security rates are high as well. However, direct tax rates (personal and corporate) are relatively low compared to the GDP.

Access to financing

"Access to finance is an essential driver for economic growth in developing and transition economies. It is also important in developed economies, where it stimulates markedly the social inclusion of certain groups of the population. Access to finance empowers people, gives them the opportunity to have an account, to save and invest, to insure their homes or to take a loan and – in many cases – to break the chains of poverty." (UNEP, 2020)

As regards the difficulty of access to financial resources, it is not typical only in Hungary; the scarcity in resources is spread worldwide due to the recession. Above this fact, we have to mention the vulnerability of the national currency, and the high market interest rate. As Figure 2 clearly demonstrates, the Hungarian currency HUF seems very vulnerable. This is obviously not optimal regarding the business environment, as the hectic and unpredictable exchange rates influence the purchase of households and business market actors negatively.

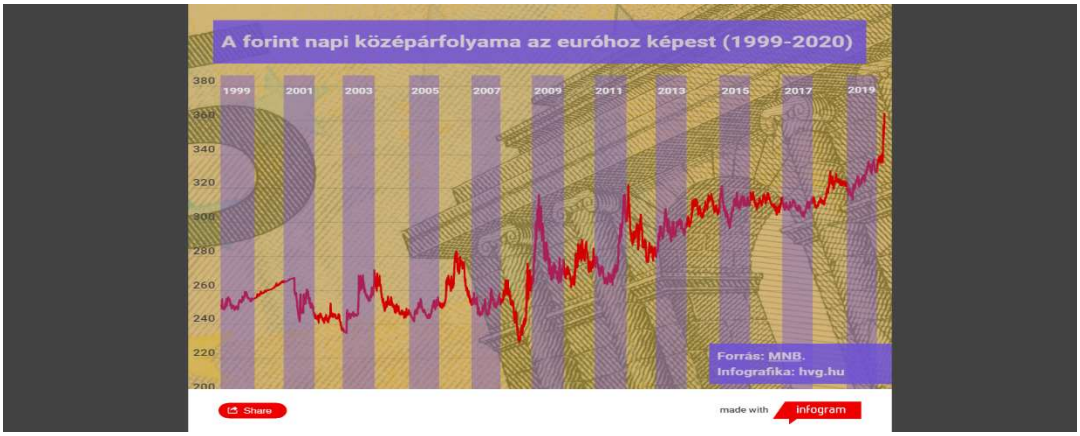

Figure 2. The HUF/EUR exchange rate between 1999 and 2020

Source: MNB http://www.exchange-rates.org/

Corruption

We have to admit that corruption does not belong closely to the economic dimension; therefore this factor will not be discussed in detail. However, it is also a very serious problem and does contribute to the weak competitiveness and investment environment of Hungary.

Political instability

Finally, nor the previous factor, neither political instability is measurable; but still, it really can pull back the number of investments, as if the financial / regulation / legal background is variable, carrying out a business plan is hardly possible.

Social dimension of sustainable development

Social sustainability concerns the quality of life, which includes health indicators, living standards, social cohesion, and integration. These factors depend highly on the environmental and economic dimensions; thus, the social dimension will be demonstrated on the basis of the previous two sections.

Biofuels represent in developed countries a solution for two problems: climate and oil. By time we had to realize that first generation biofuels are not solution to either, it even contributes to a third global problem: the current food crisis. Meanwhile the danger is that they allow rich-country governments to avoid difficult but urgent decisions about how to reduce consumption of oil, while offering new avenues to continue expensive support to agriculture at the cost of taxpayers. In the meantime, the most serious costs of these policies – deepening poverty and hunger, environmental degradation, and accelerating climate change – are being 'dumped' on developing countries.

For poor countries that tend to have comparative advantages in the production of feedstock, biofuels may offer some genuine development opportunities, but the potential economic, social, and environmental costs are severe. Oxfam report says that about 5.6 million square kilometres of land will be used for biofuel production, which means that approximately 60 million people are going to face the fact, that instead of food, fuel "grows" on their land.

On the Hungarian market neither food scarcity, nor water scarcity is a threatening option, because of the large resources of both raw materials and water supplies.

Conclusion

The primary aim with this research was to demonstrate and analyze the Hungarian possibilities regarding liquid biofuels. Now that we have looked through the concerning issues, we are ready to declare, that the World – including Hungary – is trying to stick with them, as a solution for the global problems – decreasing fossil stocks, growing energy consumption and high energy dependency - described in the Problem definition chapter. By now, it is clear that there are many opinions for and against biofuels; after we learned the environmental, economic and social dimensions of its production and utilization, this is quite understandable.

As it was stated by Hill in 2016, biofuels "to be a viable alternative, a biofuel should provide a net energy gain, have environmental benefits, be economically competitive, and be producible in large quantities without reducing food supplies".

Obviously, these are very high standards, but in our opinion we cannot lower our expectations, as we are not searching for a short or medium term solution, but for quite the long term. According to these conditions we are going to evaluate the generations of biofuels.

Except the net energy gain, first generation biofuels do not comply any of these conditions. As recent studies showed, first generation biofuels do not have environmental benefit on the life cycle compared to fossil fuel neither. As for the economic competitiveness, South American countries already produce first generation biofuels with developed, mature procedures, thus profitability is possible. However, in terms of world scale the production of first-generation biofuels is not profitable. For the question, if it reduces food supplies, the answer is trivial; the raw material of first generation is all edible products, so yes, the production does require and does reduce food supplies.

The second generation of biofuels is a much more developed and environmentally friendly solution. The first question is, if it has a positive net energy balance; the answer is yes: the energy outcome is higher than the energy input, thus the net energy ratio is positive. The question of environmental benefits is much more complex. As we learned from the study, the raw material of this type of fuel is biomass, what stands of biodegradable residue products from agriculture, forestry, and waste. Unfortunately, the utilization of these resources is not optimal, as the balance tilts to forestry products, and CO_2 emissions created by deforestation is very high. If the shares of resources could change so that biodegradable residues, by-products, and waste could be the main source, second generation could be environmentally sustainable. The production of second-generation biofuels should be much more efficient and developed; with technological developments, this generation of biofuels can become profitable. Additionally, the food supplies are not involved in the process, they are not used as raw materials, and thus the

production is not reducing the global food supplies. In our opinion, development of second-generation biofuels could be a step forward, which we must take in order to avoid the presently known negative effects of first generation biofuels. It is not negligible, that the rightful bad judgment of biofuels is created by the previous generation, but has a negative effect on this generation as well, as an average person cannot distinguish properly – the moral is against this, what makes international regulations harder to make.

Finally, the third generation of biofuels seems the ultimate solution for us in the following 25-30 years' period. The fuel production by the raw material of algae is highly net energy positive, does not pollute the environment, does not need large lands and is much more efficient than the previously mentioned alternatives. However, based on the present technologies, it is not economically sustainable, as the production costs are higher than the others – this will be the challenge of the future; but the experimental lab and reactor in Százhalombatta is a promising start in the research and development. Additionally, cultured algae do not reduce food supplies, thus the four conditional evaluation of Hill is complete, third generation can be a viable alternative of fossil fuels.

The secondary aim of the study was to call the readers' attention: what if a complex energy matrix is possible using only renewable energy. The study stipulated that the Hungarian energy potential vary from the actually exploited energy types on a very high extent. The European Commission and the Hungarian government are on the right way only in one particular sector: the transport. In the present infrastructure and technology, the substitution of fossil transportation fuels can be solved by partly second and partly third generation biofuels based on the previously mentioned factors. A coherent and sustainable solution is possible for all the other sectors, supplied by other renewable energy forms.

Multiple utilization ways of hydro power plants are already known, and we also know that the capacity of Hungary allows the establishment for more than 12 sustainable plants. The integration of energy generation and the irrigation of

cultivated land – where possible - has been successfully used in other Western-European countries.

We were also able to learn, that the domestic capacity for windmills is very high based on the windy field resources; if the financial support and regulations (for example oblige MVM to buy electricity on market prices, and without limitations) were given, the energy matrix could be completed this way, too.

Last, but not least: the complex possibilities of solar and hydrogen power – our vision for this matter. As we could see on the Hungarian solar map, there are huge possibilities in establishing solar collector fields. For maximizing the energy output, we would suggest creating mixed hydrogen power plants and solar power plants in the sunniest areas of Hungary. The purpose of this would be that as the study have discussed, both need sun, and we also learned, that the greatest drawback of the hydrogen power is the possibilities of storage: it is complicated, expensive etc. The solar collector could maintain both hydrogen and solar power plants – with all the surrounding buildings and needs – while hydrogen power plant could directly improve the energy matrix by contributing through daytime. Obviously, this type of mixture is not available on the less sunny parts of Hungary.

This vision of complex, localized energy matrix is still very expensive, thus needs a coherent systematic, modern view of regulations, taxation and a new approach to the governmental support in order to attract investments. As for the regulations for the transport sector, not only blending of biofuels should be compulsory, but the government should force oil suppliers to buy bio-component from second and third generation production sources. Obviously, due to the present prices it is not possible; however integrated governmental support could create a bridge over this gap – energy tax allowance on these types of biofuels could be a good start.

The final conclusion of this study is that the Hungarian energy matrix needs to be widened by renewable energy sources. The new energy matrix should be localized instead of centralized, based on the comparative advantages of the certain parts of Hungary. Still, second and third generation biofuels are sustainable and

appropriate for the transport – on a centralized production, because of the high-volume plants – however, the other energy consuming sectors should be supplied by other, more environmentally friendly solutions. Additionally, due to the expensiveness of these energy sources, new governmental regulations and aid are indispensable for attracting the investors.

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Logistical Processes Interaction Model Design in Agglomeration Development

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Abstract

Purpose of this study is to develop a logistics processes interaction model within the development of urban agglomeration, taking into account basic functional areas of logistics. Objectives of the study were to define the concept of "agglomeration logistics", to identify the main logistics processes of agglomeration, to calculate the logistics stability index (LSI) for the Almaty urban agglomeration

In this paper such research methods as text analysis, logic modeling, survey method of analysis of hierarchies were used.

The significance of the study lies in the development of a model explaining the nature of logistics processes interactions in Almaty urban agglomeration. The novelty of the research lies in adaptation and practical application of the methodology for assessing sustainability of urban agglomeration logistics and identifying most influencing factors in order to improve it.

The main results of the research are: formulating the concept of "agglomeration logistics", identifying interaction algorithms of the main agglomeration logistics processes and calculating the logistics stability index for Almaty agglomeration.

The following conclusions were made: there are problems of inefficient functioning of logistics processes within the agglomeration. Increasing number of road cargo and passengers has revealed the need to increase road transport network efficiency and carrying capacity; as a result of territorial structure, insufficient development of transport communications between the agglomerations 'districts, loads on the road

transport network increased, which led to violations of fundamental logistics` rules such as "just in time", "optimal route", "high delivery speed", which increases the load on logistics processes and hinders its integration; main constraints to the sustainability of logistics in Almaty agglomeration are air pollution and poor road safety.

Keywords: urban agglomeration, logistics sustainability, logistical processes.

Introduction

Currently, the Republic of Kazakhstan has approved an interregional action plan for Almaty agglomeration in order to solve the socio-economic development problems, figure 1 (Appendix 1, Figure 1). In the current Almaty agglomeration development scheme the core is Almaty city which consists of the Esik town and 14 Enbekshikazakh rural districts, 6 Zhambyl rural districts, Otegen batyr and 8 rural countries in the Ili district, Kaskelen city and 10 Karasai rural districts, Talgar city and 10 rural districts, the Kapshagai city and 2 rural districts, administrative subordinates of the Kapshagai city and planned Gate City town. The population of the Almaty agglomeration in September 1, 2019 is 3,103. 6 thousand people, of which 1,884. 6 thousand people live in Almaty (Resolution of the government of the Republic of Kazakhstan,2020).

Formation and agglomeration development leads to the intensification of industrial, service, transport, social and cultural development ties between cities and leads to multi-component dynamic system formation of material, transport, information, and financial flows (figure 2). The model of logistics interaction processes (supply, distribution, loading, unloading and delivery) directly depends on the production process in Kazakhstan and the gross regional product (GRP). The share of GRP in Almaty agglomeration in 2019 amounted to 2. 79 trillion tenge.

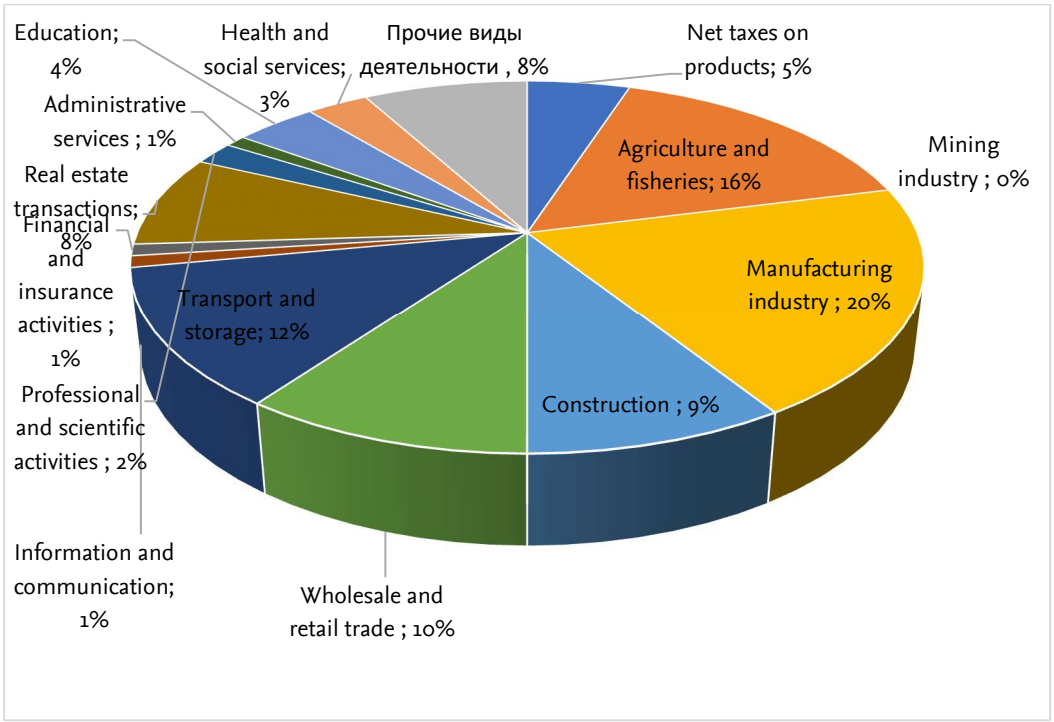

Figure 1. Average GRP share of Almaty agglomeration for 2014-2019 by economic sector. Reprinted from Statistical collection Transport, Nur-Sultan: Committee on statistics of MNE of RK, 2020

The total share of the GRP in the Almaty region was 4.52, which is the 7th place according to Figure 2.

Agriculture, forestry and fisheries well developed in the Almaty region. Almaty region ranks 5th in terms of manufacturing industry 20%, 7th place in terms of transport and storage volumes 12%, 4th place in terms of construction volume 9%. The region also shows results in the field of trade growth 45%. The main production is concentrated in the Ili, Karasai and Talgar regions.

The agglomeration formation carries a number of problems such as the lack of methodological approach to the agglomeration leads to such problems as an excessive burden on the logistics infrastructure, which negatively affects the environmental situation and economic indicators. A comparative analysis by questioning the respondents of Almaty agglomeration shows that there is a problem of inefficiency in logistics processes functioning, which leads to an

increasing cost of transporting goods and passengers, an increase in losses of working time, a deterioration of environmental situation. The work forms the dependence of the GRP growth as the main indicator of the Almaty agglomeration development due to the contribution of agglomeration logistics as the basic regional economy service component.

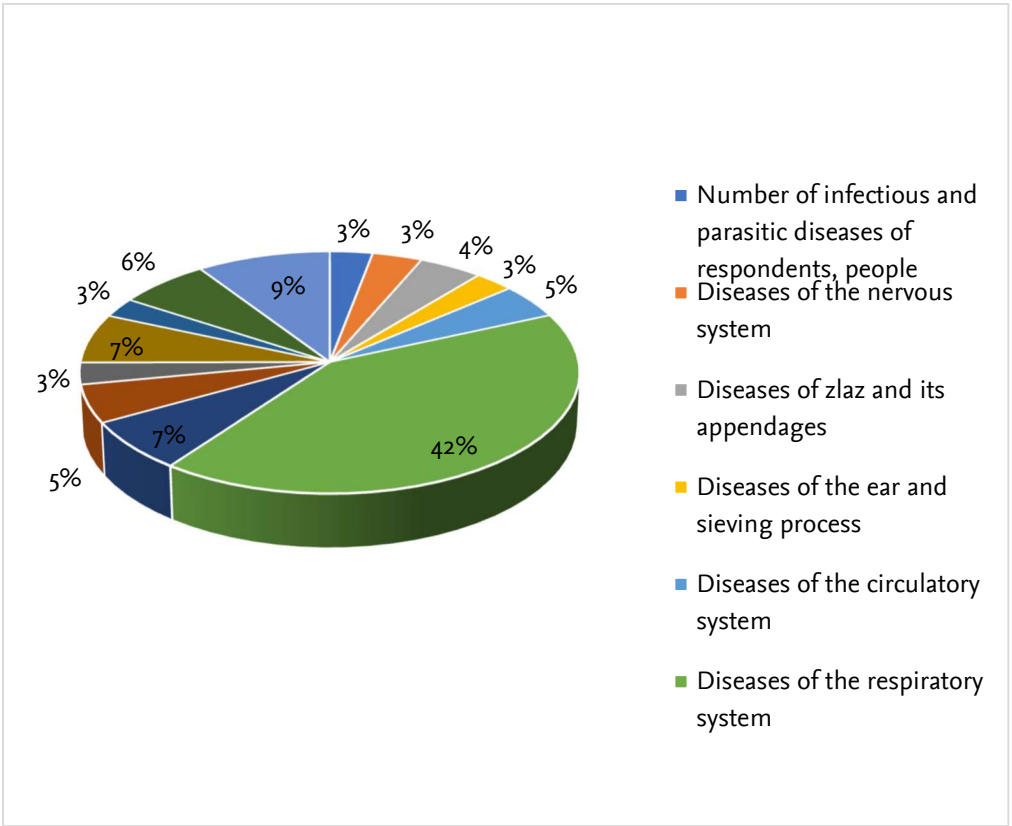

Figure 2. The structure of Almaty agglomeration population morbidity. Adapted from Health statistical collection of the Kazakhstan population and the activities of health organizations (Usser, 2019) and compiled by authors based on the source.

Literature review

According to the statistics in Figure 3, respiratory diseases of the population in Almaty agglomeration account for 41.8%, which indicates the level of air pollution and environmental problems.

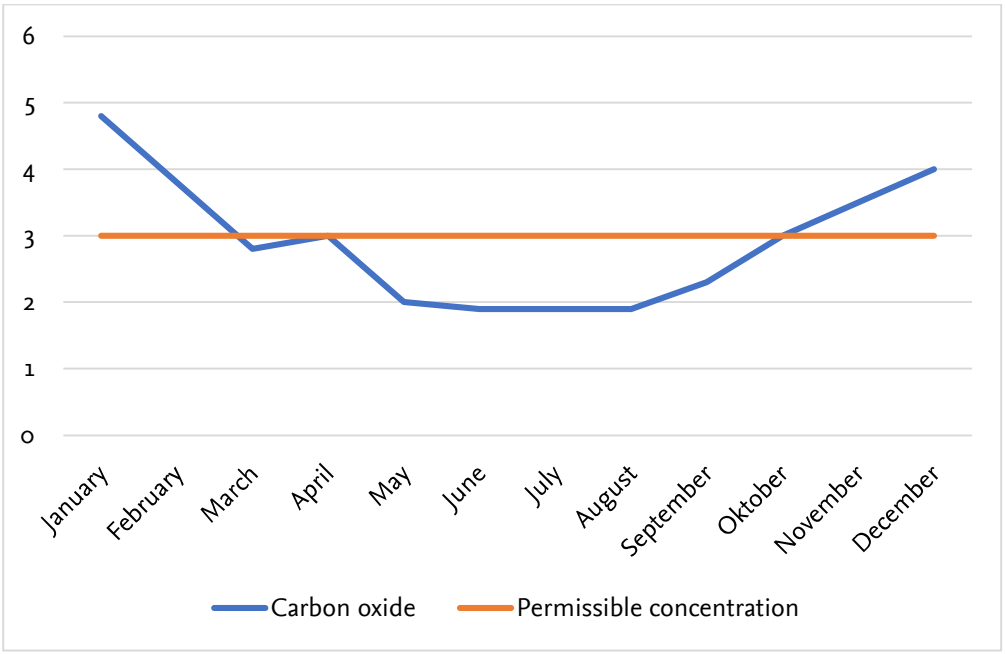

Figure 3. Average annual distribution of oxide concentration. Carbon in the Almaty agglomeration, mg / m3

Today, there are three indicators of air quality used in the Almaty agglomeration:

1) API – Total air pollution index.
2) SI – Standard index (maximum one-time impurity concentration divided by MPC).
3) NP in % (the highest frequency of exceeding the MPC) *(*Prokifyeva and Lopatkin, 2017*).*

Figure 4 shows the annual distribution of averaged carbon monoxide concentrations. The excess of MPC values occurs only during the heating season, their values reach 4,8 mg/m^3 in January, 4,0 mg/m^3 in December, with the maximum permissible no more than 3,0 mg/m^3. The increase in concentration in winter is associated with the work of heat and utility companies, as well as a weak wind regime in winter. In the summer, more intensive mixing of air layers in the atmosphere occurs (Committee on statistics of the MNE of the Republic of Kazakhstan, 2020).

Therefore, its minimum falls on May, when the concentration reaches a level of 9 мg/м^3 for 2019.

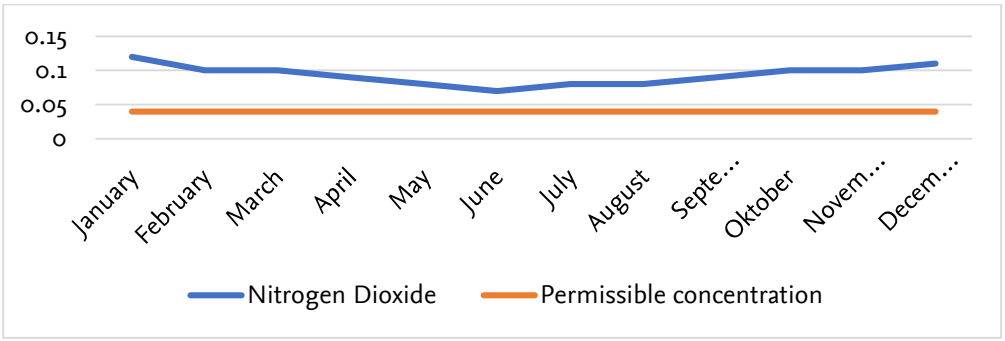

Figure 4. Average annual distribution of dioxide concentration nitrogen, mg/m3

Nitrogen oxides (NO2) formed during combustion at high temperatures by oxidizing part of the nitrogen in the atmosphere. Nitrogen dioxide is the main source of tropospheric ozone and nitrate aerosols, which make up a significant part of the atmospheric air mass, Figure 5.

The main sources of NO 2 emissions are: internal combustion engines, industrial boilers, furnaces. Even at low concentrations nitrogen dioxide, breathing disorder, cough observed.

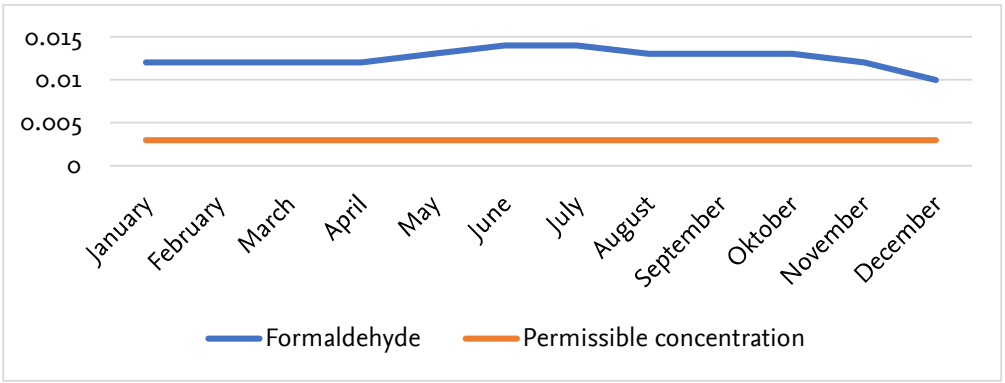

Figure 5. Average annual distribution of formaldehyde concentration, mg/m3

The formaldehyde distribution, as shown in Figure 6, is quite different from the above pollutants' distribution.

The excess of the MPC is visible throughout the year, reaching its maximum values in summer, where the values reach 4.7 MPC, for example, in June, July up to 0.014 mg / m3. The minimum values fall on December, where the value is less and is 0.011 mg / m3.

In general, in Almaty agglomeration, the average annual concentration of nitrogen dioxide was 2.1 MPC, and formaldehyde - 1.3 MPC. Content of suspended solids - 1.2 MPC, sulfur dioxide - 1.12 MPC, the content of other pollutants did not exceed the maximum permissible concentrations. The maximum individual concentration of nitrogen dioxide was 5.0 MPC, suspended particles PM-2.5-3.9 MPC, suspended particles PM-10 - 3.2 MPC, carbon monoxide - 3.1 MPC, nitric oxide - 2.5. MPC, sulfur dioxide - 2.3 MPC, suspended solids - 1.8 MPC. MPC for phenols and formaldehyde not exceeded, the data indicate the deterioration of the environmental situation in the Almaty agglomeration

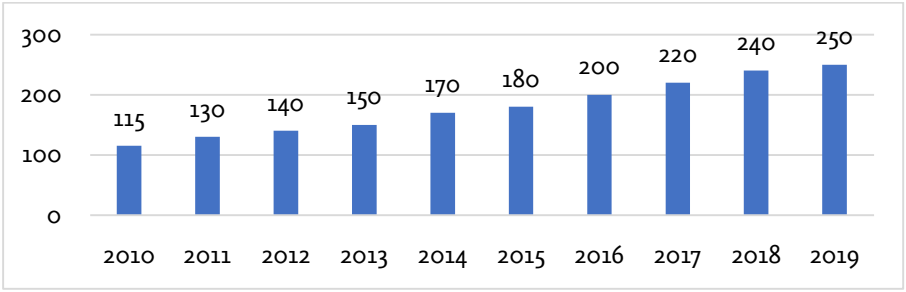

Figure 6. Transported cargo and luggage, cargo luggage by road in. Almaty agglomeration, million tons. Statistical collection transport (2020).

According to Figure 7, it is necessary to note an increase of transportation of cargo and cargo luggage volume in Almaty agglomeration. If in 2010 traffic volume amounted to 120 million tons, then in 2019 it was 250 million tons, there was a 2-fold increase + 130 million tons in 10 years, which indicates the development of road transport in Almaty agglomeration.

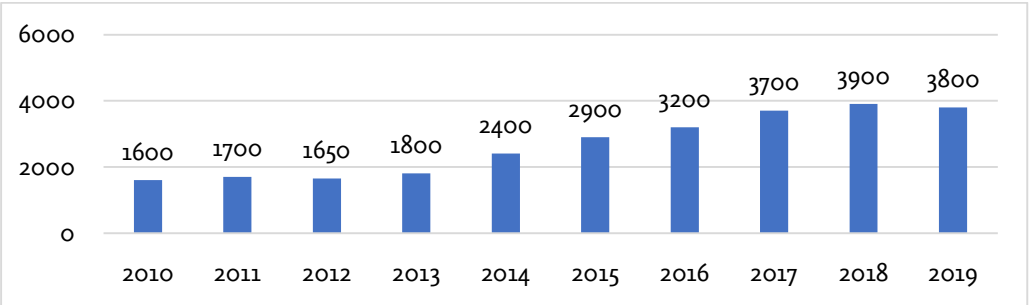

Figure 7. Passengers transported by road in the Almaty agglomeration, thousand people. Compiled by authors based on the Department of Statistics in Almaty city statistical collection, Almaty 2014-2019 (Statistical collection Transport, 2020)

According to Figure 8, it is necessary to note an increase in the number of passengers in Almaty agglomeration. If in 2010 the number of passengers was 1,500 thousand people, then in 2019 there were 3,700 thousand people, there was an increase of 2.5 times + 1,800 thousand people in 10 years, which indicates the development passenger traffic in Almaty agglomeration

Number of cargo transportation and passengers growth by Almaty agglomeration road transport reveals the need to increase the throughput and carrying road transport network capacity

It can be concluded, that consequence of the territorial structure, insufficient development of transport communications between the Almaty agglomeration regions, increased loads on the road transport network have become, which leads to logistics rules violation "just in the lines", "optimal route", "high delivery speed". This factor increases the burden on logistics processes and prevents its integration (Anikina, 2020).

Table 1. Analysis of the population mobility types and their Almaty agglomeration share

Cycle structure	Sequence of movement targets in closed loops	The specific weight of cycles, %	The specific weight of movements, %
linear	Home ↔ Work	36,6	33
	Home ↔ Cultural and household facilities	31,1	28
	Home ↔ Study	17,6	16,2
Triangular	Home ↔ Study ↔ Cultural and household facilities	6,4	8,6
	Home ↔ Cultural and household facilities ↔	2,6	3,8
	Home ↔ Study ↔ Cultural and household facilities	1,6	2,3

Quadrangular	Home ↔ Work ↔ Cultural and household facilities ↔ Home	2,6	4,8
Others		1,3	3,3

Note. Compiled by the authors based on their research.

The analysis of the population mobility types and their Almaty agglomeration share according to the data in Table 1 indicates the linear movement of 33% of the population "Home ↔Work", 28% "Home ↔ Cultural and household facilities" and 16.2% "Home ↔ Study" (Appendix 1 Figure 2).

The analysis of the total mobility distribution by purpose of travel in the Almaty agglomeration and the numerical values of Figure 9 indicate that 75% are citywide travel, and 65% are travel from home.

Table 2. Analysis of the main mobility travel purposes per inhabitant of Almaty agglomeration per day.

Purpose of travel	Mobility per inhabitant per day	Transport utilization rate
Labor	1,06	0,76
Educational	0,28	0,50
Household	0,83	0,48
Cultural	0,21	0,52
To resting places	0,45	0,53
Total for all goals	2,83	0,60

Note. Compiled by the authors based on their research.

Analysis of the main travel purposes and mobility per inhabitant of the Almaty agglomeration per day in Table 2 show the labor travel purposes with a transport utilization rate of 0.76.

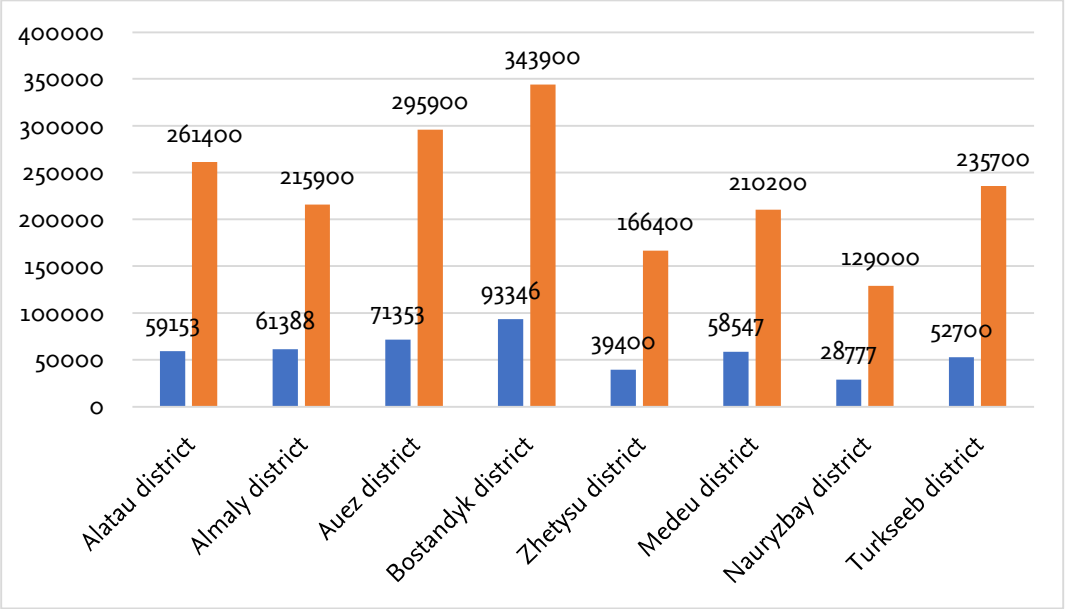

Figure 8. Number of jobs and population in Almaty for 2019.

Note. Compiled by the authors based on Statistical collection Transport (2020).

According to Figure 9, the total number of employees in Almaty was 464,664 people. This number of residents move in the direction of "Home-Work".

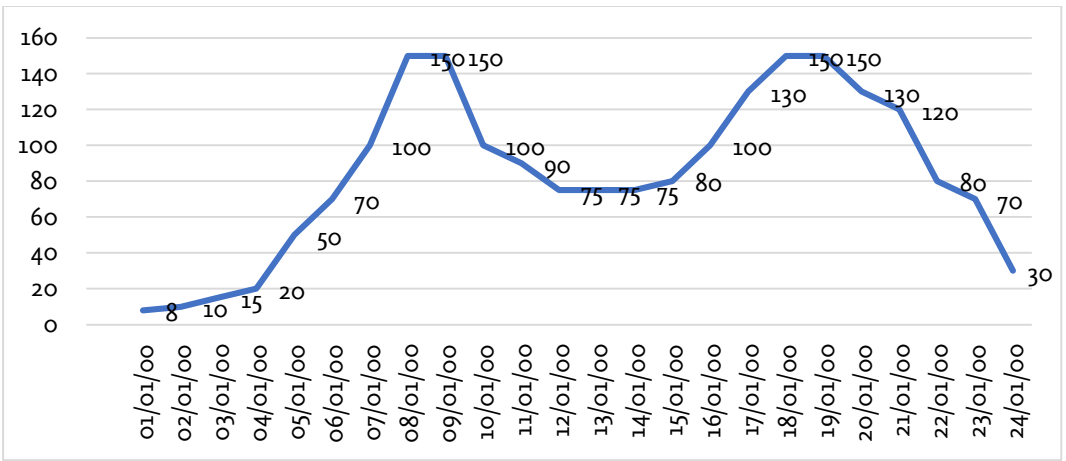

Figure 9. Change in traffic intensity during the day in the Almaty agglomeration

Note. Compiled by the authors based on Statistical collection Transport (2020).

According to the data of the motor transport movement time study, it is necessary to conclude that the main flow is concentrated from 6 am to 10 am, which indicates

the movement of the population in the direction of "Home - Work" and "Home - Study" in relation to schoolchildren and students.

The next peak occurs in the time frame from 5 pm to 9 pm, which indicates the direction "Work - home", "Study - home"

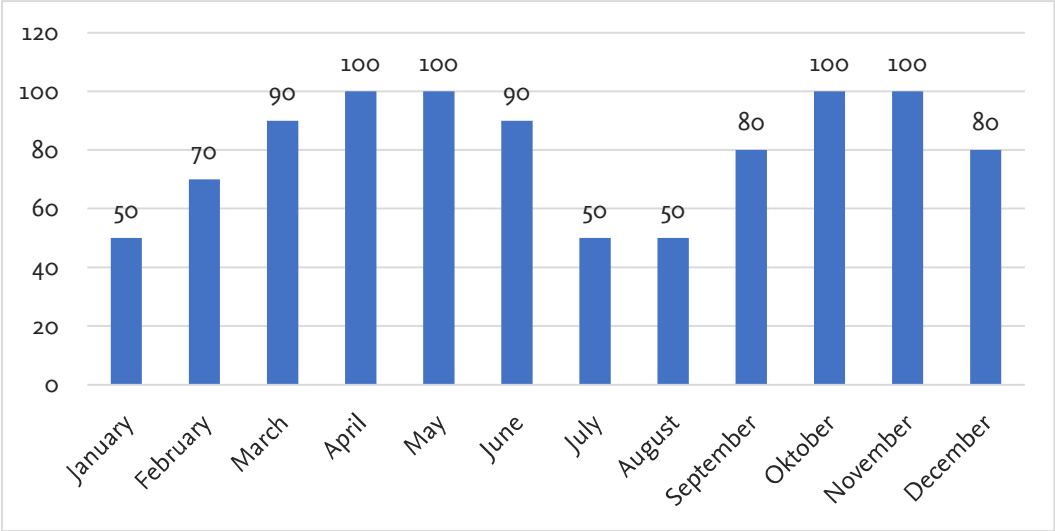

Figure 10. Change in traffic intensity throughout the year in the Almaty agglomeration

Note. Compiled by the authors based on Statistical collection Transport (2020).

According to the data of the road transport movement chronometric study in Figure 11 during the year, it is necessary to conclude that the main flow is concentrated in the months of March, April, May, June, September, October, November, December. The decline in traffic intensity in January, July, August testifies to the vacation period of the working population and the vacation period for students.

Based on the above data, a "Model of the logistics processes interaction in the agglomeration development " was compiled (Appendix 2, Figures 1,2,3) considering the types of logistics development, such as production, warehouse, information, environmental, lean, customs according to the domestic regional product development in Almaty agglomeration. Highlighted logistics processes such as transportation, storage, information services, customer service, production organization, customs clearance. The main goals of the logistics agglomeration are

determined. When investigating the issue, the authors have developed a new definition as "logistics of agglomeration" - a complex of logistics solutions, actions, processes aimed at optimizing organizational solutions for the vehicles and material flow movement within the agglomeration subsystems (Burakov, 2009).

The authors have developed a "Model for making a decision on the logistics development in a specific agglomeration" based on the Almaty agglomeration development analysis (Appendix 2, Figures 1, 2, 3). To make a decision on the logistics services and processes quality, characterizing parameters in the Almaty agglomeration conditions, taking into account the road transport development intensity and the increase in the roads throughput and the transport infrastructure inconsistency, are criteria as "the right place", "the right time" and "emission reduction". This indicates the deterioration of the ecological situation in Almaty agglomeration. In conditions of the maximum intensity of automobile and urban transport movement organization, it is difficult to withstand the conditions for making the decision "the right place", "the right time" and "emission reduction". In this regard, the main evaluation criteria are set to parameters such as "speed of traffic", "quality of services in transport", "digitalization", "quality of roads", "delivery time", "optimal price of the service", "level of pollution", " traffic safety " (Burakov, 2008; Gadzhinsky, 1999).

The implementation of the tasks proposed in the framework of the Model for deciding on the logistics development in a particular agglomeration (Appendix 2, Figures 1, 2, 3) will allow to form an integrated agglomeration logistics, creating a basis for the further Almaty agglomeration development.

Methodology

Sustainable development in modern realities is one of the most urgent problems from natural and applied Sciences to fundamental ones. In logistics, there are several approaches to determining sustainability of logistics system, supply chain, company and its business processes that considered in the territorial aspect.

The method of indicative assessment of logistics sustainability LSI, developed in the framework of the SULPiTER project, involves a comparative assessment of criteria affecting logistics' integrated development in the study area. The calculation steps are shown in the figure 11 below (Dzhunusova and Zhameshova, 2019).

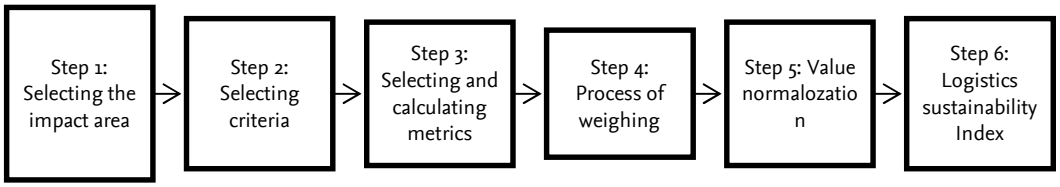

Figure 11. Stages of LSI calculation (D.T.1.2.1 SULPITER Software Tool Development For Understanding Fright Behaviors and Impacts in FUAS, 2018).

Step 1. The choice of the impact area. The first stage is the selection of the impact zone. There are seven areas of impact, and the user chooses for which the assessment will be performed. According to the LSI calculation method, the main areas affecting the sustainability of logistics development in a certain territory are: economy and energy; environment; transport; mobility and society; policy maturity; social recognition; user perception (Dzhunusova and Zhameshova, 2019).

The focus area for this study is the city of Almaty as the largest economic activity center in the Republic of Kazakhstan. The Almaty agglomeration, along with the agglomerations of Nur-Sultan and Shymkent, has a key strategic role in the formation of the Kazakh economy on the so-called hub principle according to a number of strategic program documents, such as the "national plan - 100 concrete steps to implement five institutional reforms" and The state program "Kazakhstan 2050".

Step 2. Criteria selection. The indicators are selected taking into account the areas of impact, from the point of view of stakeholders – business, the population and the state.

Step 3. Selection and calculation of indicators. Within the criteria given above, the following indicators were selected to assess the sustainability of logistics in Almaty:

Economy: the level of development of industrial production (in terms of production volume), the level of development of the small and medium – sized business - since these two sectors are the main consumers of transport and logistics services.

Environment: emissions volume of solid pollutants into the air, since this indicator is the main influencing factor of transport and logistics activities on the environment. In Kazakhstan, emissions of pollutants are recorded from stationary sources, i.e. from enterprises, while separate statistics on the impact of transport on the environment are not kept.

Transport. This group of criteria is reflected in two main indicators – transport productivity (cargo turnover) and road safety (number of road accidents per year).

The maturity of the policy. This criterion is cut off in the indicator "investment in fixed assets" (direct investment).

Step 4. Weighing prosses. Weighting, according to the LSI calculation method, is the process of comparing two or more elements according to the preferences of the decision maker. There are several weighing methods, but they all follow the same standard principle: the higher the weight, the more important the corresponding element (D.T.1.2.1 SULPITER Software Tool Development For Understanding Fright Behaviors and Impacts in FUAS, 2018). In the framework of the SULPiTER project, Analytical Hierarchy Process (AHP) method of for criteria evaluation is used to calculate the logistics sustainability index.

AHP is considered the most widely used multi-criteria analysis method in the field of transport and urban logistics. The main strengths of the AHP method are: it can be used in a very wide range of applications; it is easy to understand; flexibility and ease of use; the interdependence of various criteria; it can be used for both monetary and non-monetary scales (D.T.1.2.1 SULPITER Software Tool Development For Understanding Fright Behaviors and Impacts in FUAS, 2018).

According to this method by Saati (2016), a subjective comparative assessment of the priority of the criteria for sustainable logistics development relative to each

other is made, followed by measuring the specific impact weight on the final index of each of the criteria.

The process of determining the specific weight of each criterion for calculating the final rating is carried out by collecting public (expert) opinions of respondents from various groups: legal entities engaged in logistics activities in the study area – representatives of the logistics business; public administration entities in this territory; the population of the study area.

The focus group consisted of 224 respondents from the category of logistics business sector and local population of Almaty. The age structure of respondents is shown in the graph below (Figure 12).

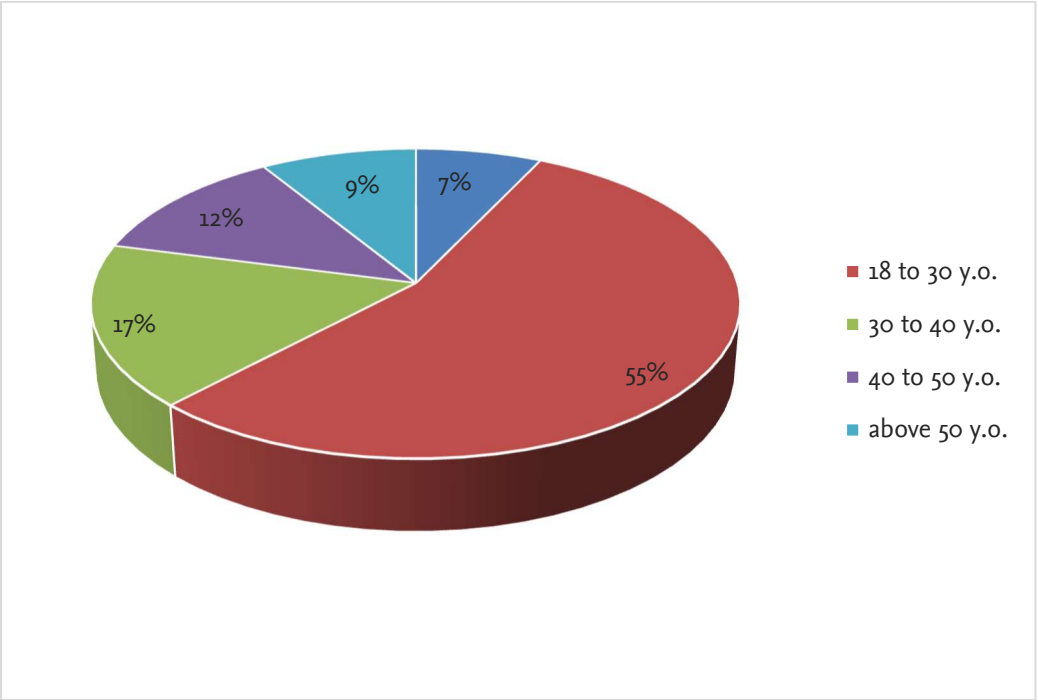

Figure 12. Focus group structure (224 responses).

The survey was conducted online. It is noteworthy that more than half of the respondents are between 18 and 30 years old. The smallest number of respondents is people over 50 years of age. This is probably due to the high economic and social activity of people aged 18-30: employment, ability to use electronic and technical resources, which contributed to the success of the survey online. And, on the

contrary, significantly lower economic, social and informational involvement of the category of people over 50 years of age. The contingent of respondents was 54% of the respondents from the number of middle and senior managers of companies engaged in logistics activities on the territory of Almaty and 46% of the city's population who are not employed in the field of transport and logistics (Figure 13).

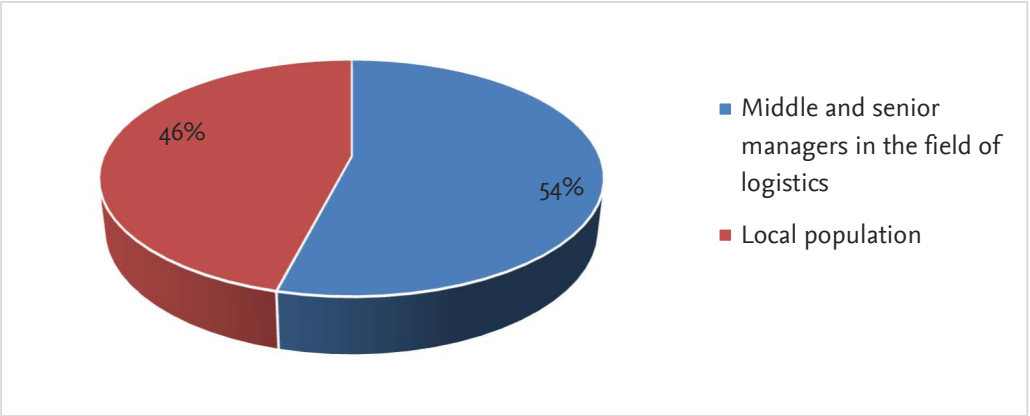

Figure 13. Structure of respondents.

This figure illustrates respondents` occupation structure. The territorial distribution of respondents across the city's administrative territories is shown in Figure 14.

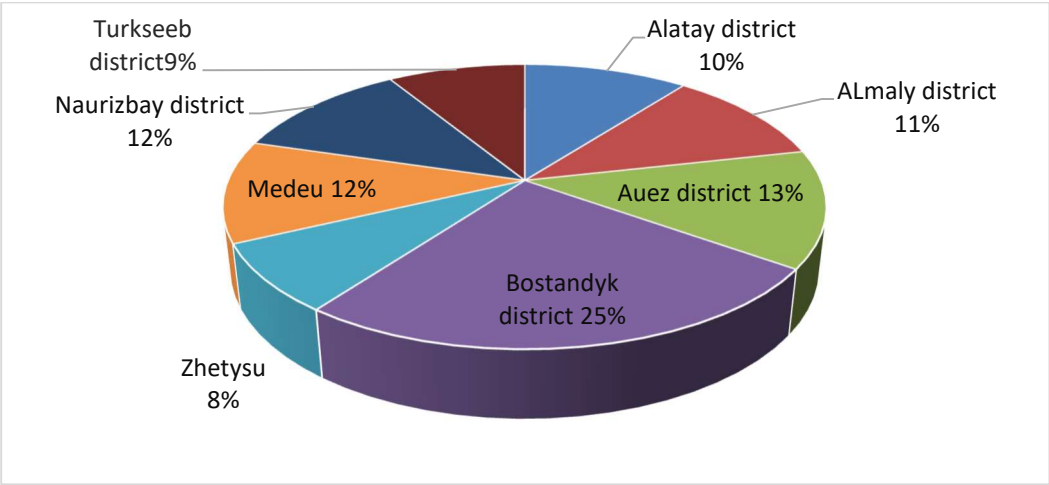

Figure 14. Respondents distribution by area of residence.

The figure illustrates respondents' structure by urban districts. The respondents were asked to subjectively determine the priority in each pair of criteria on a scale

from 1 to 10, where the closer to the left or right criteria in each pair the Respondent makes a mark, the more important this criterion is for the development of the city. The average response "5" is intermediate, indicating that both criteria are equally important (Figure 14).

The questionnaire included scales for assessing the priority of the criteria "industrial production" and "air purity".

Possible scores ranged from 1 to 10. If element 1 is less important than element 2, the corresponding inverse value is assigned (for example, 1/5).

The user fills in A matrix A (n x n), called a “comparison” or “inverse matrix”, where n is the number of elements to compare. The cells below the unitary diagonal cells are filled with the input values of the user's rating, while the rest below are equal to the inverse value of the input value (Dzhunusova and Zhameshova, 2019).

An example is the following matrix A (3x3) (Formula 1).

$$A = \begin{matrix} 1 & a_{12} & a_{13} \\ a_{21} & 1 & a_{23} \\ a_{31} & a_{32} & 1 \end{matrix}$$

Figure 15. The principle of constructing the criteria evaluation matrix when calculating LSI (Dzhunusova and Zhameshova, 2019).

Findings and Discussion

A matrix of the specific weight of criteria was formed according to the respondents' assessment (Table 3). The comparison is made in pairs with determining the priority of one criterion over another. It is noteworthy that the "air pollution" criterion has a clear advantage, which reflects the respondents ' concern about the impact of the environmental situation in the city on its sustainable development, including from the point of view of logistics. Fluctuations in the priority of other criteria are not so pronounced. Most respondents gave a neutral assessment of the priority between

such criteria as the development of industrial production, investment volumes, the level of SMEs development, and the frequency of road accidents when they are trampled on.

Table 3. Matrix of evaluation criteria for calculating the LSI of Almaty.

Criteria:	Development of industrial production	Direct investment	The development of SMEs	The frequency of road accidents	Air pollution
Development of industrial production	1,00	5,00	5,00	5,0	10,0
Direct investment	0,20	1,00	5,00	5,00	5,00
The development of SMEs	0,20	0,20	1,00	5,00	5,00
The frequency of road accidents	0,20	0,20	0,20	1,00	5,00
Air pollution	0,10	0,20	0,20	0,20	1,00
Sum	1,70	6,60	11,40	16,20	26,00

Step 5. Normalization of values. The use of criteria of different properties and expressed in different measurement units in the General assessment methodology requires the establishment of a comparable scale, which makes it possible to compare the criteria values. For this purpose, the so-called normalization of each criterion (and its numerical indicator) is performed. Data normalization consists of scaling data values to a single specified range, such as 0 to 1 or 0 to 100.

There are several different ways to normalize criteria value. The methodology used for calculating LSI uses normalization compared to the best alternative: all indicator values are divided by the priority of each criterion divided by the value sum of this criterion compared to the rest. (table 4).

Table 4. Criteria Value Normalization

	Development of industrial production	Direct investment	The development of SMEs	The frequency of road accidents	Air pollution
Development of industrial production	0,59	0,76	0,44	0,31	0,38
Direct investment	0,12	0,15	0,44	0,31	0,19
The development of SMEs	0,12	0,03	0,09	0,31	0,19
The frequency of road accidents	0,12	0,03	0,02	0,06	0,19
Air pollution	0,06	0,03	0,02	0,01	0,04
Sum	**1,00**	**1,00**	**1,00**	**1,00**	**1,00**

Impacts are converted to uniform values using different methodologies depending on the specific impact. All values are then normalized, multiplied by their value weight, and the final index is estimated for each impact area, shown in tables 3 and 4.

Table 5. Normalized priority vector.

Criteria:	Normalized priority vector
Development of industrial production	0,50
Direct investment	0,24
The development of SMEs	0,15
The frequency of road accidents	0,08
Air pollution	0,03
Sum:	1,00

Table 6. Normalized priority vector results.

Criteria:	NPV	Sum	Result
Development of industrial production	0,50	1,70	0,84
Direct investment	0,24	6,60	1,60
The development of SMEs	0,15	11,40	1,68

The frequency of road accidents	0,08	16,20	1,36
Air pollution	0,03	26,00	0,82
λmax			6,30

Step 6. Sustainability index of logistics.

The criteria used to assess the sustainability of logistics in Almaty can be divided into 2 categories: indicators whose growth is a positive dynamic for sustainable development, such as development of industrial production, volume of direct investment and the development of small and medium-sized businesses; indicators whose growth has a negative value for sustainable development: the road accidents frequency per year, the level of air pollution.

Table 7 shows the values of these indicators in 2015 and 2019 and their impact on the final logistics sustainability index.

Table 7. The quantitative values of evaluation criteria LSI.

	Measure unit	2015	2019	Signification (+/-)
Industrial production development	millions of tenge	662 981	957 131	+
Direct investment	millions of tenge	533 370	820 449	+
SMEs development	tens of millions of tenge	366 587	833 373	+
Road accidents frequency	number	5552	4489	-
Air pollution	thousand tons	5900	7900	-

To assess the dynamics of LSI changes, the criteria were evaluated for 2015 and 2019 shown in tables 7 and 8

Table 8. Calculation of the LSI of Almaty in 2015.

	2015			
Criterion	Criterion Value	Specific weight	Significati on (+/-)	In the LSI structure
Industrial production development	1,00	0,50	+	0,495532981
Direct investment	0,80	0,24	+	0,194481828
SMEs development	0,55	0,15	+	0,081460914
Road accidents frequency	0,01	0,08	-	-0,000702654
Air pollution	0,01	0,03	-	-0,000280285
LSI				77%

Table 9. Calculating LSI of Almaty by indicators of 2019.

	2019			
Criterion	Criterion Value	Specific weight	Significati on (+/-)	LSI
Industrial production development	1,00	0,50	+	0,495532981
Direct investment	0,86	0,24	+	0,20722003
SMEs development	0,87	0,15	+	0,12827474
Road accidents frequency	0,00	0,08	-	-0,000393524
Air pollution	0,01	0,03	-	-0,000259959
LSI:				83%

As can be seen from tables 5 and 6, the LSI indicator in 2015 is 77, in 2019 this index is 83. Therefore, the logistics sustainability index in Almaty has a positive trend with an increase of 6%.

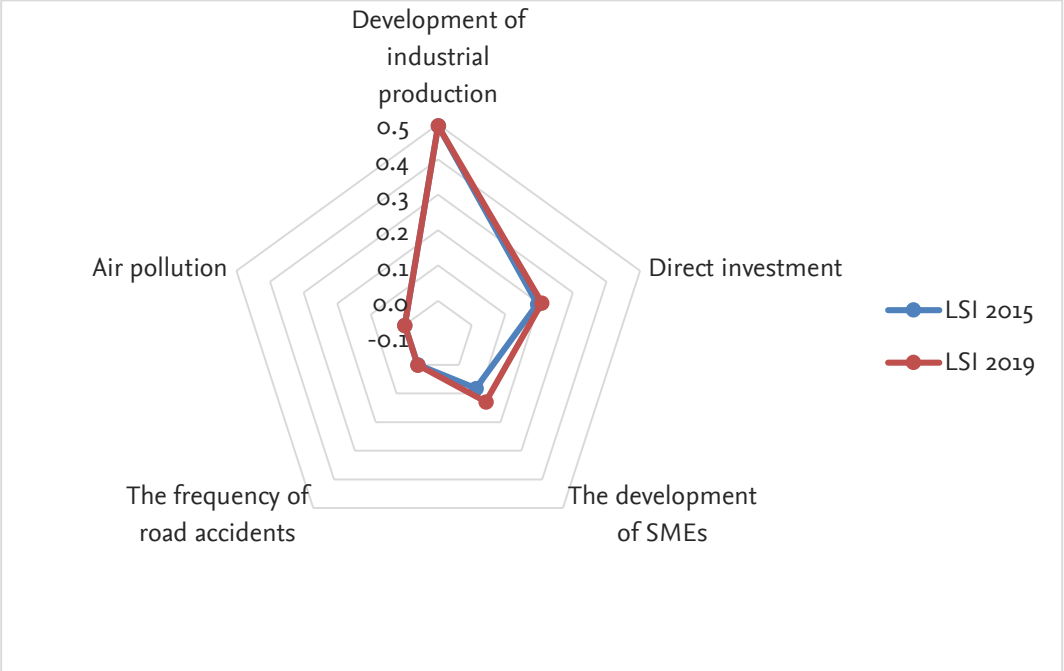

Figure 16. Comparison of Almaty LSI indices for 2015 and 2019.

The figure illustrates LSI development between years 2015 and 2019. As can be seen from figure 17, the increase is due to positive dynamics of changes in the criteria for direct investment and SMEs` development. According to The statistics Committee of the Republic of Kazakhstan, direct investment growth rate for the period from 2015 to 2019 was 53.82%; The growth rate of SMB output from 2015 to 2019 was 127.33%.

According to the graph, the areas to be further developed urban logistics sustainability indicator integrated development in Almaty are improving the environmental situation, in particular, air quality and improving road safety.

The main purpose of applying the Sulpiter concept is to create an information product aimed at providing support management decision making when choosing a transportation option for a certain territory (D.T.1.2.1 SULPITER Software Tool Development For Understanding Fright Behaviors and Impacts in FUAS, 2018). Therefore, it is a decision support tool that can be used to assess impact of a particular decision (project) on the city's` sustainable development. If the forecast results of management decision making show an increase of logistics sustainability

index, the project should be adopted; if this index decreases according to the project's forecast, the project negatively affects the territory`s sustainable development and is subject to rejection.

Conclusion

Designing an integrated model of logistics processes integration in scope of urban agglomeration logistics systems is a source of increasing urban agglomeration logistics sustainability and efficiency.

The interaction of logistics processes, such as delivery, distribution, loading, unloading and delivery to consumers, in urban agglomeration is directly dependent on the development of production.

Sustainable development in modern realities is one of the most urgent problems of a number of branches of scientific knowledge: from natural and applied Sciences to fundamental ones. In logistics, there are several approaches to determining sustainability. The most common approaches are to determine the sustainability of logistics in terms of the logistics system, supply chain, company and its business processes. In this paper, the sustainability of logistics is considered in the territorial aspect.

Development of urban agglomeration and main socio-economic processes in it is linked with development of such areas as production, business, transport and transport infrastructure, investment, and road safety. These factors have different effects on the sustainability of agglomeration logistics. Based on the results of applying the LSI calculation method, it was determined that the factors of increasing logistics stability for Almaty agglomeration are increasing volumes of direct investment and the development of SMEs. Air quality and the frequency of road accidents are limiting factors.

Further research based on the results obtained can be aimed at improving the stability of agglomeration logistics by influencing negative factors. Also, this

technique can be applied to other agglomerations to assess their logistics sustainability, taking into account specific factors.

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Cooperative R&D and Technological Innovation Performance between Enterprises: An Empirical Analysis Based on the 2019 World Bank Survey of Kazakhstani Enterprises

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Abstract

Kazakhstani companies have a long-standing problem of low technological innovation performance. With the increasing complexity of technology research and development and the continuous increase of costs and risks, cooperative research and development between enterprises has become one of the important ways of corporate innovation. This article is based on the World Bank 2019 Survey Data of Kazakhstani companies, the propensity score matching method and the generalized propensity score matching method are used to investigate the impact of inter-firm cooperative R&D decisions and the intensity of inter-firm cooperative R&D on the technological innovation performance of enterprises. The research results show that compared with not carrying out cooperative R&D between enterprises, carrying out cooperative R&D among enterprises can significantly improve the technological innovation performance of enterprises; only when the intensity of cooperative R&D between enterprises is at a relatively low level, increasing cooperative R&D between enterprises can significantly improve the technological innovation performance of enterprises, and when the intensity of cooperative R&D is too high, it will not effectively improve the technological innovation performance of enterprises.

Keywords: cooperative R&D; technological innovation performance; knowledge spillover; R&D intensity; R&D alliance

Introduction

In an economic environment where the global division of labor continues to be refined, competition continues to intensify, and the complexity of technological innovation, risks, and costs have risen sharply, the core capabilities of enterprises are becoming more professional, and the degree of external dependence is deepening. Enterprises are gradually moving from going alone to uniting others. The Enterprises have formed a group development. During the 1960s and 1970s, the development of cooperative R&D between enterprises was slow. In the 1980s, with the increasing risks and costs of R&D projects, the continued complexity of scientific and technological development and the shortening of R&D cycles, global enterprises cooperated in R&D. It has begun to appear in large numbers (Hagedoorn, 2002). Cooperative R&D between enterprises has become an important technological innovation method for different enterprises to integrate resources and achieve complementary advantages. By carrying out cooperative R&D between enterprises, enterprises can better obtain external resources and achieve economies of scale and scope. Economy, exert the synergy effect of R&D among enterprises, reduce risks and reduce repeated R&D (Becker and Dietz, 2004).

At present, Kazakhstan's economic growth has entered the stage of "innovation-driven" development. The economic growth model that relies on increasing factor input and then expanding the scale of investment is not sustainable, and scientific and technological innovation is increasingly supporting and leading the economic and social development. Enterprise technological innovation is the foundation of Kazakhstan's economic innovation-driven development. For a long time, while Kazakhstan's scientific and technological innovation investment has increased significantly, the production technology level of Kazakhstani companies is still relatively backward, and most companies are still stuck in low-tech and low-value-

added fields. The effectiveness of corporate technological innovation is not obvious. Kazakhstani companies are also facing practical problems such as a shortage of innovative talents and financial difficulties, which hinder the development of corporate technological innovation activities and the improvement of technological innovation capabilities. Overcoming the problem of insufficient corporate innovation capabilities and focusing on improving The performance of enterprise technological innovation is the focus and difficulty of Kazakhstan's economic innovation-driven development. Cooperative R&D between enterprises relieves the inherent constraints of independent innovation of a single enterprise and promotes the integration and optimal allocation of different resources between enterprises, providing new ideas for improving enterprise innovation capabilities. So, can cooperative R&D among enterprises improve the technological innovation performance of Kazakhstani enterprises? In addition, some studies have shown that for improving enterprise performance, the more investment in enterprise R&D is not better than is the investment in cooperative R&D between enterprises more beneficial to improving the technological innovation performance of Kazakhstani enterprises?

Based on the 2019 survey data of Kazakhstani companies by the World Bank, this paper uses the propensity score matching method and the generalized propensity score matching method to investigate the impact of inter-firm cooperative R&D decisions and the intensity of inter-firm cooperative R&D on the technological innovation performance of enterprises. The research results show that compared with the previous carrying out inter-enterprise cooperative research and development, and carrying out inter-enterprise cooperative research and development has significantly improved the technological innovation performance of enterprises. When the intensity of cooperative research and development between enterprises is at a low level, increasing cooperative research and development investment can significantly improve the technological innovation performance of enterprises. While cooperative research and development between enterprises is at a low level. At a higher level, the increase in cooperative R&D investment cannot effectively improve the technological innovation performance of

enterprises. The research results of this article have certain reference value for the planning and development of cooperative R&D activities between enterprises.

Literature review

The literature of enterprise cooperative R&D is mainly divided into three categories, namely the influencing factors of cooperative R&D, cooperative R&D model, and cooperative R&D performance effect . The main research content of this paper is to analyze the impact of cooperative R&D between enterprises on the technological innovation performance of enterprises. In the scope of the literature on cooperative R&D performance effects, here we mainly select and comment on the relevant literature that belongs to the scope of corporate cooperative R&D performance effects. Cooperative R&D between enterprises mainly affects the technological innovation performance of enterprises in two ways, direct and indirect.

Cooperative R&D between enterprises has brought supplementary resources, risk cost sharing, and external knowledge spillover. The resource-based theory believes that enterprises can obtain the supplementary resources needed for their R&D through cooperation with other organizations, and realize the sharing of costs and risks (Srholec, 2014). Cooperative research and development can bring about knowledge spillovers outside the enterprise, and enable the enterprise to internalize external knowledge spillovers. D'Aspremont and Jacquemin (1988) constructed a three-stage game model, which believes that when the external knowledge spillover is sufficiently high enterprises' cooperative R&D investment has increased, and the company's equilibrium output has been improved. The indirect effect is mainly manifested in cooperative R&D to improve the efficiency of internal R&D. The relationship between internal R&D and cooperative R&D is complementary or alternative, which depends on the technology, what is needed for innovation is specific knowledge or general knowledge. Alternative internal and external innovation activities make external R&D cooperation bring about a drop in R&D costs and improve the efficiency of enterprise R&D. Complementary innovation activities allow companies to integrate different innovation strategies to increase its innovation output.

However, cooperative R&D by enterprises is not easy, nor is it cost-free. Cooperative R&D faces transaction cost issues, especially in the coordination, management, and control of R&D activities of different participants, such as coordinating different organizational behaviors and integrating complementarity. The assets and resources of the company, and formulate rules and regulations for joint research and development. The selection of partners is also a laborious and time-consuming event, which increases the search cost of cooperative research and development (Srholec, 2014). In addition, cooperative research and development also faces potential research and development risks and information asymmetry problems may bring threats of opportunistic behavior.

Most empirical studies have shown that cooperative R&D between companies can significantly improve the technological innovation performance of companies. Arvanitis (2012) used Swiss company data for empirical analysis, which shows that corporate cooperative R&D has increased the proportion of company's new product sales. Using German company data analysis Later, Aschhoff and Schmidt (2008) also found that cooperative research and development of enterprises increased the sales proportion of new products of enterprises, but the sales proportion of new products imitated by enterprises did not play a positive role. Becker and Dietz (2004) also used German enterprise data. The empirical findings show that corporate cooperative R&D has significantly increased the proportion of new product sales of enterprises. Miotti and Sachwald (2003) used French corporate data, and also found that corporate cooperative R&D increased the proportion of corporate new product sales. Belderbos et al. (2004) used Danish corporate data. After conducting empirical analysis, it was found that corporate cooperative research and development significantly promoted the increase in per capita sales of new products. Peeters and Potterie (2006) used Belgian corporate data and found that collaborative research not only increased the probability of companies applying for patents, but also increased the number of companies applying for patents. Other documents did not find a significant positive relationship between the two. Klomp and Leeuwen (2001) used Dutch enterprise data to conduct empirical analysis and found that cooperative research and development failed to significantly increase the

proportion of new product sales. Kemp and Folkeringa (2003) used the Netherlands according to the enterprise data, the conclusion is consistent with Klomp and Van Leeuwen (2001).

Most empirical studies use the proportion of new product sales to characterize the company's technological innovation performance (Arvanitis, 2012). After reviewing relevant literature, Hagedoorn and Cloodt (2002) pointed out that the narrowly defined corporate technological innovation performance refers to the extent to which a company can introduce new inventions. Market, and the broad sense of corporate technological innovation performance covers the measurement of the performance of the firm's technological R&D and product market commercialization stage. Both narrowly and broadly defined technological innovation performance reflect the economic benefits of corporate technological innovation. New The proportion of product sales directly connects innovation activities with market success, reflects the economic benefits of enterprise technology innovation activities, and is a suitable variable reflecting the performance of enterprise technological innovation. Some studies use patents to characterize enterprise technological innovation performance, except that they fail to reflect enterprise technology in addition to the economic benefits of innovation, there are also some improprieties. Whether to apply for a patent is a strategic decision of a company. For some companies that are unwilling to apply for a patent, trade secrets or market leading time is better protection methods. Enterprises such as small enterprises are not capable of applying for patents (Kemp and Folkeringa, 2003).

The limited research by domestic scholars has focused on the impact of corporate cooperative R&D experience, partner diversification, and organizational relationships on corporate technological innovation performance. However, an intuitive question has not yet been analyzed, that is, whether Kazakhstani companies carry out inter-company collaborative R&D to enhance corporate technological innovation performance? In view of this, based on the World Bank's 2019 Kazakhstani Enterprise Survey Data, this paper uses propensity score

matching to empirically examine the impact of inter-firm collaborative R&D on enterprise technological innovation performance, provides robust empirical evidence for micro-enterprises in Kazakhstan, and enriches the relevant fields. In addition, most empirical studies have examined the linear impact of corporate cooperative R&D intensity on corporate technological innovation performance. Such analysis potentially assumes that the impact of different corporate cooperative R&D intensity on corporate technological innovation performance is homogeneous and does not consider the heterogeneous influence of different enterprise cooperative R&D intensity. This paper also adopts the generalized propensity score matching method to empirically analyze the heterogeneous influence of different inter-firm cooperative R&D intensity on enterprise technological innovation performance, and rationally plan inter-firm cooperative R&D for enterprises Input to provide reference.

Methodology

Cooperative R&D between enterprises is a strategic behavior of the enterprise, and it is an action taken based on the market environment, operating conditions and business objectives faced by the enterprise. Whether the enterprise makes inter-enterprise cooperative R&D decisions or determines the strength of inter-enterprise cooperative R&D, it is selective bias. If you directly use the least squares method to analyze the impact of inter-firm cooperative R&D decisions and the intensity of inter-firm cooperative R&D on enterprise technological innovation performance, it will lead to the estimation of the correlation coefficient bias. This article will use propensity score matching and generalized propensity score matching methods respectively, to examine the impact of cooperative R&D decision-making and cooperative R&D intensity on enterprise technological innovation performance.

Data description

The sample data we use comes from the World Bank's 2019Kazakhstani Enterprise Survey Data. In 2019, the World Bank surveyed 1,600 companies located in 17 regions, including Nursultan, Almaty and Shymkent cities. The industry types include manufacturing and service companies. The survey content covers basic corporate information, infrastructure, sales and supply, production capacity utilization, innovation and technology, financing, government-enterprise relations, and labor issues. The survey content mainly involves information from 2018 and the period from 2016 to 2018. Compared with other micro-enterprise data, this data has two advantages: one is that the data has relatively comprehensive and rich enterprise technological innovation information, especially information on cooperative research and development; the other is that the data is relatively recent and publicly available micro enterprise data and information content are relatively rich.

Since this article examines the technological innovation performance of enterprises, we first delete the sample of service industry enterprises, and then delete the sample of enterprises whose answers are unclear or omitted by related variables, and get a sample of 974 manufacturing enterprises. Most of the sample enterprises are small and medium-sized enterprises, and more than 90% of them the total annual sales of the company did not reach 3 million US$. Among them, the companies that carried out cooperative research and development between enterprises accounted for 10.24% of the total sample enterprises, and the enterprises that carried out internal research and development accounted for 40.74% of the total sample enterprises. Internal R&D and collaborative R&D between companies are still the behavior of a few companies.

Propensity score matching model setting.

The propensity score matching method is based on a counterfactual inference framework, divides the research objects into treatment groups and non-treatment groups. Also, it matches two sets of samples through observable conditions, and constructs unobservable that can be compared with actual observations To determine the causal effect of the processing behavior, we set up a dual dummy

variable to divide the company into a sample of the treatment group that conducts cooperative research and development between enterprises and a control sample that does not conduct cooperative research and development between enterprises, and establish Logit model is as follows:

$$P(D=1 \mid \mathrm{X}) = Exp(\beta \mathrm{X}) / [1 + Exp(\beta \mathrm{X})] \quad (1)$$

In formula (1), D is whether the enterprise is to carry out inter-enterprise cooperative R&D. If it is carried out, it is assigned a value of 1, otherwise it is 0. X is a matching variable. The technological innovation performance of firms performing cooperative R & D is represented by Y1 and Yo, respectively.

According to the estimated propensity score for cooperative R&D between enterprises, the processing group companies are matched, and the conditional independence and common support conditions are established, $E(Y_0 \mid D=1, \mathrm{X}=\mathrm{X}_i) = E(Y_0 \mid D=0, \mathrm{X}=\mathrm{X}_i)$ is established, that is, to find potential "counterfactual" control samples for the treatment group samples. Therefore, the difference in technological innovation performance between enterprises and non-enterprise cooperative R&D can be estimated based on the matched samples, namely The average treatment effect (ATT) of participants is expressed by equation (2):

$$ATT = N_1^{-1} \sum_{ieI1} [Y_{1i} - E(Y_0 \mid D=0, \mathrm{X}=\mathrm{X}_i)] \quad (2)$$

In formula (2), $N_1$is the number of individuals in the matching treatment group, and I_1 is the sample set of the matching treatment group. In addition, if matching is performed against the control group, according to $E(Y_1 \mid D=1, \mathrm{X}=\mathrm{X}_i) = E(Y_0 \mid D=1, \mathrm{X}=\mathrm{X}_i)$ condition, the average treatment effect (ATU) of non-participants can be estimated by formula in equation:

$$ATU = N_2^{-1} \sum_{ieI2} [E(Y_1 \mid D=1, \mathrm{X}=\mathrm{X}_i) - Y_{0i}] \quad (3)$$

In formula (3), N_2 is the number of individuals in the matched control group, and I_2 is the sample set of the matched control group. The average treatment effect (ATE) of the sample can be further estimated, and the formula is (4)

$$ATE = N^{-1}\sum_{ie\{I1\cup I2\}}[E(Y_1 \mid D=1, \mathrm{X}=\mathrm{X}_i) - E(Y_0 \mid D=0, \mathrm{X}=\mathrm{X}_i)] \quad (4)$$

In formula (4), $N=N_1+N_2$.

Generalized propensity score matching model setting.

We establish a generalized propensity score matching model to examine the impact of the strength of cooperative R&D between enterprises on the technological innovation performance of enterprises. Similar to the propensity score matching method, the generalized propensity score matching method matches samples through observable conditions. And then infer the causal effect. The difference is that in generalized propensity score matching, the sample has countless choices in a continuous processing interval. By selecting a certain processing level, the corresponding "counterfactual" result can be constructed by matching the sample. Hirano andImbens proposed a three-stage method for estimation (Hirano and Imbens, 2004). We use this method to estimate the dose response function and treatment effect of inter-firm cooperative R&D on enterprise technological innovation performance.

The first stage is to estimate the conditional distribution of the processing variables and fit the generalized propensity score. Due to the large number of biased distributions of zero-valued cooperative R&D intensity among processing variables, we use the fractional Logit model proposed by Papke and Wooldridge (1996) to estimate. After standardizing the processing variables between [0, 1], the maximum likelihood estimation method is used to estimate the equation (5):

$$E(D_i^c \mid \mathrm{X}_i) = F(\beta \mathrm{X}_i) \quad (5)$$

In formula (5), D_i^c is the inter-firm cooperation R&D intensity of sample i, and X_i is the matching variable. The generalized propensity score R_i^e is fitted after estimation.

The second stage is to expand the result variable to deal with variables D_i^c and generalized propensity score R_i^e multi-order approximation to fit. Multi-order approximation can include D_i^c and R_i^e first, second or third order, you can add or without adding the interactive terms of the two, the form is flexible and diverse (Hirano & Imbens, 2004). In order to better investigate the non-linear relationship between the cooperation R&D intensity and the technological innovation performance of enterprises, we use the second-order approximation and the third-order approximation is used to fit, and cross terms are added, and multiple regressions are used for comparison and insignificant regression terms are eliminated. The regression equation is as shown in equation (6):

$$E(Y_i \mid D_i^c, R_i^e) = \sigma_0 + \sum_{j=1}(\sigma_{1j} D_i^{cj} + \sigma_{2j} R_i^{ej}) + \sigma_3 D_i^c R_i^e \quad (6)$$

The third stage is to estimate the dose-response function and its treatment effect. According to the estimated results of the second stage, the expected mean value of technological innovation performance conditions and the treatment effect for a specific treatment level d are estimated according to formula (7) and formula (8).

$$E(Y_i \mid D_i^c = d) = N^{-1}\sum_i[\sigma_0^e + \sum_{j=1}(\sigma_{1j}^e D_i^{cj} + \sigma_{2j}^e R_i^{ej}(d, \mathrm{X}_i) + \sigma_3^e D_i^c R_i^e(d, \mathrm{X}_i)] \quad (7)$$

$$TE(\Delta \mid D_i^c = d) = E(Y_i \mid D_i^c = d + \Delta) - E(Y_i \mid D_i^c = d) \quad (8)$$

Among them, N is the total number of samples and D is the increase in processing variables. We take d as 20 processing levels with an average interval of 0.05 between [0, 1), and set D to 0.01.

Variable description.

Technological innovation performance data is taken from the "proportion of sales revenue related to the introduction of new products or services by the company in

the past three years". Cooperative R&D decision variable data between enterprises is taken from "whether the company has cooperated with other companies in research and development in the past three years" ", if the answer is yes, the value is 1, otherwise it is 0. The data on the enterprise cooperative R&D intensity variable is taken from "the average investment in R&D cooperation between the enterprise and other enterprises in the past three years", and the total sales of the enterprise are de-scaled.

Whether it is propensity score matching or generalized propensity score matching, the aim is to select appropriate matching variables to correct for the selection bias between the treatment group and the control group. We take into account variables that may affect both the treatment variable and the outcome variable. At the same time. On the basis of reference to relevant literature and data availability, the following matching variables are selected:

(1) Absorptive capacity. Stronger absorptive capacity enables enterprises to better internalize external knowledge spillovers, encourage enterprises to carry out cooperative research and development, and data acquisition. Since "in the past three years, did the company have internal R&D expenditure", if it is, assign a value of 1, otherwise it is 0.

(2) The size of the company. The larger the company, the more capable it is to find partners, but at the same time it is also more capable of developing Independent research and development, the data are taken from the "Total sales of enterprises in 2018", taking the natural logarithm.

(3) Export intensity. The higher the export intensity, the stronger the competitiveness and the better the ability to carry out cooperative research and development. The data is taken from "Indirect Export Sales of Enterprises" "Proportion" and "Proportion of direct export sales of enterprises" are obtained by adding the two data and dividing by 100.

(4) Financing constraints. Insufficient funds can hinder companies from developing cooperative research and development. The data is taken from "Does the company have an overdraft account", if the answer is yes, then the value is 1, otherwise it is 0.

(5) The degree of industry competition. The intense pressure brought by the fierce competitive environment can make companies seek cooperative research and development. The data is taken from "impact of informal competition on business operations".

(6) Foreign-funded enterprises. Foreign-funded enterprises are more likely to participate in cooperative research and development, especially the cooperative research and development of foreign enterprise networks. The data is taken from "The proportion of foreign-funded enterprises in enterprise shares". If the proportion exceeds 50%, the value is 1, Otherwise, it is 0.

(7) High-tech enterprise. High-tech enterprises pay more attention to the creation, learning and absorption of knowledge, and are more likely to participate in cooperative research and development. If it is a high-tech industry, the value is 1, otherwise it is 0. The descriptive statistics of variables are shown in Table 1.

Table 1. Variable descriptive statistics.

	Variable name	Average value	Standard deviation	Minimum value	Maximum value
Result variables	Technological innovation performance	11.85	16.365	0	100
Working with variables	Cooperative R&D decisions	0.98	0.299	0	1
	Cooperative R&D strength	0.003	0.021	0	0.5
	Absorption capacity	0.405	0.486	0	1
	Enterprise size	4.563	1.175	1.681	10.298
	Export intensity	0.137	0.256	0	1

Matching variables	Financing constraints	0.321	0.353	0	1
	Degree of competition	0.827	0.757	0	4
	Foreign-funded enterprises	0.039	0.100	0	1
	High-tech companies	0.253	0.328	0	1

Findings and Discussion

Propensity score matching regression results

1. Propensity scores estimation and balance test. We use the Logit model to estimate the propensity score. After matching the sample according to the estimated propensity score, the balance test before and after the comparison is performed. The results are shown in Table 2.

Table 2. Tendency score estimation and matching balance test results.

Variables	Logit estimates	Sample	Mean difference test		Standardized difference test		
			Processing group	Control group	Standard deviation	Decline	t-test
Absorption capacity	1.834*** (0.130)	Before matching	0.731	0.247	102.4	100	11.05***
		After matching	0.731	0.731	0		0

Enterprise size	0.124** (0.044)	Before matching After matching	15.530 15.530	15.67 16.403	38.5 6.2	74.2	5.08*** 0.51
Export intensity	0.604** (0.210)	Before matching After matching	0.103 0.103	0.024 0.106	29.9 2.4	80.7	2.35*** 0.1
Financing constraints	0.341** (0.080)	Before matching After matching	0.382 0.382	0.024 0.382	28.1 0	100	3.74*** 0
Degree of competition	0.174*** (0.099)	Before matching After matching	1.015 1.015	0.70 1.046	23.6 -2.4	75	1.80*** -0.17
Foreign-funded enterprises	0.138 (0.246)	Before matching After matching	0.068 0.068	0.032 0.085	14.0 -6.1	41.6	2.99** -0.42
High-tech companies	0.054 (0.199)	Before matching	0.211 0.211	0.142 0.299	14.1 1.2	73.6	1.72* 0.19

		After matching					
	Propensity score model pseudo R2		LR statistic (p-value)		Average standard deviation		Decline
Before matching	0.151		147.38*** (0.000)		32.2		81.1
After matching	0.001		0.76 (0.886)		2.1		

Note: the balance test results are calculated based on the 1: 5 K-nearest neighbor matching method; in the Logit estimation results, the standard error in parentheses; *, **, * * * indicate a significant degree of 10%, 5%, 1%, respectively.

Table 2 reports the 1:5 K-nearest neighbor matching balance test results. From Table 2, it can be seen that after matching, the standard deviation of each matching variable is significantly reduced compared to before matching. The results of the two-tailed t test show that after matching, there is no significant systematic difference in the mean of each matching variable. Overall, the average standard deviation has dropped significantly. Compared with the pre-matching, the estimated propensity score of the sample after the matching shows that the pseudo R2 has dropped significantly and is close to zero. The LR statistics reject the null hypothesis that the matching variables are jointly significant. These indicate that the matching variables after matching have low explanatory power to the model, and there is no systematically significant difference between the matching variables between the treatment group and the matched control group. The lower pseudo R2, greatly reduced average standard deviation, and insignificant LR statistics all indicate that the propensity score model setting aimed at balancing matching variables and eliminating selective bias is more successful.

2. Propensity score matching treatment effect estimation results. We use the 1:5 K-nearest neighbor matching method to estimate the average treatment effect of participants (ATT), the average treatment effect of non-participants (ATU) and overall average treatment effect (ATE) of the sample after matching. Three

processing effects. In order to test the robustness of the estimation results, we also use caliper matching and kernel matching methods to estimate the processing effect. The radius of caliper matching is set to 0.06, and the bandwidth setting of kernel matching uses the default 0.06. At the same time, for a simple comparison, we also list the treatment effect estimation results before matching. The above estimation results are shown in Table 3.

Table 3. Tendency score matching processing effect estimation results.

	Processing effect	Standard error	Significance level	Estimation method
Before matching	12.087	1.327	0.000	OLS
ATT	5.002	1.170	0.008	K-nearest neighbor matching
ATU	10.508	1.637	0.001	K-nearest neighbor matching
ATE	10.049	1.429	0.000	K-nearest neighbor matching
ATT	5.036	1.755	0.000	Caliper matching
ATU	10.728	1.474	0.001	Caliper matching
ATE	10.212	1.310	0.001	Caliper matching

ATT	4.860	1.779	0.000	Nuclear matching
ATU	10.541	1.434	0.000	Nuclear matching
ATE	10.037	1.271	0.001	Nuclear matching

Note: The standard errors of the treatment effects estimated by the propensity score matching methods are all calculated using the 500-bootstrap method.

The results of OLS estimation using the sample before matching show that cooperative R&D between enterprises has significantly improved the technological innovation performance of enterprises. The estimation results of the three matching methods of propensity score matching show that ATT is significantly positive, which also indicates that cooperative R&D between enterprises has significantly improved The technological innovation performance of the enterprise, but the processing effect is greatly reduced compared to the estimated result before the matching. This proves that there is a selective bias in the cooperative R&D decision-making between enterprises. Considering the strategic behaviors performed, the overall performance is that the higher the company's technological innovation performance is, the more likely it is to carry out inter-company cooperative research and development. From the estimation results of the three matching methods of propensity score matching, ATT, ATU, and ATE are all positive, and the significance level reaches 1%. This further verifies that cooperative R&D between enterprises has effectively improved the technological innovation performance of enterprises, which is similar to the results of most empirical studies. Enterprises can seek to cooperate with other enterprises in research and development to obtain what they lack It can absorb knowledge spillovers, break through the limitations of its own innovation capabilities, and achieve higher technological innovation performance.

Generalized propensity score matching regression results

1. Generalized propensity score estimation and balance test. We first use the fractional Logit model to estimate the generalized propensity score, and use the generalized propensity score to adjust and match the sample for balance test. The results are shown in Table 4.

Table 4. Generalized propensity score estimation and matching balance test results.

Variable	Fractional Logit estimates	[0,0.1]		[0.1,1]	
		Mean deviation	t statistics	Mean deviation	t statistics
Absorptive capacity	1.421*** (0.260)	0.023	0.596	-0.026	-0.65
Enterprise size	-0.133** (0.105)	-0.039	-0.122	0.063	0.144
Export intensity	-0.120 (0.497)	0.012	0.186	-0.037	-0.681
Financing constraints	0.156 (0.200)	-0.98	1.056	-0.132	-1.204
Degree of competition	0.161 (0.062)	0.076	0.392	-0.122	-0.632
Foreign-funded enterprises	1.225** (0.554)	-0.001	-0.030	0.012	0.437
High-tech companies	0.789** (0.215)	-0.023	-0.310	-0.088	-1.051

Note: The standard errors are in parentheses; *, **, *** indicate a significance level of 10%, 5%, and 1%, respectively.

We refer to the practice of Hirano and Imbens to perform a balance test, divide the processing level into two sub-intervals [0,0.1] and [0.1,1], and test that the sample after the generalized propensity score adjustment, and matching is in the two sub-intervals The conditional mean difference of each matching variable (Hirano and Imbens, 2004). The conditional mean of each matching variable is calculated based on the mean value of the processing variable in two subintervals. The balance test results show that in the two subintervals, the average deviation of each matching variable is a two-tailed t The test is not significant, indicating that the matching variables are not related to the cooperation R&D intensity between the processing variables after the matching. In other words, there is no systematic difference between the matching variables after the matching, and the generalized propensity score model is set well. The balance condition is met.

2. The generalized propensity score matches the treatment effect estimation result. We choose the second-order approximation of the generalized propensity score and the treatment variable to fit the enterprise's technological innovation performance. After stepwise regression testing, it is found that the cross-term of the generalized propensity score and the treatment variable is not significant, so we do not It is not included in the regression of fitting technological performance. In order to better fit and compare the technological innovation performance of enterprises, we also carried out a third-order approximation estimation. Similarly, the cross term of the generalized propensity score and the processing variable is not significant Figure 1 depicts the dose-response function. From the shape of the dose-response function, whether it is a second-order approximation estimation or a third-order approximation estimation, the dose-response function is roughly in the shape of an inverted U. This shows that with the gradual increase in the intensity of enterprise cooperative research and development, the enterprise's technological innovation performance first improves and then decreases. According to the second-order approximation estimation, the peak of the dose response function appears between [0.3,0.35].

Finally, we estimated the processing effect on the level of cooperative R&D intensity between different enterprises, and the estimated results are shown in Table 5.

Table 5. Generalized propensity score matching treatment effect estimation results.

Significance level	Processing effect a	Processing effect b	Significance level	Processing effect a	Processing effect b
0	1.293*** (0.241)	1.557*** (0.535)	0.50	-0.283 (0.542)	-0.565 (1.006)
0.05	1.023*** (0.167)	1.182*** (0.222)	0.55	-0.452 (0.630)	-0.628 (1.346)
0.10	0.854*** (0.111)	0.849*** (0.135)	0.60	-0.622 (0.729)	-0.669 (1.887)
0.15	0.684*** (0.183)	0.526* (0.244)	0.65	-0.802 (0.808)	-0.660 (1.523)
0.20	0.514*** (0.196)	0.245 (0.346)	0.70	-1.062 (1.088)	-0.639 (2.258)
0.25	0.344* (0.143)	0.105 (0.404)	0.75	-1.131 (1.077)	-0.567 (3.063)
0.30	0.174 (0.211)	-0.101 (0.402)	0.80	-1.301 (1.078)	-0.573 (4.964)
0.35	0.105 (0.288)	-0.299 (0.373)	0.85	-1.471 (1.167)	-0.359 (5.951)
0.40	-0.043 (0.370)	-0.346 (0.412)	0.90	-1.641 (1.260)	-0.204 (6.024)

0.45	-0.113 (0.455)	-0.471 (0.587)	0.95	-1.812 (1.350)	-0.007 (7.182)

Note: *a* is the second-order approximation estimation result; *b* is the third-order approximation estimation result;

parentheses are self-sampling robust standard error, calculated using 100 bootstrap method.

*, **, * * * indicate a significant degree of 10%, 5% and 1%, respectively.

It can be seen from Table 5 that the treatment effect estimated by the second-order approximation gradually decreases with the increase in the level of cooperative R&D between enterprises, which is manifested as a change from the positive treatment effect to the negative treatment effect. The treatment effect estimated by the third-order approximation is presented The trend of first decline and then rebound, but its recovery has not yet reached a positive value. The second-order approximation estimation results show that the intensity of standardized inter-firm cooperative R&D is at the level of 0 to 0.25, and increasing cooperative R&D investment will significantly improve enterprise technology Innovative performance, and the cooperative R&D intensity between standardized enterprises reaches 0.3, that is, when the cooperative R&D intensity between real enterprises reaches about 0.15, the processing effect of the cooperative R&D intensity between enterprises is no longer significant. The third-order approximation estimation results show that the standardized The R&D intensity of inter-enterprise cooperation significantly improves the technological innovation performance of enterprises at the level of 0 to 0.15, and the standardized inter-enterprise cooperative R&D intensity reaches 0.2, that is, when the actual inter-enterprise cooperative R&D intensity reaches about 0.1, The processing effect of cooperative R&D intensity is also no longer significant.

Even though there are some differences between the second-order approximation estimation and the third-order approximation estimation in the treatment effects

of inter-firm cooperative R&D intensity, in general, the two are basically the same. Under the situation that the inter-firm cooperative R&D intensity is at a relatively low level, the increase in cooperative R&D investment between enterprises has significantly improved the technological innovation performance of enterprises, and when the intensity of cooperative R&D between enterprises is at a relatively high level, the increase in cooperative R&D investment between enterprises cannot significantly change the technological innovation performance of enterprises. This shows that in When the intensity of cooperative R&D between enterprises is relatively high, companies continue to increase their investment in cooperative R&D with other companies and cannot improve their technological innovation performance. Excessive cooperative R&D investment means that internal R&D is low or even complete Relying on external R&D, this can lead to insufficient internal knowledge accumulation in the enterprise. Excessive R&D investment will also have an "eroding effect" on the accumulation of human capital in the enterprise. Insufficient knowledge accumulation and human capital accumulation in the enterprise both reduce the absorptive capacity of the enterprise Even if companies continue to increase investment in cooperative R&D between companies, they cannot improve their technological innovation performance. In addition, Teece pointed out that the profitability of innovation depends on some complementary capabilities of the company, especially in the marketing and logistics links, which lack these Supplementary capabilities, innovative ideas cannot achieve commercial profitability (Teece, 1986). Most of the sample companies are small and medium-sized enterprises, and their own financial strength and financing capabilities are relatively poor, and excessively high cooperative R&D investment has squeezed the company's use of new products. The funds for other supplementary business activities such as market commercialization have offset the benefits of cooperative research and development between enterprises, thus failing to effectively improve the technological innovation performance of enterprises.

Conclusion

Based on the 2019 survey data of Kazakhstani companies by the World Bank, this paper uses the propensity score matching method and the generalized propensity score matching method to examine the impact of inter-firm cooperative R&D decisions and the intensity of inter-firm cooperative R&D on the technological innovation performance of enterprises. The technological innovation performance of companies that cooperate in research and development is higher than that of companies that do not carry out cooperative research and development between enterprises. This shows that Kazakhstani companies may achieve resource complementarity through cooperative research and development between enterprises, absorb external knowledge spillovers, and share costs and risks. Thus improving the company technological innovation performance, and only when the intensity of cooperative R&D between enterprises is at a relatively low level, increasing the investment in cooperative R&D between enterprises can significantly improve the technological innovation performance of enterprises. That shows appropriate cooperative R&D investment can effectively play the role of cooperative R&D between enterprises. The positive role of the enterprise's technological innovation performance, while excessively high cooperative R&D investment may hinder the accumulation of internal knowledge and human capital of the enterprise, and may also squeeze the capital investment of supplementary business activities such as the commercialization of new products of the enterprise, and cannot effectively improve the enterprise technological innovation performance.

There are three main enlightenments from this article. Firstly, companies should actively seek external R&D partners to carry out inter-company R&D cooperation. At present, the market competition of Kazakhstani companies is becoming increasingly fierce and the risks and importance of technological innovation are becoming more prominent, but at the same time, most companies are trapped in financing. Difficulties and the lack of innovative talents make it impossible to carry out R&D activities on their own. Through collaborative R&D between companies, companies can use external resources, absorb external knowledge, and integrate

internal and external R&D activities to improve corporate technological innovation performance and achieve corporate innovation Secondly, enterprises should reasonably plan the investment in cooperative R&D between enterprises. The results of this article show that the intensity of cooperative R&D between enterprises is not as high as possible. Simply increasing the intensity of cooperative R&D between enterprises cannot effectively improve the technological innovation performance of enterprises. In the case of insufficient internal investment and lack of independent absorptive capacity, increasing investment in cooperative R&D between enterprises will cause the internal R&D investment of enterprises to be squeezed and over-reliance on external technology and knowledge, and enterprises cannot effectively internalize external knowledge spillovers. Enterprises should combine their own operations and external needs, under the principle of overall coordination, rationally plan inter-enterprise cooperative R&D investment and integrate internal and external R&D activities. Finally, this article finds that only at a relatively low level of cooperative R&D intensity, companies can enhance inter-enterprise cooperation R&D intensity can significantly improve technological innovation performance. This does not mean that it is undesirable to deepen cooperative research and development between enterprises by increasing the intensity of cooperative research and development. The transaction costs and risks brought by cooperative research and development are the reasons for enterprises to further deepen cooperative research and development between enterprises. Enterprises can reduce the transaction costs and risks brought by cooperative R&D between enterprises by strengthening the construction of cooperative governance mechanisms, and provide an institutional foundation for deepening cooperative R&D between enterprises. Insufficient human capital and knowledge accumulation and insufficient product commercialization capabilities also hinder enterprises deepen cooperative research and development between enterprises. Under the condition of ensuring normal operations, carrying out internal research and development, focusing on the accumulation of internal knowledge and human capital, and strengthening product commercialization capabilities will also help enterprises benefit from deepening collaborative research and development between enterprises.

Enterprise cooperation R&D includes inter-enterprise cooperation R&D and "industry-university-research" cooperation R&D. This paper empirically analyzes the influence of inter-enterprise cooperation R&D on the performance of enterprise technology innovation. Technological innovation requires not only strengthening cooperation between enterprises, but also intellectual support from universities and research institutions, especially in the field of basic research. Cooperative R&D is a multi-subject system engineering. The characteristics of cooperative R&D participants and the external environment may affect the performance of cooperative R&D activities and technological innovation of enterprises. The main characteristics of cooperative R&D participation and external environmental factors are included in the empirical analysis framework. In addition, there is still less empirical research on the cooperative R&D model and the influencing factors of cooperative R&D in Kazakhstan, which needs to be supplemented by more research. These issues may become the focus of further research in the future.

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A Scientific Expedition: Koyandy Fair and its Impact on the Development of Kazakh Traditional Culture

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Abstract

The purpose of the article is to study the legacy of the Koyandy fair and its impact on the development of traditional Kazakh culture. The research is based on the scientific expedition results collected by the authors of this work during the field trip to Karkaralinsk (Karaganda region, Kazakhstan). The work studies the history of one of the largest fairs in Kazakhstan - the Koyandy fair, which was functioned from the second half of the XIX- the up to the beginning of the XX century territory Kazakhstan. The Koyandy fair had a significant impact on the spread of the popularity among the broad masses of the works of Kazakh artists. The renowned Kazakh folk composers such as Ukili Ybray, Birzhan sal, Akhan-Sere, Estay, Tattimbet Kazangapuly, performers Amre Kashaubaev, Maira Ualikizi, Isa Bayzakov, wrestlers Kazhymukan Munaitpasov and Balauan Sholak performed at the fair. It is essential to mention that the fair was a trading place and a site for a regional art festival's conduction. The Koyandy fair was a place for exchanging and interacting with different types, genres, and traditions of diverse performing arts schools.

Keywords: Koyandy fair, theatrical performances, trade, traditional Kazakh culture, intercultural communication.

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Introduction

Following the traces of the famous and most extensive in Kazakhstan - Botov - Koyandy fair, researchers, members of faculties: «Scenography and Decorative Arts», «Painting and Sculpture», «Art Criticism», «Film and TV directing», «Traditional Singing», «Dombyra» of the Kazakh National University of Arts in the last days of summer 2020 went on a scientific expedition to Karkalinsk. Relied on the basic scientific research and publications of the project author - Mukhtarova Gaini, dedicated to the study of the cultural heritage of the Koyandy fair, the scientific expedition's mission along the route «Nur-Sultan - Karkaralinsk - Akzhol - Koyandy - Nur-Sultan» was a search of original primary sources related to the history of the fair (Mukhtarova, 2019; Mukhtarova, 2020)

Figure 1. Members of the scientific expedition: lecturers of the Kazakh National University of Arts with residents with Koyandy, descendants of the Botov, and employees of the Karkaralinsk Museum of History and Local Lore. Koyandy village Karkaralinsk region Karagandy area of Kazakhstan. 28 August 2020.

Literature Review

On the territory of Kazakhstan, the largest fairs were: Koyandy - Botov fair (Karkaraly district), Konstantinovsko-Yelenovskaya (Akmola district), Petrovskaya (Atbasar district), Tainshykulskaya (Petropavlovsky district), Charskaya (Semipalatinsk district), Karkara (Vernenskii district), Zharkent (Zharkent sity), Aulie-Ata (Syrdarya region), Uil and Temir (Ural region).

Figure 2. View onto Karkaralinsk. Karkaralinsk Museum of History and Local Lore

One of the largest fairs mentioned above on the territory of Central Kazakhstan, and in general, throughout the entire Kazakh steppe, was the Koyandy fair, located 50 kilometers from the Karkaralinsk town, which was founded 172 years ago. The fair's appearance is associated with a merchant's name from the Ural city of Yalutorovsk - Varnava Botov. «Varnava was born in a wealthy family of metallurgists, the Botovs, who served with the famous Demidovs. Varnava's father was initially a metallurgist. Having accumulated considerable capital, he became a merchant. In 1814 Serafim Botov set off with freight wagons deep into the Kazakh steppe. And as soon as he reached the Karkaralinsk tract, his goods quickly sold out in exchange for well-fed rams and horses. Then meat from the Kazakh steppe was well bought at the Ural factories and Moscow. Dying, Seraphim told Varnavas to go to trade in the Karkaraly district. In 1848, Varnava set off on the return journey with

ten carts of freight wagons from the Chinese city of Urumqi. The Ural merchants' trade route to China ran according to the following scheme: Tobolsk - Petropavlovsk - Kokshetau - Akmolinsk - Karkaralinsk - Ayaguz - Chuguchak - Kuldja - Urumqi.

On May 15, 1848, Varnava Botov, with freight wagons 50 kilometers, makes a halt near the village of Karkaralinsk, located on the left bank of a small river called Taldy, which flows into the Salt Lake Karasor. This river's broad valley is bordered by low, gentle mountains (absolute height 569 m.) Koyandy. The literal translation of the oronim «Koyandy» is a place teeming with hares, «writes a member of the Union of Journalists of the USSR Serik Dzhaksybayev in his article « Lessons from the Koyandy Fair» (Dzhaksybaev, 2017).

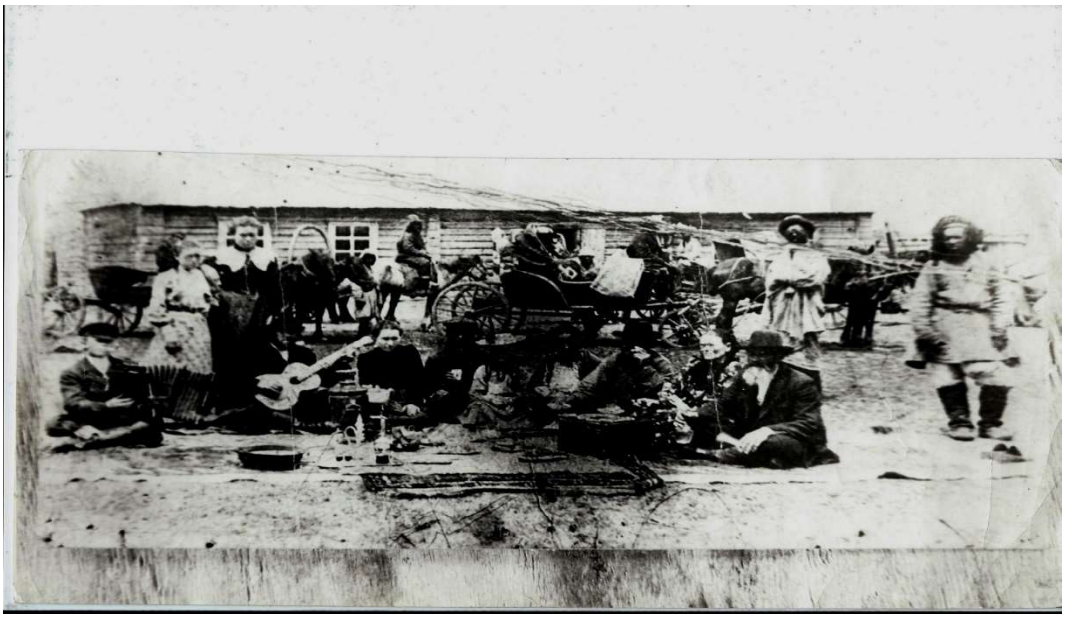
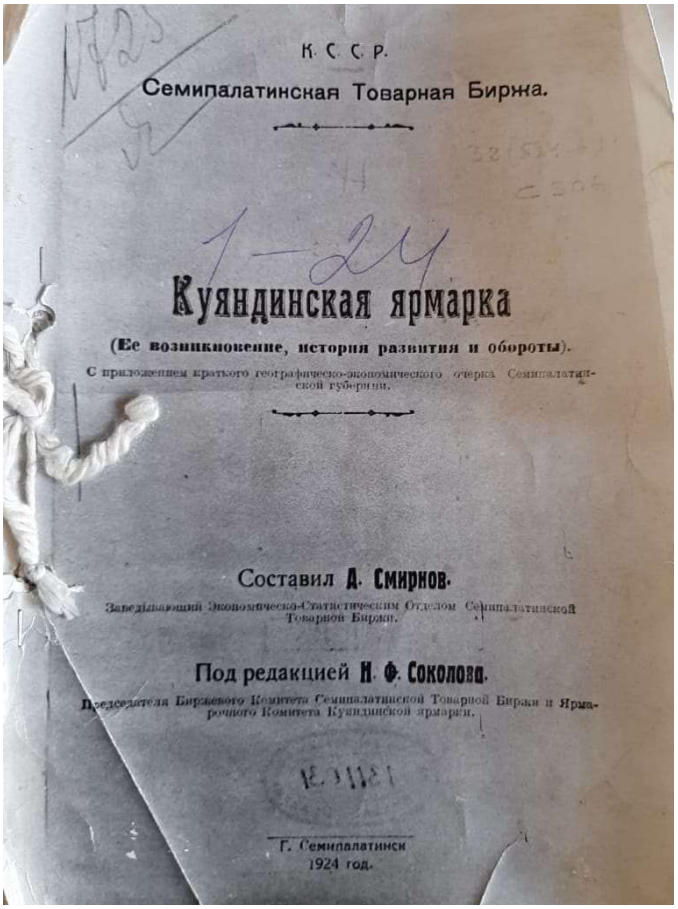


Figure 3. The Botov family in the days of the Botov-Koyandy fair. Karkaralinsk Museum of History and Local Lore



К. С. С. Р.

Семипалатинская Товарная Биржа.

Куяндинская ярмарка

(Ее возникновение, история развития и обороты).

С приложением краткого географическо-экономического очерка Семипалатинской губернии.

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Г. Семипалатинск
1924 год.

Figure 4. Document of stock market of Koyandy fair. Karkaralinsk Museum of History and Local Lore

Figure 5. General view of the Koyandy Fair. The Museum of Peter the Great (the Kunstkamera). St. Petersburg. Photographer S. M. Dudin. 1899. (https://forum-eurasica.ru/)

The members of the scientific expedition carried out a field trip to the Karkaralinsk town. Historical information about the Koyandy fair is partially preserved in the Karkaraly Local History Museum, opened in 1974. The article used photo materials taken from the exposition of the Karkaraly Local History Museum; Also, researchers took photos in the village of Koyandy at the historical site of the fair during a scientific expedition in August 2020.

Methodology

The authors applied qualitative methods of research, namely ethnographic research and interviewing. The authors applied ethnography and interviewing methods. The data collection techniques include archive visual (video and photo collection from the site), accompanied by interviews and secondary scientific materials.All collected interviews were recorded on video and were collected and presented in a documentary movie: "Botov - Koyandy Fair" (Mukhtarova & Dadyrova, 2020) . Interviews were taken from different respondents, namely local ethnographers: a resident of the local village Koyandy, a retired history teacher Mr. Serik Nabianov; an ethnographer, researcher, and an honorary citizen of the Karkaralinsk region Mr. Yurii Popov. Besides, professors of the Kazakh National University of Arts: a Professor of the «Dombyra» department, Honored Artist of the Republic of Kazakhstan – Mr. Zhangali Zhuzbay and a researcher of Kazakh traditional music, Professor of the «Traditional singing» Department, People's Artist of the Republic of Kazakhstan, a famous singer Mr. Kairat Baybossyn. Also, were interviewed employees of the Karkaralink Museum of History and Local Lore, represented by the Director of the museum Mrs. Nazym Abisheva, the museum's researcher – Mr. Slambekov Satbek, and the Head of the museum branch Akzhol - Kasym Askhat. Also, descendants of the merchant Botov have interviewed, e.g., the candidate of philological sciences, Mr. Samokhin Andrey, Ms. Kubeeva Nurilla, and Ms. Kamilla Ospanova.

Figure 6. Karkaralinsk Museum of History and Local Lore.

Findings and Discussion

The fair is one of the foundations and one of the earliest types of spectacular performances in humanity's history. Studying the history of the origin of the theater, it is essential to mention that fair performance is considered the cornerstone of the spatiotemporal art form. The fairs' communicative function contributed to the preservation and dissemination of various regional schools' performing arts among the broad masses of the population. Trade fairs were not just the place of trade, but also platforms for communication and creative exchange, intercultural communication, and interaction.

The conclusion is made about the fairs' communicative function contributed to the preservation and dissemination of the traditions of the performing arts among the broad masses. Botov-Koyandy Fair was a point of exponential growth and spread of culture, a place of interchange and synergy of arts, broadcasting musical and poetic performing arts traditions.

The basic scientific research dedicated to studying the cultural heritage of the Koyandy fair, the scientific expedition's mission along the route "Nur-Sultan - Karkaralinsk - Akzhol - Koyandy - Nur-Sultan" was a search of original primary sources related to the history of the fair.

Theoretical or Practical Implications

The authors apply ethnography and interview methods to study the rich heritage of the Koyandy fair and its impact on the development and evolution of Kazakh traditional art and culture.

Returning to the history of fair development, it should be noted that the Koyandy fair was held annually from May 25 to June 25. A significant area in the Taldy river valley was allocated for the fair. The territory was a pasture for livestock brought in for sale.

Figure 7. The historic place where the Koyandy Fair took place in the village of Koyandy.

This is how the Koyandy fair is described in the written cources published in Saint Petersburg in 1903: «Every year at the specified time, the Taldy Valley, deserted and

silent before, is announced by the noise of a thousand-voiced crowd, which was literally "a mixture of clothes and faces, tribes, dialects, states» is teeming with vast herds of horses, camels, rams. Despite the exhausting heat and stuffiness of the June day, all around the noise, din, incessant movement. In the two central rows, forming a long, wide street, there are manufactory, tea houses, etc. shops, hardware stores, temporary transport offices, etc. There is also a small chapel where services are performed on holidays. In the rows adjacent to them are residents of Tashkent with their goods (coarse calico, silk fabrics, carpets, dried fruits, etc.), a warehouse of «Singer» sewing machines, which have recently become widespread in the steppe, a Mohammedan prayer house, places where kumis was sold, bread traders, trading baths» (Novikov, 1903).

Since 1885, a post office has functioned at the fair, and since 1889 the telegraph has been operating. In 1928, the first cinema moving machine in this region began to work at the fair. Since 1894, the Russian State Bank had opened a branch here every year. Due to the millionth turnover, the Koyandy-Botov fair ranked in the first category among fairs.

«In 1869, the Koyandy trading place was given the 2nd category among fairs, following the proposal of the head of the Karkaralinsky district, the captain Tikhonov and by order of the military governor of the Semipalatinsk province, Mr. Poltoratsky. And in the same year, on September 2, a fair in the Koyandy tract, Governor-General of Western Siberia A.P. Khrushchev, by his order in honor of its founder, named it «Botovskaya Yarmarka» and approved the time of its holding annually from May 15 to June 15. However, Kazakh historiography calls the fair in two ways: «Botov-Koyandy Fair» and «Koyandinskaya/Koyandy fair».

In 1871, by order of the Governor-General Khrushchev, 55 square kilometers of land was allocated near the Koyandy Fair for the pasture of cattle, sold and unsold (Dzhaksybaev, 2017). The main product of the fair was livestock, mainly sheep. «The number of commercial premises, located during the fair, were placed in four long rows. In 1871 these premises reached the number of 200, and in 1890 up to 270, and even 700 yurts were installed. The turnover of the fair reached 2-3 million

rubles. In 1899, according to official data, various goods worth 1,731,700 rubles were sold at the fair» (Temirgalieva, 2003).

Figure 8. Portrait of Birzhan seri. An artist- painter: Mukhtar Baybosyn

In the area of Taldy-Koyandy, one of the fair's historical architectural buildings, made of red brick, still stands. The structure is relatively well preserved and can become a popular excursion route.

Figure 9. Ruins of the shopping arcade in Koyandy

The fair as the birthplace of a regional performing arts festival.

The Koyandy Fair was not only one of the largest markets in Central Kazakhstan, but also a major arts festival. Since 1922, cultural events have also been held at the fair.

Famous folk composers such as Birzhan sal, Ukili Ybray, Estay, Tattimbet Kazangapuly, and such performers as Amre Kashaubaev, Maira Ualikyzy, Isa Bayzakov, Zhusupbek Elebekov, Kali Bayzhanov, director, playwright Ms. Baizhanov, Kazangapuly. The Koyandinsky fair was attended by the great Kazakh poet, philosopher, and educator Abai Kunanbayev (Novikov, 2003)

There is a song about Koyandy fair which was composed based on the motive of Birzhan's song. This song was performed at a Birzhan party in the Opera «Birzhan and Sara» by Kazakh famous composer Mukan Tolebayev

One of the authors of the article is the artist – painter Mukhtar Baibossyn from 2014 during 4 years have painted a series of famous Kazakh musician and composer portraits. All of them were performed at the Koyandy fair.

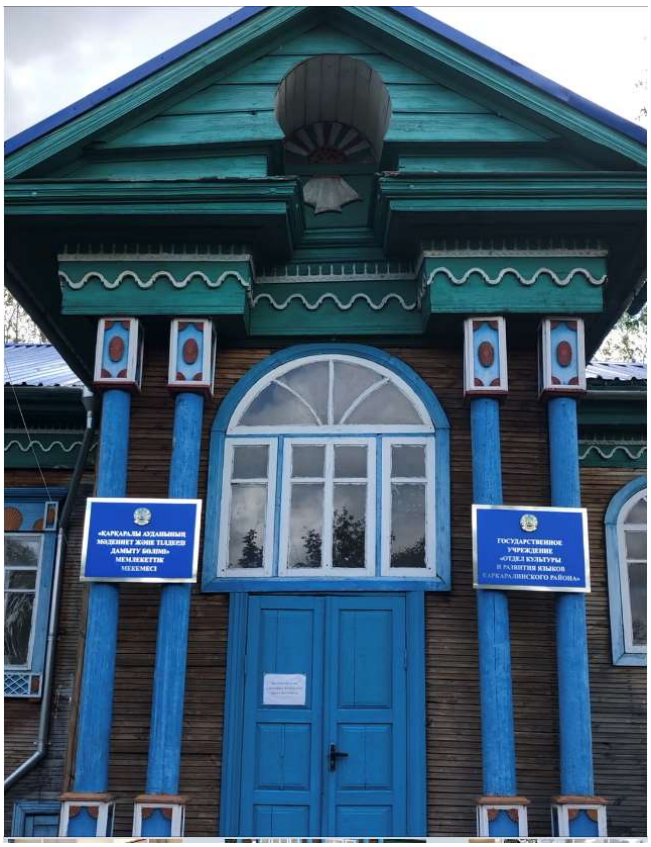

Figure 10. The house where Abai Kunanbayev stayed while visiting the Koyandy fair.

Figure 11. The safe for storing funds was used during the Koyandy fair. Karkaralinsk Museum of History and Local Lore.

The Koyandy fair was accompanied by spectacular performances, poetic competitions (aitys), performances of baluans (wrestlers), conjurers, and also horse races (baige). «And here, at the fair, in a public atmosphere, a fight took place between the famous wrestler Hadji Mukan and the Chinese wrestler, the champion of India, Korea, Japan and Singapore, Mao Deng Fu. The Chinese wrestler had a long-standing desire to try his hand at a fight with Hadji Mukan. Therefore, he specially followed in his footsteps came to the sensational fair. The tournament took place in the open air, on a carpet laid on a grassy lawn». (Dzhaksybaev, 2017).

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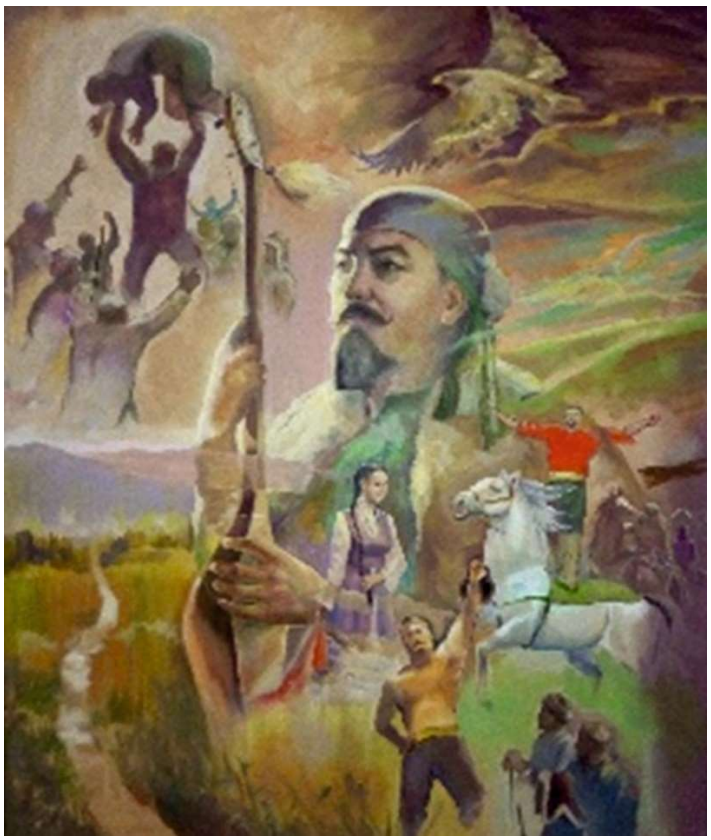

Figure 12. Baluan Sholak painted by Mukhtar Baibossyn

Figure 13. Monument to Madi Bapiyly in Karkaralinsk.

The renowned akyn artist-performer Madi Bapiuly has repeatedly performed at the cultural site of the Koyandy fair, Madi is a native of the city of Karkaralinsk.

Fair performances are valuable not only for their massiveness but also for the empathic response of the audience. «Singer Maira Ualikizi performed at the Koyandy fair. The people say that once at the Koyandy fair, Mayra met with the composer Ukili Ybyray. Two talents competed in the art for several days.

Figure 14. Maira Yulikizi painted by Mukhtar Baibossyn

The famous akyn Madi Bapiuly performed at Koyandy fair several times, Madi is a native of the city of Karkaralinsk

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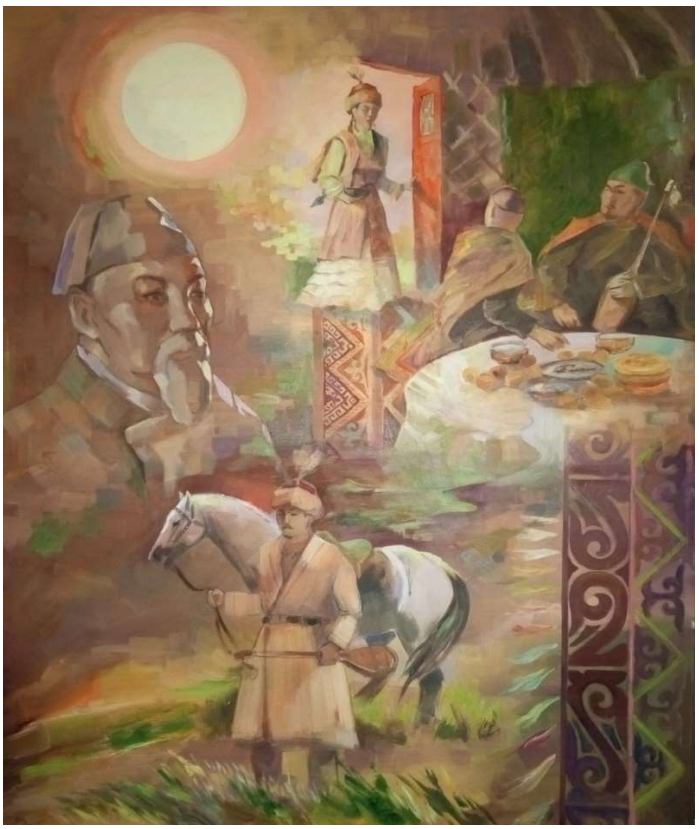

Figure 15. Ukili Ybrai painted by Mukhtar Baibossyn.

In June 1925, the traditional baiga of horse riders took place at the fair, who stubbornly fought for two honorary prizes: at the name of Maxim Gorky and Demyan Bedny. According to the official report, the baiga attracted ten thousand spectators. About this spectacle, Nikolai Anov wrote an essay «At the Koyandinsky Fair» which was published in No. 8 of the Moscow magazine "Workers 'and Peasants' Correspondent" in 1925». (Dzhaksybaev, 2017).

The famous Russian writer Nikolai Ivanovich Anov (1891-1980) published the «Yarmarochnyi Vestnik» of the Koyandy fair. Its circulation was only 100 copies, which quickly was sold out. To acquaint the news to the ten-thousandth of Kazakh workers N.I. Anov proposed to spread the newsletter also orally.

The «red yurt» workers translated each issue into the Kazakh language, and the poet-improviser Isa Bayzakov brought the news to the audience in verse. In 1956

Nikolai Anov wrote the novel «Wings of a Song» - about the history of creating the first Kazakh theater and about Kazakh folk singers, which was filmed in 1966.

The renovated People's house actively functioned at the Koyandy fair, where performances were staged in the Kazakh language. A library with a reading room worked at the people's house. The famous actor, one of the founders of the Kazakh professional theatrical art, Kalibek Kuanyshbaev, performed at many evenings of the fair, parodying the voices of either a grandmother or an older man or a child; due to these spectacular performances became famous among the people.

The perspective of the project

Interns of practical application of the project the offers would like to suggest to local authorities, a plan for development of the regional tourist cluster to develop the tourist route with a visit: 1.historical sight of the Karkaraly Local History Museum**;** 2. a visit of Karkaraly natural resorts; 3. A visit to Koyandy village where will be organized ethnovillage with national cuisine and cultural program with art performance and national tournaments and folk art festival. Based on the results of this research the offers are intended to present a new project the revival of Koyandy fair. This project will coverage three spheres: history, culture, tourism.

Conclusion

As the intervier pforesser zhangali said On the Koyandy Fair subject, three essential factors of the fair's significance must be raised.Firstly, the fair became the source of Kazakh theatrical art's birth, performing arts of kuyis, dance, even magicians.People's talents from different sides gathered at the Koyandy fair to demonstrate their art.

At the large fair, the art fair, which lasted for more than a month, there were aitys competitions held. For example, aitys Shozhe and Orynbay, aitys of Kemperbai The famous singer-composer Mayra Ualikizi, became famous at this fair.

Simultaneously, another factor that needs to be addressed is the emergence of trade on the Kazakh land of trade of the capitalist model. In the beginning, trade, speaking in modern terms, was a barter, natural exchange, later it moved to the level of turnover of state funds. Here the shops were opened, the first Kazakh merchants appeared.

The leading trade was between Kazakhstan and Russia, but there was trade with China, Uzbekistan, Kyrgyzstan, and Mongolia, too. This demonstrates the expansive geography of the fair's foreign trade coverage.

Another essential third factor of the fair must be mentioned that the Koyandy fair was a meeting place for the Alash elite, who thought about the people's aspirations.

This is evidenced by the famous Karkaraly petition, when Alikhan Bukeikhanov, having collected 140,000 signatures, appealed to the governor. This was the first unique appeal, expressing public discontent with the regime. Thanks to the meeting and discussions with representatives of the Kazakh intelligentsia at the Koyandinsky fair, the first magazines' initial concepts and projects of «Aikap» and «Kazakh» were discussed. The fair contributed to the publication of Abai's works and the works of his adherents. Also, the epics «Kyz-Zhibek», «Alpamys», «Kobylandy batyr» and others.

Summing up, the Koyandy fair remains in history a critical stage and period that further the development of Kazakh traditional art (from the interview taken by the authors at all from Zhangali Zhuzbai).

Due to the Botov - Koyandy fair, people of various types of creativity, arts, trades and crafts, merchants, traders, singers, wrestlers, artisans in various activities received widespread recognition.

The fairs' communicative function contributed to the preservation and dissemination of the performing arts' traditions among the broad masses. Botov-Koyandy Fair was a point of exponential growth and spread of culture, a place of

interchange and synergy of arts, broadcasting musical and poetic performing arts traditions.

The fair was closed in 1930. The Koyandy Fair played a significant role in the spread and the transition of performing arts traditions and the interaction of different types

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