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The possibility of application of weather derivatives by agricultural market in Kazakhstan on the expert opinion

In this paper weather derivatives as a possible tool for hedging weather risks are studied. Due to the sharply continental climate of Kazakhstan, the weather has a significant impact on business income, related to weather conditions. This article is focusing on the wheat market, since its export has a large potential for econmic development and diversification of the economy of Kazakhstan. The aim of this article is identification of the necessity of application of the weather derivatives tool among agricultural wheat producers based on expert opinion. In connection with the novelty of the instrument in Kazakhstan at the beginning of the work the concept and mechanism of weather derivatives is explained. Further the relevance of weather risks for Kazakhstani farmers is proved, as well as the specifics of weather conditions for growing quality wheat is revealed. At the moment, Kazakhstani farmers are struggling with weather risks using crop insurance. In spite of the fact that crop insurance does not satisfy local farmers, they are obliged to use this tool on the basis of the Law «On compulsory crop insurance». In this regard, the article provides a comparative analysis of weather derivatives and crop insurance. According to the analysis and farmers' opinion, weather derivatives are a more ellective tool for hedging of weather risks and have several advantages over insurance. In conclusion, the research methodology and results of interviews on the theme of weather derivatives and general market condition. Based on the work, an obvious interest on the tool of weather derivatives and the need for their implementation in the market of Kazakhstan is revealed.

Keywords: weather derivatives, weather risk, agriculture, wheat production, Kazakhstan, crop insurance.

We all grumble about the weather,
but, nothing is done about it.
Mark Twain

The financial instrument of weather derivatives first offered in September 1997 between Enron and Koch [1], US energy companies. The aim of these securities was to hedge risks of weather dependent industries mostly energy sector firms. However in our days, weather derivatives help to ensure many other industries from losses due to weather fluctuations. For example, ski resorts can make up for money they lose when there is no snow, ice-cream producers can make up decrease in revenues, construction company can compensate delay fines. Using such kind of securities can help companies, highly dependent on the weather, to stabilize their cash flows.

The weather derivatives market has huge growth potential. The volume of transactions for such contracts in Europe and the United States are growing from year to year. The annual turnover of this market exceeded $15 billion in 2009 [2].

Relatively, young country Kazakhstan has to identify what opportunities this instrument creates for it. This paper aims to identify if weather derivative is an appropriate tool to manage weather risks for Kazakhstani wheat producers based on the opinion of industry experts.

Weather risks are not controllable and despite of the significant development of new technologies are still complicated to predict. According to Chicago Mercantile Exchange, more than 30 % of USA economy depends on weather [3]. Such economy sensitivity to weather cannot be ignored. Application of derivatives allows weather dependent companies to stabilize their cash flows with small costs. This, in turn, could reduce cost of capital by reducing interest rates company borrow money, increase value of shares for publicly traded companies and reduce risk of bankruptcy [4].

The principle of exotic, from first site, weather derivatives is easy to illustrate. In a typical temperature transaction, if weather is too warm — i.e. the average temperature measured over a defined period exceeds a pre-agreed threshold — the buyer is entitled to receive a payment from the seller based on the extent to which the average temperature exceeded the threshold. The amount of payment is determined in advance in accordance with the buyer's sensitivity to adverse changes in temperature. Although air temperature is most widely used basis for weather derivatives, it is not the only: level of atmospheric pressure, wind velocity, humidity and some weather indexes also can be used [5].

Many researchers focus on weather derivatives issues. Observing the weather effects on crop yields, it is suggested that weather derivatives might be used as a form of agricultural insurance [6].

This article focuses on hedging weather risk by agricultural producers. This limitation is introduced due to the high economic potential for Kazakhstan and continues newspaper headings about harvest losses. From the Message from the President of Kazakhstan to the people of Kazakhstan: «The agricultural sector of Kazakhstan has a great exports possibilities and high potential for investments. The global demand on food will grow every year. This is the opportunity, we cannot miss». The long-term Kazakhstan strategy aims to diversify economy and shift from oil and other minerals exports as a key economic driver, wheat market is excellent alternative due to the favourable climate and large land reserves with small population density [7].

Agriculture in Kazakhstan still took a leading place on a Kazakhstan's economy. Its contribution to the GDP is under 10 % — it was recorded as 6.7 %, and as occupying only 20 % of labor. About 70 % of Kazakhstan land is covered by crops and animal husbandry.

Wheat is an important staple crop, providing 20 % of all calories consumed by people worldwide [8]. Additionally, it contributes to animal feed. Recently estimates suggest that 6.5 percent of all people ever born are alive right now [9]. This is the most conspicuous fact about world population growth: for thousands of years, population grew only slowly, but in recent centuries it has jumped dramatically. Between 1900 and 2000 the increase in world population was three times greater than the entire previous history of humanity — an increase from 1.5 to 6.1 billion in just 100 years. With the world's population of 9.6 billion by 2050, estimated by UN, demand for wheat is expected to increase substantially [10]. Farmers around the world will need to increase wheat production using constrained resources, like fertilisers, pesticides and water, as the combined factors of climate change and rising energy costs compound the pressures on agriculture. Considering organic nature of Kazakhstani production, the sector has the comparative advantage of global safety standards for environment protection and food production. Based on 2015 data, Kazakhstan is the 8th largest wheat exporter in the world with $1.2 billion of wheat exports. However, Kazakhstani export takes only 3.2 % out of overall world wheat supply [11]. Small market share, high quality product and positive net exports of wheat, creates an opportunity for Kazakhstan to capture neibour markets like Iran and China, with negative wheat net exports of $2 billion and $962 million respectively.

Although there is a rising demand for wheat in the world, Kazakhstan has a number of problems in supply side. One of the major obstacles to agriculture development is the weather risks. High quality wheat needs 13 % humidity [12]. If humidity is above the average, it requires additional drying of grain, the results of which are increased cost of production and damaged product quality. At the same time, dry winds and air temperature extremes of 35–40 °C also adversely affect plants and lower yields and grain quality. 72 % of wheat in Kazakhstan is grown in Kostanay, Akmola and North Kazakhstan provinces [13]. There is also high potential of Aktobe province in wheat production due to the Iranian demand and availability of land for cultivation [14]. Generally, climate in these regions is suitable for high quality wheat production [15]. Nevertheless, one leafing through newspapers will find a number of announcements about wheat harvest losses due to the weather conditions every year. This happens mostly because of adverse weather condition extremes and climate instability, which are caused by sharply continental climate in Kazakhstan. Further, there are some cases of harvest loss happened in Kazakhstan in recent years [16–18]. All of them deliver the same idea:

– weather affects not just harvest, but also storing and transportation;

– farmers are not able to prove harvest loss due to falsified statistics and as a result doesn't get the insurance payment;

– obligatory insurance system does not work.

Certain weather conditions, like excess precipitation and relative humidity, leads to the leaf rust development and other diseases [19]. Besides whether derivatives, there is a number of other instruments to hedge weather risks. The main are wheat futures and crop insurance. Wheat futures provide opportunity to sell product in some future date at agreed price and, therefore, help to avoid price volatility risk. But it does not hedge the quantitative risks, harvest lost or decrease in quality, considered in this article. Another alternative — crop insurance, is widely used in Kazakhstan. National compulsory crop insurance was introduced in 2005. Currently, all farmers are obligated by government to insure their harvest.

Initially, the insurance system that existed in Kazakhstan until the 1990s was based on state insurance. That dramatic contrast lead to the transition to a market economy which was marked by the formation of commercial insurance (reinsurance) organizations in the country. The main audience aimed at providing services for the compensation of property losses only to large and solvent agricultural producers. This situation

occured to the rapid decline in the volume of all types of agricultural insurance, which was also caused by high-interest contributions (2–8 % of the cost of production), which the vast majority of agricultural enterprises could not pay. The insecurity and non-guaranteed nature of the property interests of agricultural producers, both on the part of the state and on the part of commercial organizations, affected the sharp deterioration in the financial condition of the farms, which are either still trying to normalize their situation or are no longer engaged in agricultural activities.

Despite the fact that in the country mechanisms were established for the final formation of the insurance system for agricultural production (the creation of the state agricultural insurance company Kazagropolis (1996), compulsory insurance of agricultural production (1997), the adoption of the Law of the Republic of Kazakhstan «On compulsory insurance in crop production» (2004), the adoption of the Law of the Republic of Kazakhstan «On mutual insurance» (2006) according to the data of the Committee on Statistics of the Republic of Kazakhstan, the country has a low level of active STI insurance activity on compulsory insurance of the agricultural sector.

According to the sufficiently justified risk of crop insurance, insurance (reinsurance) organizations are not interested in recovering the bulk of share of their savings for agricultural losses that have a high likelihood feature. In 2009 about 30 thousand insurance contracts were concluded, in 2010 there was a sharp decrease and figured up to 17,389 contracts, and as of early 2014, only 14,525 contracts were concluded.

Initially, law on compulsory crop insurance is aimed to protect farmers' income losses from adverse weather. Additionally, it helps to ease access to financing by guaranteeing cash inflow. However, this system does not work properly according to farmers' opinion. Another side of the coin is insurance companies. Although crop insurance is compulsory, according to the Statistics Committee of the Republic of Kazakhstan, there is a decreasing trend in the agriculture sector insurance activity level. This conclusion is based on 2 indicators. The first one is a halved number of contracts concluded between insurance organizations and agricultural producers from 2007 to 2014. The second one is a decreased number of insurance companies, licensed for compulsory insurance of agricultural production from 8 existed companies in 2011 to only 2 companies in 2013. This data clearly demonstrates a lack of interest of insurance companies to the given class of insurance and their reluctance to take responsibility for the widely occurring in Kazakhstan risks in agricultural production [20].

A more deep comparative study of crop insurance and weather derivatives identify many differences. The first difference is the weather events covered by each instrument. Insurance contracts are written for rare weather events, such as extreme cold or heat and hurricanes or floods. These events are extremely fond of creating greater catastrophe with a huge impact on the company's earnings. In contrast, the weather derivatives may protect the company by periodic weather conditions with high probability of occurrence. Therefore, insurance covers high-risk and low probability events, weather derivatives, as a rule, protect from low risk and a high degree of probability of events.

Secondly, claiming compensation from the insurance company, as a rule, is time consuming and expensive. The holder of an insurance contract must first prove that the weather had disastrous consequences for his company and it has suffered financial damage due to weather conditions, in order to obtain compensation, while the result depends on the subjective views of each regulator. On the other hand, in the case of weather derivatives, the company makes a profit from the contract immediately. Furthermore, there is no need for disaster to occur at a company to receive the payment. Weather derivatives are financial instruments based on objective criteria, as an indicator of temperature, precipitation, or any other underlying index that accurately measured on a given weather station. The holder of an insurance contract must prove that he has suffered financial damage due to weather conditions, in order to obtain compensation. Weather derivatives' payoffs based on the actual weather outcome, regardless of how it affects the holder of the derivative. It does not take in any weather sensitive production, for example, to buy and benefit from the weather derivative. Like any derivatives, these contracts can be purchased for a simple speculation. Insurance contracts are generally designed to protect the wearer from extreme weather phenomena, such as earthquakes and typhoons, and they do not work well the uncertainty under normal weather conditions.

Another advantage of the weather derivatives is more freedom, they offer the purchaser, unlike insurance contracts. Derivatives also allow hedging the impact of weather conditions on the competitor. For example, the agricultural company in Zone A can protect themselves from the weather in another area in which the company is established competitive. Favourable weather conditions in the area B, to increase the quantity and quality of agricultural products in a specific area B. Thus, the demand and price of a particular product from the region A will decrease.

Finally, as a weather derivative financial instruments, received the weather cannot be later sold to a third party, for speculative reasons, until the day of expiry of the contract.

This research is qualitative. The exploratory case study research designis is chosen, because the purpose of the study is to generally understand the reasons behind some relationships. This method lead by interviews, experiments, limited number of individuals as the subject of study, real-life conditions. The primary data was collected by a number of interviews conducted. Four industry experts with background in agriculture, insurance and risk management were interviewed. All of them have managing positions in agricultural companies and able to threat the industry as a whole. Respondents were selected by non-probability sampling technique, through purposive factor.

A structured interview was selected because it is an effective method of collecting valuable information with greater understanding, allowing having higher response rates. Structured interview includes careful planning of interview objectives and their role in the appointment process, questions are predetermined and linked to job relevant criteria (skills and knowledge), each applicant is asked the same questions, detailed notes should be taken, and also should be provided preparation before interview. There are some benefits of structured interviews: enhanced objectivity and equal opportunity, accuracy and prediction, greater legal defensibility. The interview itself consisted of questions related to respondents' experience, knowledge and abilities in agricultural risk management. The length of interview was 40–45 minutes for each participant. The interview questions are self-designed, protocols and transcribed interview questions and answers could be provided by request.

Based on manual interview coding three main categories were selected according to its relevance and significance. They are:

– agriculture and its problems;

– weather risk;

– potential usage of weather derivatives in Kazakhstan.

Each of the listed categories includes important factors that have great influence on agricultural sector of economy. Thus, that factors labeled by codes, and the total number of codes is 16. These codes combined into the seven subcategories due to similarities, and then form three main categories, discussed previously. The results of coding can be found in Table.

Table

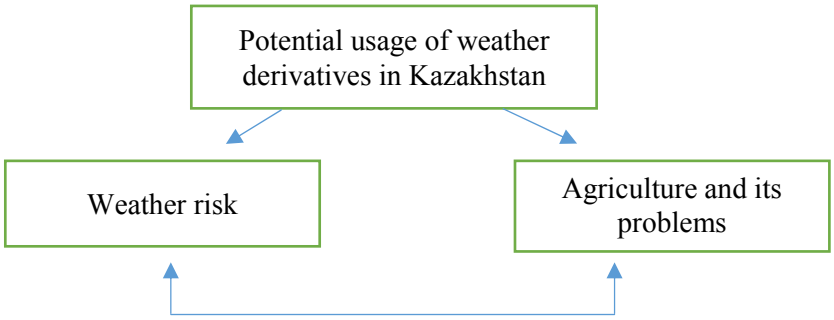
Extracted interview codes

Agriculture and its problems (category)	
1) Essential of agriculture (sub-category) 2) Barriers of agriculture development (sub-category) 3) Weak risk management (sub-category)	1) «strong sector of economy» + «influential sector» 2) «human factors» + «weak technology» + «deficit» + «destination» + «illiteracy of specialists» 3) «potential of spontaneous risk» + «non competitiveness»
Weather risk (category)	
1) Vulnerability of agro sector (sub-category) 2) Risk mitigation tools (sub-category)	1) «impact of weather» + «hazardous areas» 2) «risk hedging tool» + «subsidies» + «amelioration of risk»
Potential usage of weather derivatives in Kazakhstan (category)	
1) Exploring new market (sub-category) 3) Chances of introduction weather derivatives in Kazakhstan (sub-category)	1) «new market» 2) «potential opportunity»

Note. Compiled by author on the basis of interview results.

While collecting necessary data through interview by asking research question: what are the chances for the potential introduction of weather derivatives as a risk mitigation tool in Kazakhstan? Compulsory categories were detected. According to interview results a figure was created, which demonstrates connection among categories. Figure highlights «Potential usage of weather derivatives in Kazakhstan» category as a main one, and indicates continuous connection of this category with «Weather risk» and «Agriculture and its problems» categories.

Agricultural issues stand as a crucial object of this paper. This sector is really sensitive to weather changes, which leads to weather risks and tools to mitigate them. That's why these categories linked with each other.



Note. Compiled by the author on the basis of interview results.

Figure. Connections between main categories

Analyzed data used to answer the primary question of the study: What is the possibility of applying weather derivatives as a risk mitigation tool for agricultural producers in Kazakhstan? So, during the data analyses three categories identified, they are agriculture and its problems, weather risk and potential usage of weather derivatives in Kazakhstan.

According to the respondents' answers, there are several key factors of stagnation in the agricultural sector. Each respondent figured out common factors such as: human factors, weak technology, deficit, destination factors and illiteracy of specialists. All respondents claimed that scarcity of real qualified professionals hindered development of the agricultural sector in our country. As the first respondent said:

«The main ones are: the lack of qualified specialists, the absence of risk management and access to cheap money. These factors lead to the low level of productivity, competitiveness, both on the domestic and foreign markets. Therefore, government takes complex measures, develop new programs and implement new mechanisms».

Also one of the respondents noted that the development of agricultural sector does not subject any progress due to the old-fashioned system.

«Kazakhstan and USSR former countries have similar problems. Firstly, the first place it is an old fashioned system. Only in the cattle breeding for 500 cattle heads 10–15 cattlemen are intended and it is only in the meat direction, and this is one of the comfortable directions. For example in Australia, there is only one family looking at 5000 heads of cattle, that is, a maximum of 10 people. The reason for this is the automation of processes. And the work of 10 people makes one, which can be both a veterinarian and a cattleman for example.»

So, the absence of risk management leads to the low productivity and potential of spontaneous risk. As our second respondent mentioned:

«A risk has always been a part of the business of agriculture. It's an industry built on the unpredictable forces of nature. What looks like a promising crop or herd can suddenly fall victim to the weather, insects or disease. Farmers are continually developing new ways to manage risk, from the use of hardier and higher yielding crop varieties and animal breeds to the application of new technologies on the farm to innovative marketing strategies».

So the second obstacle is a weather risk. This category includes factors such as impact of weather, risk hedging tools and even government subsidies. Agriculture is directly dependent on the conditions of weather. This leads to production (or yield) risk, and influences the farmers' capacity to repay debt, to meet land rents and to cover essential living costs for their families. One of the respondents shared with his reply about this issue:

«Kazakhstan is a zone of risky farming and changes can influence in a different way».

Another respondent replied to this question in the following way:

«Weather conditions are extremely important in agriculture, because climate change causes a number of serious changes, such as: drought, new types of diseases, etc.».

Developing countries dependent on weather vagaries and suffer from natural disasters (due to the unpredictable environmental conditions).

Identified challenges and answers from interviewed respondents helped to indicate types of mitigation tools. Risk mitigation tools includes development of mitigation plans to control, eliminate, facilitate or reduce risk to an appropriate level. When asked about this issue one of the respondents exclaimed:

«There is a compulsory insurance system in crop production, where two insurance companies and mutual insurance societies act as insurers. The state at the expense of subsidies covers 50 % of the insurance payment, upon the occurrence of an insured event».

From this statement it is clear that there is a possible effect in mutual insurance. Also a substitute from government also stands as a beneficial tool. Another respondent gave an example of irrigation as an effective instrument:

«Irrigation. Effective irrigation will influence the entire growth process from seedbed preparation, germination, root growth, nutrient utilization, plant growth and regrowth, yield and quality».

Weather insurance has a number of pros. It is not so expensive, it allows for standardization, keep away the need to manage and control individual contracts. It can be contributed by the private sector with small amount of government subsidy. It is suitable for poor and rich farmers and available to several sectors.

Finally, potential usage of weather derivatives in Kazakhstan is not so popular. According to the interviewee's answer:

«It is possible to develop the potential of weather derivatives in Kazakhstan. If we will use worldwide cases in a right way, we can benefit from it».

Another respondent announced the following:

«It is hard to say something on this point because there are no notable actions regarding to that. But we have started to implement several available tools for now».

So, there is a hope that the usage of weather derivatives become more prevalent, hedging with weather derivatives. However, improved climate, and the growing global demand for it has already mitigated much of that risk. As the worldwide market for weather derivatives expands and options become more available and effective, Kazakhstan has the potential to provide essential hedging possibilities for agricultural industries corresponds with the economy.

«I think we have many possibilities to introduce weather derivatives to our Kazakhstani market.

But we should consider detailed mechanisms and plan it in a right way.

There are about 85 % private owners who deal with agro crops and livestock in the country. This amount of people has a land but do not have their investments. Only 15 % are those who have both. Because of the youth development of our country farmers did not faced with this term in a real life. I think that this is closely related to the illiteracy of farmers, but I am confident that over time companies will begin to learn about this more and more.»

To sum up the result of the proved study that there is an urgency need of exploring weather derivatives in our country. Kazakhstan successfully fulfill the gaps in many important sectors like: agriculture, livestock and etc. Introducing weather derivatives in Kazakhstan requires time. We are witnessing today the emergence of small steps in order to manage with weather derivatives.

The valuable disadvantage of this method is difficulty in finding suitable respondents for interview. It is recommended to extend study by increasing number of experts.

It can be concluded that it is possible to use weather derivatives in agricultural sector of Kazakhstan as an insurance tool. However, US and European experience could not be blindly applied to our market. Legal and financial literacy of the nation have to be considered prior to instrument implementation due to the weak financial markets in Kazakhstan. Also the reasons of failing instrument in Russia have to be analyzed to avoid it in Kazakhstan experience. Finally, weather derivative is useful tool to manage weather risks, particularly in agriculture sector. Based on the work, Kazakhstani farmers demand such instrument, but for some reason there is still no supply. If local financial intermediaries are not able to provide such service, it's a time to invite foreign companies. Creation of derivatives market in Kazakhstan is also a way to alive local financial sector. However, a number of obstacles may arise in front of weather derivatives success:

– the weak legal framework;

– the general underdevelopment of derivatives market and low liquidity;

– weak weather prediction accuracy.

Although today, it is difficult to even imagine that soon these exotic securities become a trivial risk management tool in our country, all the stated above problems could be solved with the support of government. Based on the research, there is obvious necessity for weather risk hedging tool, and weather derivative is a best alternative. Next step is to develop the instrument structure and identify its price. Defi-

nitely, weather derivatives could not solve all the problems of wheat market. Farmers are still have to monitor global climate changes and try to adapt to new market conditions. What weather derivatives will do, is eliminate farmers extra headache and make their income stable, letting producers focus on the product quality and new opportunities to capture.

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А.Т. Кусниева

Сараптамалық кеңесінің негізінде Қазақстандағы ауыл шаруашылығында ауа райы деривативтерін қолдану мүмкіндігі

Мақалада ауа райы деривативтері табиғи тәуекелін теңестіру үшін ықтимал құрал ретінде зерттелді. Қазақстанның шұғыл континенталды климатына байланысты, ауа райы жағдайларына қатысты бизнестердің табысына айтарлықтай әсер етеді. Бидайдың экспорты Қазақстан экономикасының дамуы және диверсификациясы үшін зор әлеуетке ие. Сол себепті бұл мақала бидай нарығына көңіл бөледі. Мақаланың мақсаты бидай өндірушілер арасындағы ауа райы деривативтеріне деген сұраныстың бар екендігін және сатып алуға дайын екендігін анықтау болып табылады. Жұмыстың басында Қазақстандағы экзотикалық құралға қатысты «ауа райы деривативтері» ұғымы мен тетігі мысалдармен түсіндіріледі. Сонымен қатар қазақ фермерлері үшін ауа райы тәуекелдерінің өзектілігі және де жоғары сапалы бидай өсіру үшін ауа райының ерекшеліктері дәлелденіп, анықталды. Осыған

байланысты қазақстандық аграрийде егінді сақтандыру арқылы ауа райы тәуекелдермен күресіп жатыр. Егінді сақтандыру жергілікті аграрияны қанағаттандырмайтындығына қарамастан, олар осы құралды «Өнімді міндетті сақтандыру туралы» ҚР Заңы бойынша қолдануға тиіс. Сондықтан мақалада ауа райы деривативтері және егінді сақтандырудың салыстырмалы талдауы ұсынылған. Жасалған талдау және аграрийлер пікірінше, ауа райы деривативтері ауа райы тәуекелдерін теңестіру үшін неғұрлым тиімді құрал және сақтандыруда бірқатар артықшылықтары бар екендігі дәлелденді. Қорытындылай келе, ауа райы деривативтері және жалпы нарықтық жағдайлар тақырыбында бидай өндірушілермен өткізілген сұхбат нәтижелері келтірілген. Жұмыстың негізінде автор «ауа райы деривативтеріне» айқын сұраныстың бар екендігі және олардың Қазақстанда іске асыру қажеттілігі анықтады.

Кілт сөздер: ауа райы деривативтері, бидай өндірісі, Қазақстан, табиғи тәуекелдері, өсімдік сақтандыру, ауыл шаруашылығы, бидайға сұраныс.

А.Т. Кусниева

Возможность применения погодных производных рынком сельского хозяйства в Казахстане на основе экспертного мнения

В статье исследованы погодные деривативы в качестве возможного инструмента для хэджирования погодных рисков. В связи с резко континентальным климатом Казахстана погода имеет значительное влияние на доходы бизнеса, связанного с погодными условиями. Эта статья фокусируется на рынке пшеницы, поскольку ее экспорт имеет большой потенциал для экономического развития и диверсификации экономики Казахстана. Целью данной статьи является определение возможности применения инструмента погодных деривативов среди сельскохозяйственных производителей пшеницы на основе экспертного мнения. В связи с новизной инструмента в Казахстане в начале работы объяснены концепт и механизм работы погодных деривативов. Далее доказывается актуальность погодных рисков для казахстанских фермеров, а также раскрывается специфика погодных условий для выращивания качественной пшеницы. В данный момент казахстанские аграрии борются с погодными рисками с помощью страхования урожая. Несмотря на то, что страхование урожая не удовлетворяет местных аграриев, они обязаны пользоваться этим инструментом на основе Закона «Об обязательном страховании в растениеводстве». В связи с этим в статье приведен сравнительный анализ погодных деривативов и страхования урожая. Согласно проведенному анализу и мнению аграриев, погодные деривативы — более эффективный инструмент для хэджирования погодных рисков и имеет ряд преимуществ над страхованием. В заключение автором приведены методология исследования и результаты интервью на тему погодных деривативов и общего состояния рынка. Выявлен очевидный интерес на инструмент «погодные деривативы» и необходимость их внедрения на рынке Казахстана.

Ключевые слова: погодные деривативы, погодные риски, сельское хозяйство, производство пшеницы, Казахстан, страхование посевов, спрос на пшеницу.