Risk in the food economy – theory and practice

INSTITUTE OF AGRICULTURAL
AND FOOD ECONOMICS
NATIONAL RESEARCH INSTITUTE

Risk in the food economy – theory and practice

Editors:
dr Justyna Góral
dr Marek Wigier

MULTI-ANNUAL PROGRAMME 2015 - 2019

THE POLISH AND THE EU AGRICULTURES 2020+
CHALLENGES, CHANCES, THREATS, PROPOSALS

Warsaw 2017

This monograph has been prepared under the Multi-Annual Programme 2015-2019
"The Polish and the EU agricultures 2020+. Challenges, chances, threats, proposals".

The work aimed at analysis of different types of risk and its valuation in the food economy.
Additionally, the authors presented the possibilities within the field of risk management. An active part of the state and the European Union in the field was shown in the background.

Reviewers:
PhD Gabriel Popescu, Professor, The Bucharest University of Economic Studies, Bucharest, Romania
PhD Dimitre Nikolov, Professor, Director of the Institute of Agricultural Economics, Sofia, Bulgaria

Proofreaders :
Joanna Gozdera
Katarzyna Mikulska

Technical editor
Joanna Gozdera

Translated by
Summa Linguae S.A.

Cover Project
IERiGŻ-PIB

ISBN 978-83-7658-681-6

Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej
– Państwowy Instytut Badawczy
ul. Świętokrzyska 20, 00-002 Warszawa
tel.: (22) 50 54 444
faks: (22) 50 54 636
e-mail: dw@ierigz.waw.pl
http://www.ierigz.waw.pl

Contents

1 Introduction

Agriculture is the activity which has always been, to a greater extent than other sectors of the national economy, at risk, especially when it comes to the weather. It results from the specific nature of the activity related to the environmental conditions, over which man has no control. These risks include drought, floods, excessive precipitation, occurrence of spring frosts, etc. The fact that the agricultural activity is highly risky is also determined by other factors, such as: either low price flexibility in the market of agricultural products – i.e. the price risk, or the variable efficiency –i.e. the production risk.

The literature of the subject identifies several dozens of risk classifications. In general, we can say that the farmers face, *inter alia*, institutional, production, technological, price, disaster, property, financial or personal risks. Their common feature is that they are all associated with conducted food production. Given the source and subject of the risk, we may also distinguish its three groups i.e.: natural, social and personal, and although it is known that the risk may not be completely eliminated, the farmers have learned to reduce its effects.

The risk in agriculture is very common but efficient solutions to related problems are not so common, due to which it remains one of the more important problems of agribusiness. In the literature of the subject, we may find many methods describing risk management. They suggest the farmer what kind of attitude he should take towards a potential or actual risk, they allow him to get prepared for its effects or to select and implement an appropriate strategy of action. Risk management strategies usually come down to avoiding, stopping, controlling or transferring the risk.

As the risk is an integral part of achieving economic success, of importance for the farmer remains its proper definition, indication of its sources of origin and the level of risk. Existing experience shows that no risk elimination tool is fully efficient. Therefore, risk management puts an emphasis on the production diversification while implementing, to the broadest possible extent, a risk-sharing strategy (through e.g. insurance policies, surety funds, marketing agreements, forward contracts, etc.). Some countries with the free market economy have created well-developed risk mitigation systems for producers consisting in stabilising income. However, the problem of the risk is still up-to-date – it was, it still is and it will always be a part of production activities in agriculture and in the food sector.

By organising the international scientific conference entitled “Risk in the food economy – theory and practice” held on 23-25 November 2016 in the Windsor Hotel in Jachranka near Warsaw, the Institute of Agricultural and Food

Economics – National Research Institute joined the analysis of this extremely important research issue. Both the conference and the Institute's studies have been carried out based on the Multi-Annual Programme entitled "The Polish and the EU agricultures 2020+. Challenges, chances, threats, proposals". The objective of the conference was to present the study results and to carry out a discussion around the issues of the broadly defined risks in the agri-food sector with regard to: megatrends in the economy, transmission of price shocks, risk management, public policy, social polarisation, economic stability, structural transformation, innovative development, environmental risks, bioeconomy and circular economy, GMO in agriculture, production, price and income risk for enterprises and agricultural holdings, variability of margins and risk evaluation in the food economy.

During the conference, 6 plenary sessions and discussion workshops were organised and 25 papers were presented, as follows:

- Prof. Andrzej Kowalski, Prof. Włodzimierz Rembisz – The question of price and income risks in agriculture;
- Prof. Bernardo Reynolds Pacheco de Carvalho – Risks and vulnerability in the food system: food security and sustainable development;
- Prof. Jacek Kulawik, Dr Joanna Pawłowska-Tyszko, Dr Michał Soliwoda – The major problems of risk management in the food sector;
- Prof. Thomas Doucha, PhD Marie Pechrova, MSc Ondrej Choloupka – Price prediction tool for agricultural risk management and policy-making purposes;
- Prof. Szczepan Figiel – Incentives versus risk associated with innovation activity in the agri-food sector. Theoretical premises;
- Prof. Dimitre Nikolov, Adriana Mihnea, Dr hab. Ivan Boevsky, PhD Petar Borisov, PhD Teodor Radev – Benefits, opportunities, cost and risk in delivering public goods in agriculture: South Central Planning Region in Bulgaria case study;
- Dr Mariusz Hamulczuk – Globalization of price risk – the example of cereal market;
- Prof. Anikó Juhász, Prof. Gábor Kemény, PhD András Molnár, MSc Anna Zubor-Nemes – The role of public policy in risk management: the case of the Hungarian Risk Management System;
- Dr hab. F. Sinabell, PhD T. Url, PhD K. Heinschink – An index-based margin insurance for agriculture – the example of wheat production in Austria;
- Prof. Irena Kriščiukaitienė, PhD Tomas Baležentis – Production and price risk in Lithuanian crop farming;
- PhD Bozhidar Ivanov – Price transmission in dairy industry in Bulgaria;

- Dr Danuta Zawadzka – Price and production risk in the live pigs market;
- Prof. Adriana Mihnea, Dr. Liliana Craciun, PhD Student Andrei Raduţu – Production, price and income risk in expected gross margin in agriculture using analytic network processes modelling;
- PhD Vasyl D. Zalizko, Andriy Gordiychuk, Aleksandr Matiushok – Methodology for integral estimation of Ukrainian agriculture efficiency;
- Dr Cristian Kevorchian, Dr. Camelia Gavrilescu – An approach based on state-space models for the agricultural production risk assessment;
- Prof. Wojciech Józwiak, Prof. Wojciech Ziętara, Mgr Zofia Mirkowska – Megatrends linear or nonlinear: is it possible today to predict reasonably the state of the economy in the year 2025?;
- Dr Iwona Szczepaniak, Dr Łukasz Ambroziak – The currency risk and the foreign trade in the Polish agri-food products;
- PhD Mirza Uzunović, PhD Aleksandra Nikolić, MSc Alen Mujcinovic – Mitigating financial risk through agile balancing between market orientation and total quality management factors: evidence from Bosnia and Herzegovina beverages industry;
- Prof. Merilin Ratas, Prof. Maire Nurmet – Risk management approaches in Estonian agricultural enterprises;
- Mgr Cezary Klimkowski – Incomes of farms versus the currency risk;
- Prof. Oleksandr Pavlov – Risks of rural development in Ukraine;
- Prof. Józef Zegar, Dr Wioletta Wrzaszcz, Dr Konrad Prandecki – GMO in agriculture – the selected threats;
- Prof. Drago Cvijanonivić, PhD Vesna Kocic Vugdelija, PhD Željko Vojinović, PhD Otilija Sedlak – Entrepreneurial process and risks in small and medium-sized organic agricultural holdings in Serbia;
- PhD Mirza Uzunović, PhD Aleksandra Nikolić, MSc Alen Mujcinovic – Successful certification schemes as a tool for marketing risk mitigation: case study – Organic and traditional labels in Bosnia and Herzegovina;
- Assoc. Prof. Julia Doitchinova, Assoc. Prof. Dr Hristina Harizanova, Assoc. Prof. Dr Zornitsa Stojanova – Structural changes and agri-environmental assessment of agriculture in Bulgaria.

The papers presented at the conference contained an overview of methods and studies on measures to prevent or minimise the risk and threats in agricultural and food production. Science and practice know many of them: the system of insurance, economic analyses and forecasts, technical measures, achievements of life sciences and biotechnologies, etc. However, it is important to know how to use these instruments in practice.

The monograph you are provided with, containing the selected papers from the conference prepared in a form of articles for publication, has been divided into two volumes. The first volume entitled "Risk in the food economy – theory and practice" contains the introduction and six chapters in Polish. They are as follows:

- Political economy of price risk in agriculture, by Prof. dr hab. Andrzej Kowalski and Prof. dr hab. Włodzimierz Rembisz;
- Selected problems of risk management in the food sector, by Prof. dr hab. Jacek Kulawik, dr Joanna Pawłowska-Tyszko, dr Michał Soliwoda;
- Megatrends linear or nonlinear: is it possible today to predict reasonably the state of the economy in the year 2025?, by Prof. Wojciech Józwiak, Prof. Wojciech Ziętara, mgr Zofia Mirkowska;
- Incomes of farms versus the currency risk, by mgr Cezary Klimkowski;
- The currency risk and the foreign trade in the Polish agri-food products, by dr Łukasz Ambroziak, dr Iwona Szczepaniak;
- Price and production risk in the live pigs market, by dr Danuta Zawadzka;
- GMO in agriculture – the selected threats, by dr Wioletta Wrzaszcz, dr Konrad Prandecki.

The present second volume entitled "Risk in the food economy – theory and practice" consists of the introduction and 18 chapters originally prepared in English. The articles presented in both volumes make us more familiar with the problem of risk in the Polish, European and global food economy, describe risks taken in the individual countries and at many levels as well as the methods to resolve them. We are aware that despite the comprehensiveness of the study, we have not exhausted the list of questions related to the analysed issue. However, one thing is certain – this subject is so important that we think that these matters should be further studied, substantively discussed, and the conclusions should be provided to the public, administration and politicians. By encouraging you to read them, we are leaving ourselves a possibility of continuing the discussion on the above topic. We will continue it on the forum of seminars and scientific conferences organised by the Institute as well as in a publishing series Monographs of the Multi-Annual Programme. Therefore, we encourage all readers to observe the results of our studies and scientific investigations, inter alia, the discussion forum and through the website of the Institute:www.ierigz.waw.pl

Dr Marek Wigier,

IERiGŻ-PIB

2 The role of public policy in risk management: the case of the Hungarian Risk Management System[1]

Gábor Kemény, András Molnár, Anna Zubor-Nemes, Ivett Illés, Anikó Juhász
Research Institute of Agricultural Economics (AKI), Budapest, Hungary
kemeny.gabor@aki.gov.hu, molnar.andras@aki.gov.hu,
nemes.anna@aki.gov.hu, juhasz.aniko@aki.gov.hu

Abstract

Authors of the article present the evolution, operation and results of the Hungarian agricultural risk management system taking into account the past 20 years with special emphasis on the period from 2012 to 2015. Government support for agricultural insurance is a common practice of helping farmers to have better access to risk management tools especially as, under certain conditions, the support for insurance can be regarded as a Green Box measure within the WTO agreements [OECD, 2009]. Our focus turns to review the recent history of public policy tackling risk management of the farming sector. In this exercise, we focus on both the EU and the national perspective, with special emphasis on implementation experience. We discuss in details the current two-pillar risk management system that was introduced in Hungary in 2012 in which the first pillar refers to an "all-risk" crop damage mitigation fund, while the second pillar is a voluntary, market-based insurance with state support scheme. In this regard we present recent figures of all important aspects of the system including participation and financial performance using the annual assessment reports. Finally, we present the continuing progress of the national risk management system discussing the challenges of the implementation of the IST programmed in the RDP and possible ways to go forward with the risk management system based on the most recent developments in the field.

Keywords: risk management, public policy, Hungarian agriculture

JEL Classification: Q14, Q54, Q18, G32

2.1. Introduction

The natural endowments are unequivocally favourable for crop production in Hungary, which is the primary land use form and important building block of the economy. However, Hungary is also situated in the most vulnerable zone of Europe and has to face the effects of changes in the climatic conditions [OLSEN

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

et al., 2011]. Increasing risk of exposure of crop producers to natural hazards, such as increasing frequency of extreme weather events and climate change, in general requires more tailored risk management of the sector. Further problem is the landlocked position and the excess transportation cost to many important markets. Due to high cropland ratio and the favourable agronomic conditions, Hungary produces far more of many products than needed for self-sufficiency. Therefore, Hungary is facing significant pressure of exporting. Furthermore, Hungary has continental / pannonian climate – thus often experiences draught – which causes high crop yield volatility. Compared to the EU, crop prices are lower and crop yield and income volatility are in general higher in Hungary. In this article we present the evolution, operation and results of the Hungarian agricultural risk management system taking into account the past 20 years with special emphasis on the period from 2012 to 2015. In the first part, we give an overview of the most relevant drivers of agricultural risk management in Hungary, including the country's geographical location, climatic conditions, economic and agricultural background. Following this, we summarize the experiences of the past four years in each pillar based on participation, damage and loss ratio.

2.2. Evolution and operation of risk management scheme in Hungary

There are three significant stages of evolution of risk management scheme in Hungary. The insurance premium system, which was introduced in 1996, was the first incentive introduced in order to foster insurance uptake by farmers. The rate of subsidy of agricultural insurance fee was 30 per cent (flat rate) between 1997 and 2003. However, this was insufficient to increase the number of insurance clients, the size of agricultural area covered by insurance and the incidence of damage even in case of plants which are mostly exposed to unfavourable conditions. Drought (42 per cent), hail and thunderstorm (21 per cent) were responsible for two third of the total damages caused by natural disasters in Hungary. Damages caused by inland water and frost were 18 per cent and 16 per cent, respectively. Other damages were around 3 per cent. Despite these facts, the compensations were paid mostly (87 per cent) for hail and the share of frost, thunderstorm and other damages was only 3-5 per cent in it. One can conclude that there was significant difference between the risks covered by insurance companies and risks farmers had to face between 1997 and 2003. Altogether the system could not increase the area covered by insurance (penetration was 30-40 per cent).

The main goal of National Agricultural Damage Compensation Scheme (NAR) – established in 2007 – was to provide coverage for crop producers with damages caused by drought, inland water and spring frost. After the limited in-

terest experienced in the first year the legislation was revised in 2008[2]. The participation was compulsory in NAR for all legal entities and individual holdings or entrepreneurs based on utilized agricultural area. For agricultural producers who are considered as licensed traditional small-scale producers[3] based on their utilized agricultural area, participation was optional.

Agricultural producers, who were obligated to pay mitigation contribution, were entitled to mitigation benefits which were set at 80 per cent of crop-revenue loss (in case of less-favoured areas – 90 per cent) in case of natural disaster[4]. Important limitation of the system was that it did not provide coverage for the total value of damages, only for their limited part. Further disadvantages of NAR were its high administrative burden and the low penetration level.

Operation of the current system

A more advanced agricultural risk management system, which came into force in 2012[5], was introduced to make up for the deficiencies of the previous systems. This experience-based development resulted in the so-called Complex Agricultural Risk Management System (MKR) and began its operation on 1 November 2014.

MKR combines the stability of the obligatory National Damage Mitigation Fund with the complementary services of private insurance companies (Figure 1).

Further aim for improvement was to fully digitalize the system, increasing the user experience and decreasing the risk of fraud. Thus, it is now a fully electronically working system, in which members of risk community may submit their statement of damage and their claim for mitigation benefits by using the service through an internet platform, electronic documents which are next evaluated and checked – e.g. to compare the area data which is necessary to take insurance coverage – using the same interlinked electronic system.

Part of MKR is the so-called data reporting system which was developed to link loss assessment organizations. Under this scheme data were entered into a central system from the National Meteorological Service, General Directorate of Water Management, Institute of Cartography and Remote Sensing and Research

[2] 2008. CI. law for national agricultural damage compensation scheme and for mitigation contributions.

[3] Licensed traditional small-scale producer is a non-entrepreneur private farmer, who conducts activities listed in the relevant law on his/her own farm and holds a registered licence for the activity.

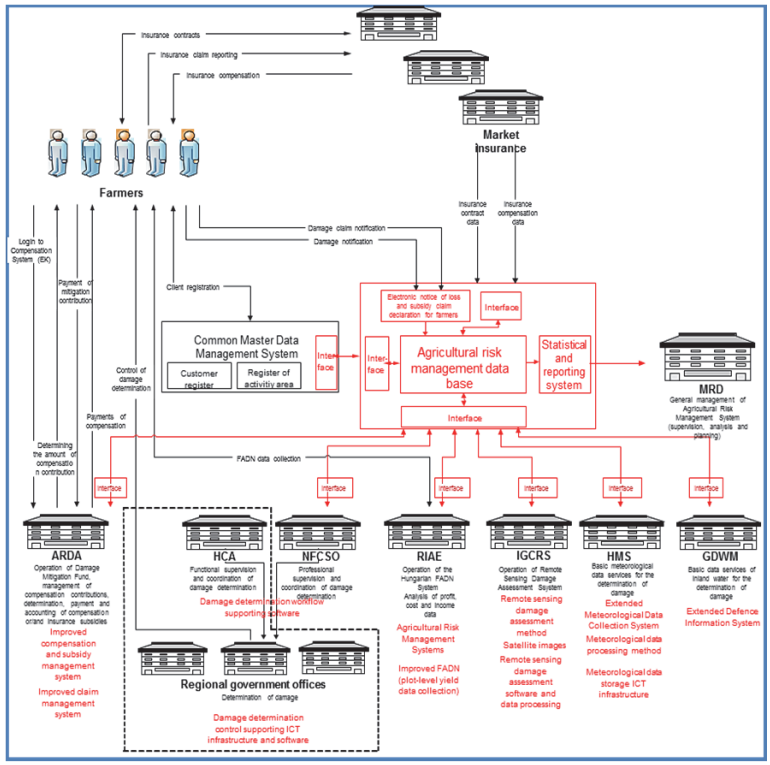
[4] The premium is decreased if needed in line with the fund possibilities.

[5] The legislative foudation of the agricultural risk management system is the law entitled "Handling of meteorological and other natural risks in agriculture [2011. évi CLXVIII. törvény]" and the enforcement order [27/2014. (XI. 25.) FM rendelet] dealing with the details of damage mitigation contribution and damage mitigation claims.

Institute of Agricultural Economics. The system is linked to the organization – National Food Chain Safety Office – performing the inquest and supporting the process of loss assessment. In this system, it is possible to take into account in the decisions the supporting results of on-the-spot investigations and to make a final decision for damage statement based on unequivocal data.

The 1st pillar in MKR is agricultural damage compensation scheme, which tackles the most important climatic and natural risks of crop producers. It is considered as a notified national subsidy (Figure 2).

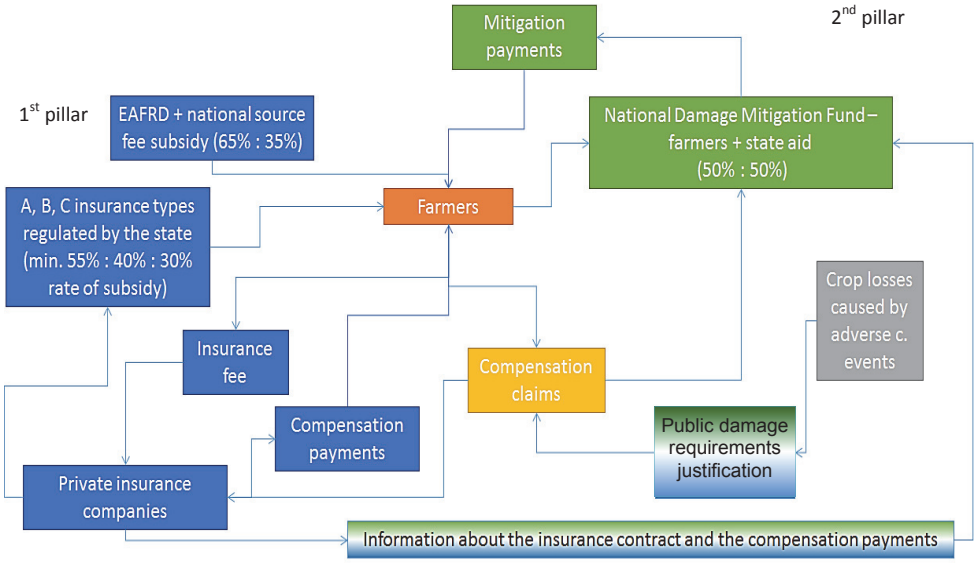
Figure 1. Organizational workflow structure of MKR



MRD: Ministry of Rural Development [now Ministry of Agriculture]; ARDA: Agriculture and Rural Development Agency; NFCSO: National Food Chain Safety Office; RIEA: Research Institute of Agricultural Economics; IGCRS: Institute of Geodesy, Cartography and Remote Sensing; HMS: Hungarian Meteorological Service; GDWM: General Directorate of Water Management.

Source: AKI, Horizontal Analysis Department.

Figure 2. Pillars of MKR



Source: AKI, Horizontal Analysis Department.

Farmers who participate in the compensation scheme are eligible for mitigation benefits if they have a crop which suffered more than 30 per cent yield loss and if their yield loss at farm level exceeded 15 per cent compared to average of past three years. Before 2015, the farm level yield loss limit was 30 per cent, so the most important modification was to reduce the limit to 15 per cent. The modification was intended so that the amount of mitigation benefits reached a wider range of producers and the utilization of the compensation fund become more efficient. The autumn frost is also a part of agricultural compensation scheme since 2015, so the scheme covered nine different risks, which are the following: drought, inland inundation, hail, spring, autumn and winter frost, thunderstorm, heavy rain and flood affecting agricultural area.

In case of flooding, payments are only eligible if it was approved in advance by the European Commission. Mitigation benefits for damage caused by inland inundation are only available three times in five consecutive years.

The 2nd pillar comprises agricultural insurance premium subsidy which is operating under state control with subsidized voluntary market insurance premium. Active farmers are eligible for subsidy in case of agricultural insurance contract type A, B or C for the area utilized as recognized and registered arable crops or orchards and vineyards in the Integrated Administration and Control System (IACS). In case of type A, the so-called pocket insurance can be taken out for

nine risks jointly, for most common arable crops: apple, pear and grape. In case of insurance type B, mainly for vegetables, fruit and some arable crops can take insurance to cover the following risks: hail, winter frost, autumn frost, thunderstorm and fire. In case of insurance type C, farmers can take insurance for any crops from nine different kinds of risks, with optional scheme for one or more damages (Table 1).

Table 1. Insurance options in the 2nd pillar

	Damage	type "A"	type "B"	type "C"
Covered risks	Hail	Compulsory	Optional	Optional
	Thunderstorm		Optional	Optional
	Fire		Optional	Optional
	Winter frost		Optional	Optional
	Spring frost		-	Optional
	Drought		-	Optional
	Heavy rain		-	Optional
	Autumn frost		Optional	Optional
	Flood		-	Optional
	Inland inundation		-	-
Subsidy rate	Maximum subsidy rate	0.65	0.65	0.65
	Minimum subsidy rate	0.55	0.4	0.3
Plants	Insurable plants	14 most important plants (maize, wheat, apple, etc.)	76 important plants (mainly fruit and vegetables)	All plants

Source: AKI, Horizontal Analysis Department.

In relation to the area covered by insurance contract for all insurance types, damage threshold may not be lower than 30 per cent of the amount of insurance for damaged area. In case of: agricultural flood, winter frost and heavy rain the damage threshold is 50 per cent insurance amount of damaged parcel. In case of drought and spring frost the damage threshold is 50 per cent of insurance amount per farms and plants.

Both pillars use the exact same risk definitions, reference crop yields and prices. The pillars in MKR are supporting each other – in case a farmer does not have insurance, he is only eligible for 50% of mitigation payments. The compensation payment is deductible from mitigation payments (Table 2).

Table 2. Covered risks in MKR

Risks	Hail, storm, fire	Winter / spring frost	Drought	Heavy rain, flood	Inland inundation
1st pillar	>15% farm level, >30% crop level				
2nd pillar	>30% crop level	>50% crop level	>50% crop level	>40% crop level	-
Private additional insurance	>5% - <30% crop level	-	-	-	-

Source: AKI, Horizontal Analysis Department.

2.3. Materials and methods

The assessment of the operation of the agricultural risk management system mainly based on data retrieved from the dedicated module of the IACS which is combined with the database for insurance. This complex database basically consists of the following three blocks:

- mitigation contributions,
- mitigation benefits,
- insurance premium and payments on claims and relevant technical data.

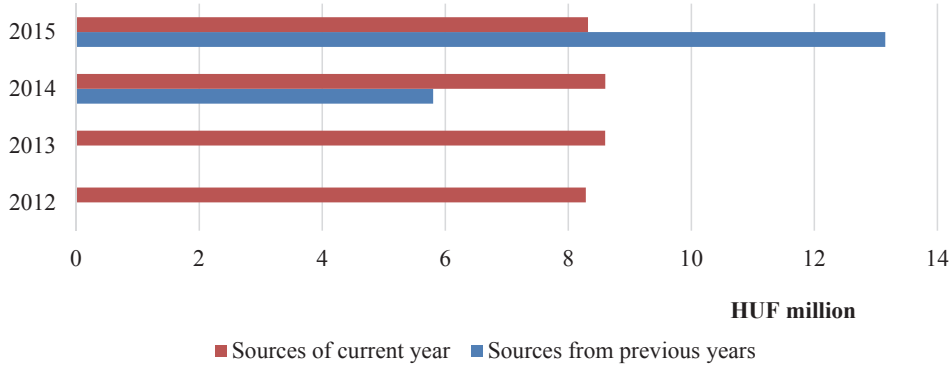
The first two register is made by the Agricultural and Rural Development Agency (ARDA – Paying Agency); the third complied by AKI based on data from market insurance companies. Finally, we complied a unified database from these data to analyse and create the required indicators.

2.4. Results of the 1st pillar

The number of farmers in the 1st pillar of risk management system increased by 5.7 per cent, from 74 071 to 78 234 in 2014. However, there was a slight decrease due to the exit of farms voluntarily joined in 2012 which had to stay in the system for at least 3 years.

Financial sources from producer's levy increased from HUF 4135 billion in 2012, more than HUF 160 million in 2013 and 2014, then decreased by 3.3 per cent. Significant financial sources were accumulated in the Mitigation Fund between 2012 and 2015, due to favourable conditions and low mitigation payments. In total the financial sources of the fund reached HUF 21 473 million in 2015, which exceeded the available amount of the previous year by 49.1 per cent (HUF 7068 million) and amount of 2012 by HUF 8285 million (Figure 3).

Figure 3. Financial sources of Mitigation Fund



Source: MVH (ARDA – Agricultural and Rural Development Agency), NÉBIH (NCSO – National Food Chain Safety Office).

Incidence of damage significantly decreased in the past four years. Producers suffered from greatest damage in 2012 (1.1 million hectare). It is remarkable that the number of entitled compensation claim was relatively low depending on increasing incidence of damage in 2012 ("only" 8017 claim was granted from 31 591). Statements and number of legal mitigation benefit claim ratio are improved which shows consolidation of the system (Table 3).

Table 3. Main indicators of the 1st pillar between 2012 and 2015

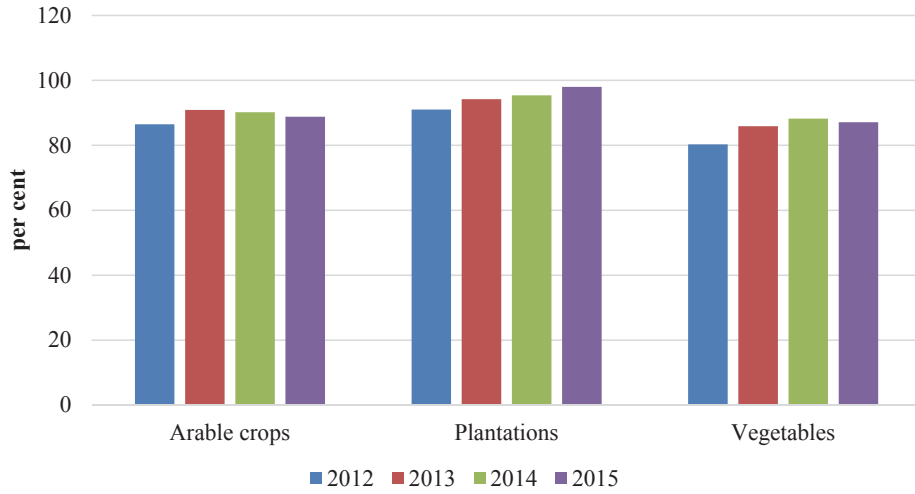
	2012	**2013**	**2014**	**2015**
Number of producers in the 1st pillar	74 071	77 628	78 324	72 474
Mitigation contributions (HUF million)	4 135	4 300	4 301	4 160
Financial sources of Mitigation Fund in current year (HUF million)	8 285	8 600	14 405	21 473
Number of reported damages (piece)	31 591	6 443	2 608	11 832
Reported damaged area (hectare)	1 131 687	149 711	48 850	202 748
Number of entitled mitigation benefit claim (piece)	8 017	2 218	505	3 312
Amount of entitled compensations claimed (HUF million)	7 411	2 453	11 99	6 050
Mitigation benefits based on damaged area (hectare)	93 922	28 375	11 752	61824

Source: MVH (ARDA – Agricultural and Rural Development Agency), NÉBIH (NCSO – National Food Chain Safety Office).

Penetration

In case of main arable crops the area covered by insurance compared to their total area was the largest in 2013 in the 1st pillar, then it experienced a moderate decrease. However, it was even higher per cent in 2014 and 2015 compared to 2012. Penetration rate within plantations exceeded 90 per cent in case of each plant in 2015. Plantations have really high penetration since 2007--2008, because on the one hand, participation in the system is compulsory in case a producer utilises 1 hectare or more, on the other hand, the system provides relatively high protection at affordable price, particularly for crops which are sensitive to spring frost and the insurers were content to insure them only since 2012, when insurance premium subsidy was introduced. Penetration was really varied in case of main vegetables during the period between 2012 and 2015, and rate of variation was even greater (between 70-98 per cent) in recent years compared to arable crops and plantations (Figure 4).

Figure 4. Penetration of main arable crops, plantations, vegetables between 2012 and 2015



Source: MVH (ARDA – Agricultural and Rural Development Agency), NÉBIH (NCSO – National Food Chain Safety Office).

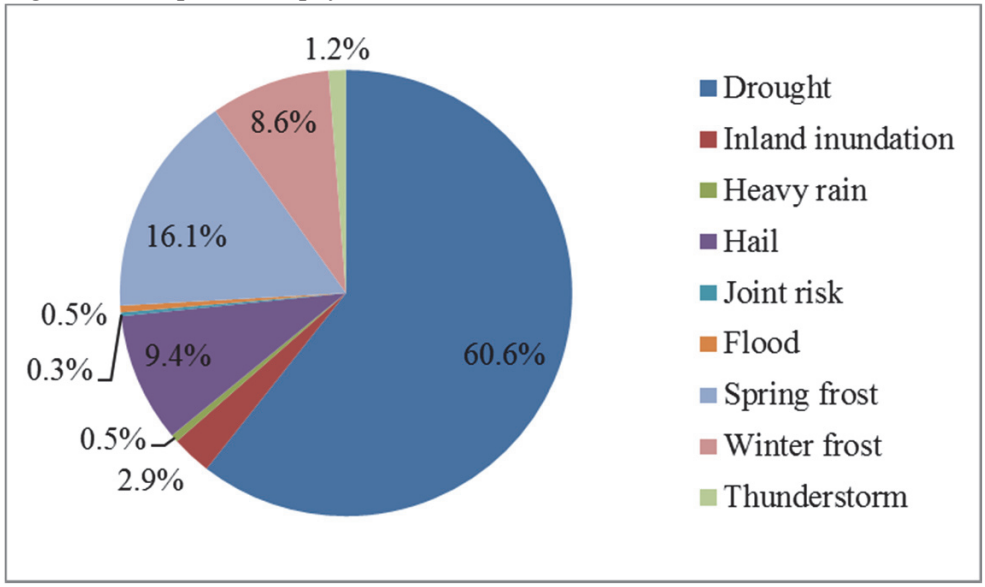
Compensation payments

The amount of compensation payments was the lowest in 2014, taking into account the past four years. Payments increased significantly because of damage caused by drought and hail in 2012 and 2015. Maize, sunflower and wheat suffered main damages. Other arable crops, were responsible for 8-30 per cent of the total compensation payments. Overall, 45-65 per cent of the total entitled

mitigation benefits claims (from HUF 6050 million) were spent on this purpose. In case of plantations the greatest damage was caused by frosts, hail and thunderstorms. Since 2015, it has been introduced as a novelty that producers can report damages for plants growing in plastic tunnels. In that year, 27-37 per cent of the total entitled mitigation benefit claims (from HUF 6050 million) were spent for this. Vegetables are also especially sensitive to weather, so in their case the main risks (if not irrigated) are drought and hail. In 2015, 5-18 per cent of the HUF 6050 million mitigation benefits was spent on this category.

Taking into account different risks, it can be concluded that the highest amount of mitigation benefit was paid for damages caused by drought, so 60.6 per cent of the total amount of compensation was paid for this risk. This was followed by spring frost, which had 16.1 per cent share of the total. The share of payments ranged from 8-10 per cent in case of damages caused by hail and winter frost (Figure 5).

Figure 5. Compensation payments as risks between 2012 and 2015



Source: MVH (ARDA – Agricultural and Rural Development Agency), NÉBIH (NCSO – National Food Chain Safety Office).

2.5. Results of the 2nd pillar

Number of premium subsidised and private additional insurance contracts increased gradually in the past four years from 3793 to 8664 by 2015. However, income from insurance fee remained at almost the same level (HUF 5.9 billion) that in the previous year. Since farmer's claims for subsidies exceeded financial source of insurance premium subsidy in the past two years, it was necessary to

pay back just like in 2014. In case of insurance type "A", the premium intensity remained at 65 per cent, while for type "B" and "C" it was necessary to reduce it to 52 and 30 per cent, respectively.

Evaluating premiums from subsidised insurance fee, it can be estimated that the number of insurance contracts and income from fee between 2012 and 2015 increased mostly in case of insurance type B. The number of contracts increased twenty-two-fold and income from fee rose fifteen-fold by "B". Income from insurance fee increased 3.5 times by insurance type "A" and in case of type "C" rose by about 1.5 times taking into account the past four years. Income from private additional insurance fee was 3.4 times greater in 2015 compared to 2012 (Table 4). Overall, the growth rate of demand for subsidised insurance decreased in 2015.

Table 4. Changes in domestic crop insurance market between 2012 and 2015

HUF billion

Denomination	2012				2013				2014				2015			
	Number of contracts	Fee	Compensation payments	Loss ratio	Number of contracts	Fee	Compensation payments	Loss ratio	Number of contracts	Fee	Compensation payments	Loss ratio	Number of contracts	Fee	Compensation payments	Loss ratio
	(piece)	(HUF million)	(HUF million)	(per cent)	(piece)	(HUF million)	(HUF million)	(per cent)	(piece)	(HUF million)	(HUF million)	(per cent)	(piece)	(HUF million)		(HUF million)
Premium subsidised "A"	547	605	393	65	995	1249	484	39	1722	1739	120	7	2406	2162	585	27
Premium subsidised "B"	307	174	45	26	4879	1739	247	14	5671	2764	333	12	6804	2654	608	23
Premium subsidised "C"	1042	688	74	11	2320	736	177	24	2898	1155	181	16	3254	930	320	34
Total premium subsidised	1896	1467	512	35	8194	3724	908	24	7302	5658	634	11	8664	5746	1513	26
Private additional insurance subsidised	**1897**	**64**	**161**	**252**	**6033**	**200**	**823**	**412**	**6975**	**305**	**752**	**246**	**8604**	**219**	**984**	**450**
Total premium and private additional insurance subsidised	3793	1531	673	44	14227	3924	1731	44	7302	5964	1386	23	8664	5964	2497	42

Note: The number of contracts in the Table indicates MVH-ARDA registration numbers of various categories of associated farmers.

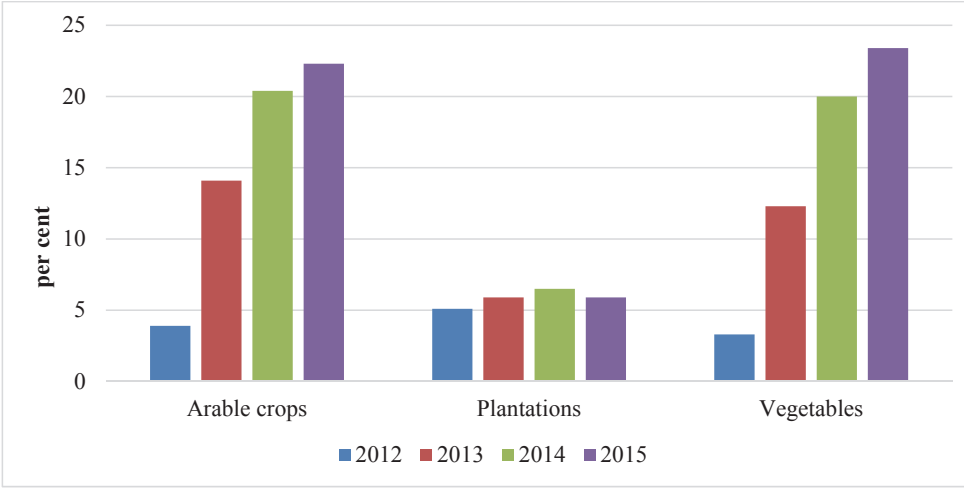
Source: data from premium subsidised insurance providing insurance.

Penetration

For those crops which are well-known and grown on larger areas, the insurance was more widespread than for those which are grown on smaller areas, and there is still no insurance for really hail-sensitive plants. As a result, in case of plantations it is still a challenge to convince those producers who never took part in insurance schemes, and also to include those crops which were not or only rarely insured before.

As shown in Figure 6, the insurance coverage of crops was significantly different compared to each other and also in each year. Penetration of arable crops and vegetables was similar and continuously rose during the period between 2012 and 2015. In case of plantations penetration reached its peak in 2014 (6.5 per cent) then it slightly decreased in 2015.

Figure 6. Penetration of crops (2012-2015)

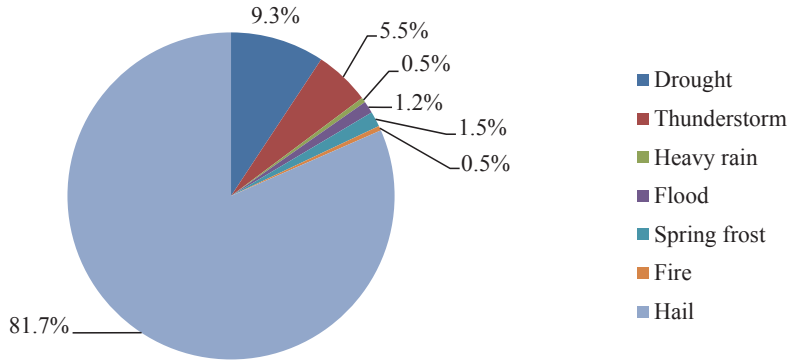


Source: AKI, Horizontal Analysis Department.

The most significant damage was caused by hail, drought and thunderstorms in the past four years.

Damage caused by hail was dominant among insurance payments. Overall the total of 81.7 per cent of the payments were paid for this risk, 9.3 per cent were paid for drought and 5.5 per cent for thunderstorms (Figure 7).

Figure 7. Premium subsidised insurance payments by risks (2012-2015)



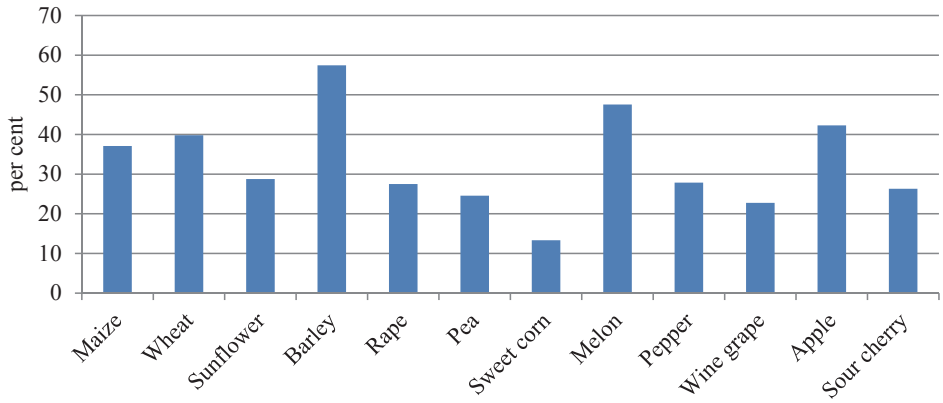
Source: AKI, Horizontal Analysis Department.

Compensation payments

The amount of compensation paid for premium subsidised insurance was increased gradually only for insurance type B and the growth was also the highest for this insurance. The compensation payments increased more than forty--fold in 2015 compared to 2012. This was a 2.5 and 3.8 times increase for insurance type "A" and "C", however, compensation payments were fluctuating in the past four years (Figure 8), the payments increased in case of type "A" because of two dry years.

The highest compensation payments were paid for maize, winter wheat, sunflower, barley, rape and other arable crops among arable crops in the past four years. Overall, 93.4 per cent of the total was paid for these crops. Payments increased twenty-four times in the past four years, because orchards and vineyards suffered significant damages in this period. Among plantations the amount of compensation was the highest in case of apple, i.e. the payments increased from HUF 206 million to HUF 392 million in 2013 compared to the previous year. In case of some vegetables, payments were affected by much more plants in the past four years. The most significant damages were suffered by pea, sweet corn, melon, paprika, green pepper, tomato, onion and other arable vegetables.

Figure 8. Loss ratios for some plants between 2012 and 2015



Source: AKI, Horizontal Analysis Department.

Among the crops grown on the largest area, the loss ratios of maize, wheat, sunflower and rape were between 27 and 40 per cent. The large cultures were damaged every year, smaller suffered damage because of extensive, low input cultivation, so the loss ratio is higher in case of this crops. In case of plantations, loss ratio of strawberry (70 per cent) and table grape (122 per cent) was significantly higher compared to other plantations loss ratio. Loss ratio of wine grape – which is cultivated on the largest area – was 23 per cent and in case of apple which has the second the largest area was 42 per cent. Among main vegetables, sweet corn and pea growing on the largest area, loss ratio was 13 and 15 per cent, respectively. Melon and paprika were also sensitive plants (28-48 per cent).

2.6. Conclusions

All in all, the Hungarian Agricultural Risk Management System "performed well" in past four years. The number of participating farmers is high in the 1st pillar and due to the favourable weather conditions financial sources in the 1st pillar provided coverage for compensation claims in every year. Significant amount is accumulated in the Fund from unused financial sources that can provide substantial assistance for farmers also in more unfavourable years to come (with more and/or significant damages). A good indication of the popularity of the 2nd pillar is that it was necessary to reduce the subsidy rate on premium in the last two years to be able to service all the interested farmers.

The Hungarian Agricultural Risk Management System faces the following challenges: further decrease in farmers' administrative burden, application of fair and risk proportionate premiums in the 1st pillar, coverage for risk currently

not covered by any pillars, decrease risk through prevention. As a response, by 2020 the National Damage Mitigation Fund will finance the establishment of hail suppression network using ground aerosol-generating systems with national coverage (prevention, pillar "0"). There is an inter-ministerial development work to implement the income stabilization tool of the Rural Development Programme to mitigate income risk (increasing coverage, the 3rd pillar). Moreover, the possibilities of introducing a *bonus-malus* system is under development (fair premiums in the 1st and 2nd pillar). Finally, the insurance companies are also introducing electronic administrative processes during the risk assessment, which will be also integrated to the Hungarian Agricultural Risk Management System, in the 1st pillar of risk mitigation (decreasing administrative burden).

References

1. Kemény, G., Varga, T., Fogarasi, J., Kovács, G., Tóth, O., *A hazai mezőgazdasági biztosítási rendszer problémái és továbbfejlesztésének lehetőségei*, Agrárgazdasági Könyvek, Agrárgazdasági Kutató Intézet, 2010, pp. 3-124 (ISBN 9789634915652, HU ISSN 20618204).
2. Kemény, G., Zubor-Nemes, A., Lőrincz, K., Keményné, H.Z., *Az Agrár-Kockázatkezelési rendszer változása 2012-2015 között*, OTP-nek készített tanulmány, Agrárgazdasági Kutató Intézet, 2016, pp. 1-59.
3. Kemény, G., Lámfalusi, I., *Az agrár-kockázatkezelési rendszer működésének értékelése 2015*, Agrárgazdasági Információk, Agrárgazdasági Kutató Intézet, 2015, pp. 1-93 (ISBN 9789634915652, HU ISSN 20618204).
4. Olsen, J.E., Trnka, M., Kersebaum, K.C., Skjelvag, A.O., Seguin, B., Peltonen-Sainio, P., Rossi, R., Kozyra, J., Micale, F., *Impacts and adaptation of European crop production systems to climate change*, European Journal of Agronomy, no. 34(2), 2011, pp. 96-112.
5. *2008. CI. law for national agricultural compensation scheme and for mitigation contributions*.

3 Price prediction tool for risk management and policy-making purposes in agriculture[1]

Chaloupka Ondřej, Pechrová Marie, Doucha Tomáš
Institute of Agricultural Economics and Information, Prague, Czech Republic
Chaloupka.Ondrej@uzei.cz, Pechrova.Marie@uzei.cz, Doucha.Tomas@uzei.cz

Abstract

Agricultural holdings are exposed to many risks. The article presents a mathematical tool for short-term predictions of farm-gate price development of basic agricultural commodities in order to help farmers to mitigate the risks of prices volatility or take these risks into consideration in their decision-making processes. The applied CEN model for the Czech Republic takes into account as explanatory variable only time (previous development of prices). A seasonal smoothing of the time series is used for predictions. The price projections are modelled for three years ahead. Two different types of regressions for both current and constant (fixed) prices are available – polynomic and linear. The CEN model was originally developed for the price predictions in the sector framework of the Czech Economic Accounts for Agriculture. From this, the price predictions can be utilized not only in the private sector by individual farmers, but also by policy-makers to prepare or assess policy measures for the price risk management. Particularly the price predictions are linked to the "RDP model" [Chaloupka, Pechrová, Doucha 2016] of cost-benefit analysis for investment projects under the Czech Rural Development Programme.

Keywords: short-term price prediction, risk management

JEL classification: G31, C53

3.1. Introduction

"The agricultural sector has always occupied a distinctive position in the economy of any country, primarily due to the need to ensure food safety for consumers, and secondly, because of the vulnerability of people involved in this activity in terms of their income's volatility" [Pop and, Rovinaru and Rovinaru, 2016]. Agricultural holdings are exposed to many risks. "Uncertainty and risk are quintessential features of agricultural production" [Moschini

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

and Hennessy, 2001]. Unlike in other sectors of the national economy, in agriculture many of the risks are hardly insurable, for example, the weather changes or price volatility.

It is important to evaluate and manage those risks. Only then it will be possible for the farmer to make decisions effective in time. "Risk analysis helps simultaneously identify threats caused by several types of risk, which leads to an increased efficiency of economic decision-making" [Girdziute and Miceikiene, 2016]. Understanding volatility and dynamics of price developments in changing scenario is vital for risk management in the private sector, and for policy purposes as well.

For example, Guerrieri et al. [2016] elaborated multivariate statistical model to predict the fuel consumption and costs of six agricultural operations: ploughing, harrowing, fertilization, sowing, weed control and shredding. The predictions in the model were conducted in two steps: first, few initial selected parameters (time per surface-area unit, maximum engine power, purchase price of the tractor and purchase price of the operating machinery) were used to estimate the fuel consumption, then the predicted fuel consumption together with the initial parameters were used to estimate the operational costs. Oglend and Asche [2016] searched whether there was a cyclical non-stationarity present in commodity price developments. Ahmadi, Behmiri and Manera [2016] investigated the effects of oil price shocks on volatility of agricultural and metal commodities. They found that the response of volatility of each commodity to an oil price shock differed significantly depending on the underlying cause of the shock for both examined periods. Similarly, Cabrera and Schulz [2016] examined the relation between energy and agricultural commodity prices in Germany and studied their dynamics over time.

There were many studies done in the field of price volatility risk management. For example, Han, Zhou and Yin [2015] analysed the overall dependencies and structural heterogeneity in price links between energy and agricultural commodities. They concluded that the global financial crisis is the most influential shock on the price links between energy and agricultural commodities. Gollisch and Theuvsen [2015] searched on specific requirements for an integral risk management system in the agricultural supply sector based on the analysis of several branch-specific factors which contribute to the high degree of economic and organisational complexity of businesses in this sector.

Longer term price development predictions on the world level using as explanatory variables macroeconomic and trade variables are done and presented in the OECD annual outlooks. European Commission is also generating price predictions. However, the drawback of both types is that they are done on a broader regional level, making the utilization of price predictions more difficult by individual farmers.

Therefore, the aim of the article is to introduce a mathematical tool that could predict the price developments of basic agricultural commodities in the short-term horizon. The results of the predictions can help farmers to mitigate the risks of the price volatility or take these changes into account in their decision-making processes.

3.2. Methodology

We developed the CEN model[2] for the price predictions. Its upgraded version, the so-called CEN 2 model, is part of the modelling tool, which is applied for price predictions in the sector framework of the Czech Economic Accounts of Agriculture (EAA). The EAA is assembled based on the Directive of the European Parliament and of the Council (EC) No. 138/2004 in all the EU Member States. It is used as one of the basic tools for measuring and assessing the economic importance and performance of the sector of agricultural primary production in the framework of the national economy. The EAA in the Czech Republic is annually assembled by Czech Statistical Office (CSO) and published on their web pages.

The Institute of Agricultural Economics and Information (IAEI) elaborated an alternative way for projections of the EAA. In study of Foltýn, Zedníčková and Chaloupka [2014] it is possible to find the description of the whole model that consists of several submodels. Each submodel projects the yearly developments for several years ahead, the projection is folded (with moving base). It means that the base input time series is moving always by one step (one year) ahead. For example, the projection for 2015 is based on the data from the period 2000–2014 and the projection for 2016 is based on the data from the period 2000–2015, where data for 2014 are taken from previous projection. All submodels are dynamic and react on the feeding of new data. Similarly, they can fill-in missing data in the time series. The year 2000 is used as baseline year for projections.

The article presents the prediction submodel CEN 2. It obtains data from monthly commodity prices on the farm-gate level from 2000. The model is based on the seasonal trend forecast method. The seasonality is stated on 12 months. There are two prediction options. Projection can be done using linear or power regression function. It is also possible to choose between current and constant (fixed) prices for 2000.

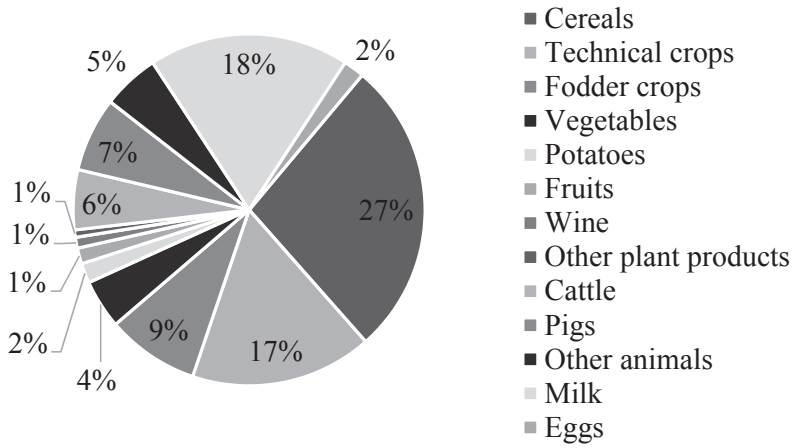
Modelled prices cover 37 basic commodities, i.e. commodities with the largest representation in the Czech agricultural production in 2015.

The area of the Czech agricultural land according to the Czech Cadastral Office is about 4.2 million ha, from which a significant part (3 million ha, i.e. 71%) is arable land. Animal production is related to the crop production and the

[2] CEN is the abbreviation of "cena" = price in the Czech language.

most frequent specialization on farms is on cattle breeding, followed by pigs and poultry. The total agricultural production amounted to CZK 121 billion (approximately EUR 4.4 billion) in 2015. As can be seen from Figure 1, the biggest part of this sum was represented by cereals, milk, technical and fodder crops, followed by production of cattle, pigs and other livestock. The share of vegetables, potatoes, fruit, wine and other crop products is much lower, but still significant for the commodities to be included into the analysis and projections.

Figure 1. The most important categories of production in the Czech agriculture



Source: own elaboration based on data from EAA.

The submodel is programmed in the Microsoft Excel software. The data were taken from the CSO, it means time series of farm-gate (agricultural producers) prices (FGP) with monthly frequency and annual averages. Above it, some additional price data from the internal database BASELINE of the IAEI were utilized.

3.3. Results

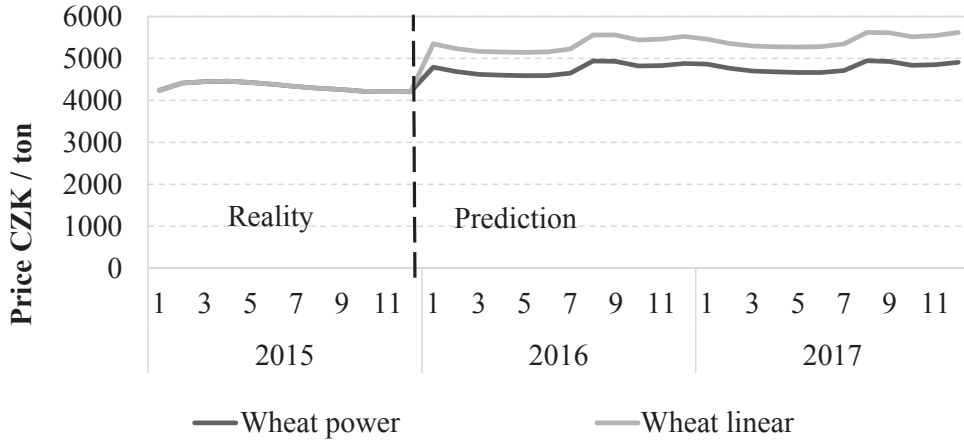
The first part of projections is calculated in current prices for the projection horizon January 2016 – December 2017. In the second part, it is shown how the projections would look if constant (fixed) prices for 2000 were applied.

Predictions in current prices

This chapter presents the predicted prices of wheat, malting barley, sugar beet, potatoes, milk, beef, and pigs. In Figures 2-8, the lighter colour lines represent prediction of prices with the application of the power function; the darker lines are used for predictions with the application of the linear function.

The price development for wheat is presented in Figure 2. The prediction curve is slightly increasing, with model expected average increase of the FGP in CZK 500/t.

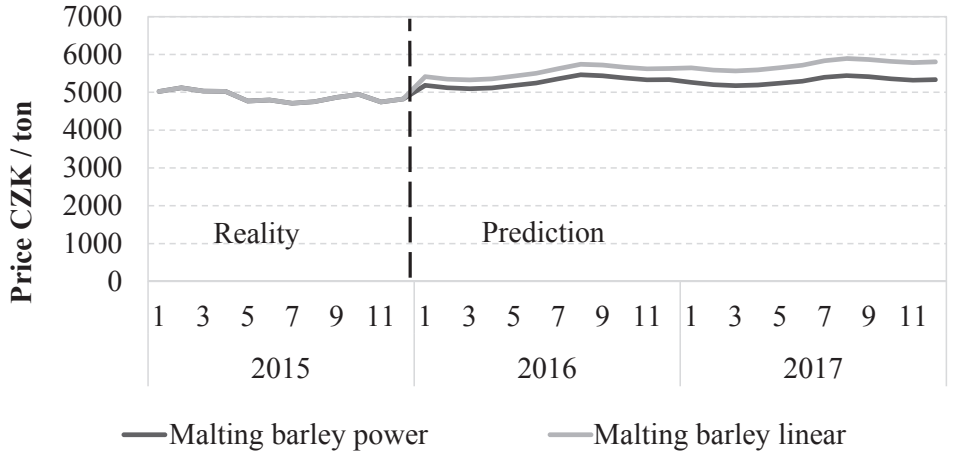
Figure 2. Prediction of wheat farm-gate price (2015-2017)



Source: own elaboration.

A similar character has the prediction curve linked with the FGP for malting barley (see Figure 3). Because real average prices for all projected commodities for 2016 are already known, we are able to compare the modelled predictions with the real price development. In case of wheat and malting barley the real prices are different from the predicted (modelled) ones in 2016. The prices of those two cereals in 2016 decreased. After including the real prices for 2016 into the CEN2 model, the total long-term increase of the prices slowed down and the prices have started to decrease. The predictions for the further period using new actual data do not project such original high increase in the prices.

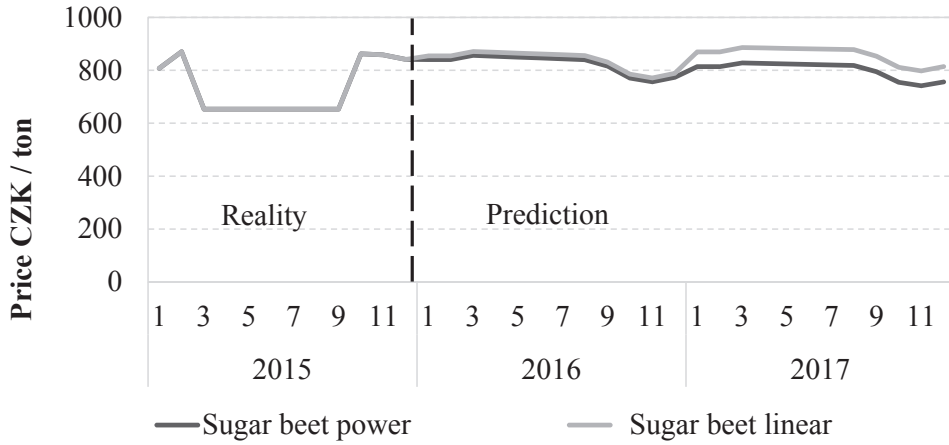
Figure 3. Prediction of malting barley price (2015-2017)



Source: own elaboration.

In case of sugar beet (see Figure 4) the trend is conversely lightly increasing, both in the modelled projection and at the same time, in the case of the real average farm-gate prices for 2016. Therefore, it is possible to expect a light increase in prices also in 2017.

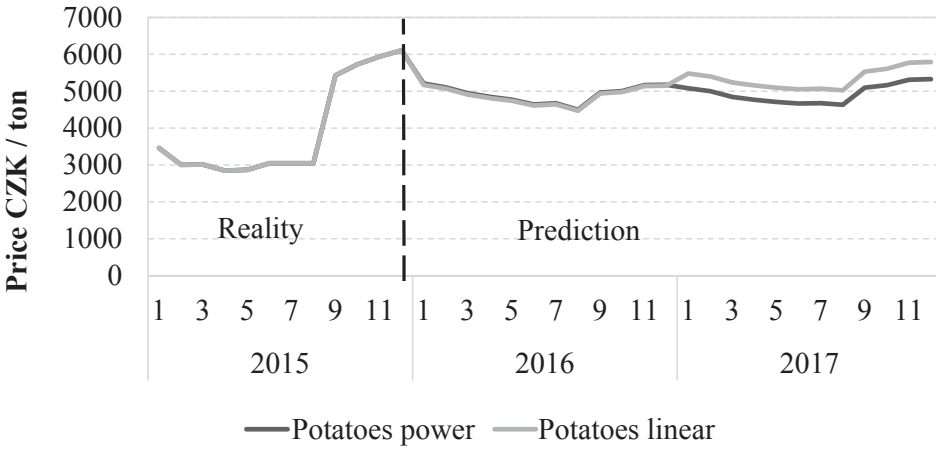
Figure 4. Prediction of sugar beet price (2015-2017)



Source: own elaboration.

As regard potatoes (see Figure 5), the price development does not differ much both for the application of the power and the linear functions. As in the case of sugar beet, the modelled price development suggests slight increase, followed the 2016 reality.

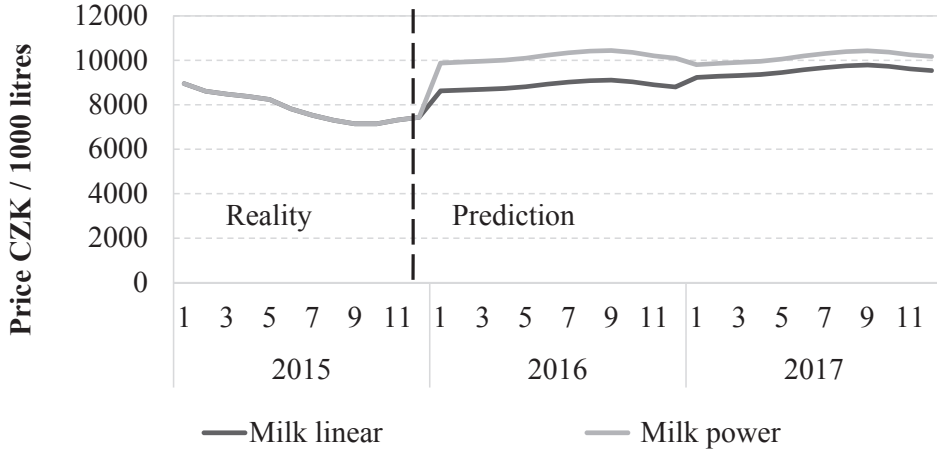
Figure 5. Prediction of potatoes price (2015-2017)



Source: own elaboration.

Price developments in livestock production shows higher volatility than in the crop production. It is closely related to the relatively high coupled subsidies policy and milk quotas up to 2015. Milk prices origin from long-time series of the previous years when the prices continually were increasing. However, in 2015 the milk quotas were cancelled and the price of milk experienced a decrease or a slight stagnation. However, the model projected an increase of the price. It is due to the fact, that it is based on mathematical relations with their limitations. Nevertheless, this weakness and obstacle shall be eliminated in the further development of the model. Also using new actual data and prolonging time series should have positive impact on the quality of the model. The linear projection expects a slighter price increase than the power regression in 2016. For the next year, the projection does not differ so significantly.

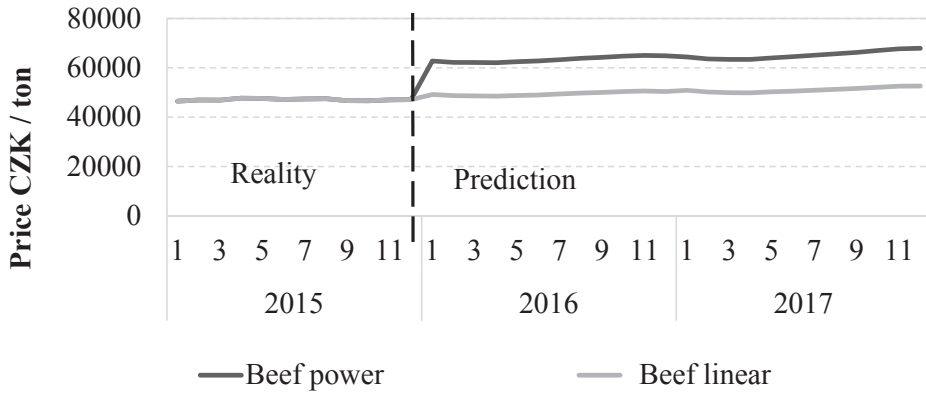
Figure 6. Prediction of milk price (2015-2017)



Source: own elaboration.

Considering the prices of beef (see Figure 7), it can be seen that a starting increase is followed by a moderate stagnation. Until 2015, the prices increased slowly and therefore the projections based on the linear function continue in this trend. This "mild" projection is probably also more realistic and it is linked with expected increase in feed prices.

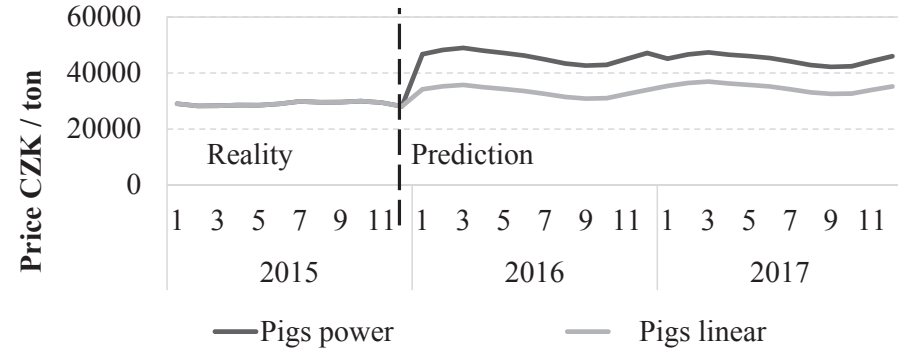
Figure 7. Prediction of beef price (2015-2017)



Source: own elaboration.

As regard pig prices (see Figure 8), the reality shows almost stagnation in 2015, followed in projections by a mild increase in the case of the linear trend and a higher increase in the case of the power function.

Figure 8. Prediction of pig price (2015-2017)

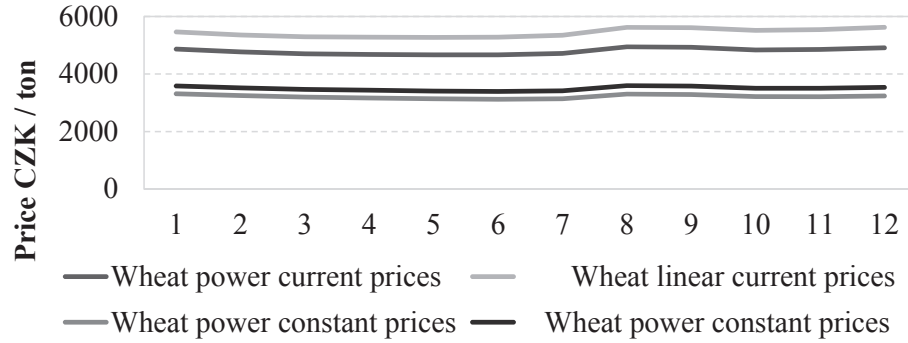


Source: own elaboration.

Comparison of predictions in current and constant prices

The differences between projection in current and constant prices for 2000 are demonstrated in Figure 9. It is obvious that the development of the trend is similar in both cases, but deflated prices have lower base than current prices. Therefore, it is preferred to use current prices in the models as they are closer to the reality.

Figure 9. Prediction of wheat price in current and constant prices (2017)



Source: own elaboration.

3.4. Conclusions

The aim of the article was to present possibilities of a mathematical tool for short term price predictions. The price predictions for basic agricultural commodities are linked with the "RDP model" [Chaloupka, Pechrová and Doucha, 2016] for the cost-benefit analyses of investment projects under the Czech Rural Development Programme 2014-2020. Besides, the CEN 2 model is a part of the model for the prediction of the Czech Economic Accounts for Agriculture. The results can be cautiously used as risk management tool by extension services or directly by individual farms for planning of production under expected price volatility. The utilization of the results by policy-makers is particularly in the field of monitoring, assessments and suggestions of the Czech policy measures, related especially with the 2nd pillar of the EU Common Agricultural Policy.

References

1. Ahmadi, M., Behmiri, N.B., Manera, M., *How is volatility in commodity markets linked to oil price shocks?*, Energy Economics, no. 59, 2016, pp. 11-23 (DOI: 10.1016/j.eneco. 2016.07.006).
2. Cabrera, B.L., Schulz, F., *Volatility linkages between energy and agricultural commodity prices*. Energy Economics, no. 54, 2016, pp. 190-203 (DOI: 10.1016/j.eneco.2015.11.018).
3. Chaloupka, O., Pechrová, M., Doucha, T., *Evaluation of projects from Rural Development Programme in the Czech Republic*, [in:] *Competitiveness of the economy in the context of social policy measures – international perspective* edited by A. Kowalski and M. Wigier, IAFE-NRI, Warsaw, 2016, pp. 75-85 (ISBN 978-83-7658-633-5).
4. Foltýn, I., Zedníčková, I., Chaloupka, O., *Alternative approaches to the prediction of EAA*, Proceedings of the 23th International Scientific Conference Agrarian Perspectives, CULS, Prague, 2014, pp. 64-73 (ISBN 978-80-213-2545-6).

5. Girdziute, L., Miceikiene, A., *Risk Management at Lithuanian Farms*, Entrepreneurship, Business and Economics, no. 3-1, [in:] *Eurasian Studies in Business and Economics*, 2016, pp. 399-409 (DOI: 10.1007/978-3-319-27570-3_31).
6. Gollisch, S., Theuvsen, L., *Risk management in the farm supply sector – characteristics, challenges and implications*, Berichte uber Landwirtschaft, no. 93(1), 2015.
7. Guerrieri, M., Fedrizzi, M., Antonucci, F., Pallottino, F., Sperandio, G., Pagano, M., Figorilli, S., Menesatti, P., Costa, C., *An innovative multivariate tool for fuel consumption and costs estimation of agricultural operations*, Spanish Journal of Agricultural Research, vol. 14, issue 4, 2016 (DOI: 10.5424/sjar/2016144-9490).
8. Han, L.Y., Zhou, Y.M., Yin, L.B., *Exogenous impacts on the links between energy and agricultural commodity markets,* Energy Economics, no. 49, 2015, pp. 350--358 (DOI: 10.1016/j.eneco.2015.02.021).
9. Moschini, G., Hennessy, D.A., *Uncertainty, risk aversion, and risk management for agricultural producers*, [in:] *Handbook of Agricultural Economics*, 1, Part A, 2001, pp. 87-153.
10. Oglend, A., Asche, F., *Cyclical non-stationarity in commodity prices*, Empirical Economics, no. 51(4), 2016, pp. 1465-1479 (DOI: 10.1007/s00181-015-1060-6).
11. Pop, L.N., Rovinaru, M., Rovinaru, F., *Managing the agricultural price volatility – a governmental approach from a global and European perspective*, *Interdisciplinary Management Research XII,* [in:] *Interdisciplinary Management Research-Interdisziplinare Managementforschung*, 2016, pp. 531-541.

4 Risk management practices of agricultural enterprises – evidence from Estonia[1]

Merilin Ratas [1], Maire Nurmet [1,2]
[1]Estonian University of Life Sciences, [2]University of Tartu
Merilin.Ratas@emu.ee, Maire.Nurmet@emu.ee

Abstract

Agriculture is associated with a number of unique risks originating from the natural environment, high volatility of supply and demand, political changes. This paper identifies agricultural risks and risk management measures in Estonian agricultural enterprises. The Estonian agricultural enterprises' present risk and implemented risk management strategies were surveyed using a web-based questionnaire. The results show that the input and output price volatility is considered one of the most important risk sources. Adverse weather conditions are of great importance not only among field crop farmers, but also among livestock farmers. The decision makers in agricultural enterprises rely on a wide spectrum of measures that allow farmers to cope with higher market pressures and intensified competition: maintaining stocks of food and seed supplies; use of weather-resistant and epidemiology-resistant cultivars and livestock species, and co-operation between agricultural enterprises are of higher relevance.

Keywords: farmers' risk awareness, agricultural risk management, Estonian agriculture

JEL Classification: Q12

4.1. Introduction

Agriculture is open to a wide spectrum of risks, and the emergence of new risks is growing. Animal diseases, volatile commodity markets, climate change, political factors and labour shortages are few of the examples that farmers have to cope with. Farmers and agribusiness companies face a high degree of risk because of certain new factors, such as greater price volatility for inputs and outputs, climate change, international trade restrictions, and new and more stringent food safety standards [Broll et al., 2013]. Agriculture is risky because of the seasonality, climate change, dependence on natural processes and biological assets as well as high fluctuations in agricultural demand and supply and prices [Girdžiūtė, 2012]. In

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

any moment of time there is a chance for unanticipated and unfavourable events that can have negative consequences for the businesses. Risk is understood as a component of business activity related to the expectations of economic results that may not be fulfilled because of unexpected events in the planning-production-sales process [Pontrandolfi and Nizza, 2012]. In order to address risks, agricultural enterprises respond with a diverse number of risk management strategies depending on their level of risk aversion, in the context of their production plans, their financial, physical and human capital [OECD, 2009]. Risk management is crucial at the farm-level. It is a fundamental issue for farmers as, apart from bankruptcy which is the ultimate consequence of catastrophic events, a variability of income and risks of income loss lead first to sub-optimal production decisions every year and then to sub-optimal investment decisions. The result is the reduction of farm competitiveness through short-time loss of productivity and long-term loss of innovation [Cordier, 2014]. Farmers in general have adapted their production and economic decision to the level and type of risk they are exposed to [Hansson and Lagerkvist, 2012]. Successful farmers have a good understanding of agricultural environment, good skills to anticipate potential problems and to reduce their adverse effects.

Previous farm-level studies about agricultural risk management are aimed to identify and assess perceptions of, management and performance under risk and uncertainty depending on the farmers' risk aversion level [Meuwissen et al., 2001; Wauters et al., 2014; Shadbolt and Olubode-Awosola, 2016]. As risk perception is the subjective mental interpretation of the risk and the chance of the exposure, the willingness to manage risks is related to the perceived risk, subjective probability of an adverse outcome and expected value of the potential loss. Risk attitude refers to the extent to which the decision makers want to avoid or face the risk [Ogurtsov et al., 2008]. The individual risk aversion affect the willingness to apply risk management tools in the farm.

In Estonia, there are few earlier studies, which focus on farm-level risk management strategies in agriculture. These studies were focused on cases of a certain production type of farms. Thus, the main risks and farmers' preferences of risk management strategies in agriculture are not completely known.

The aim of the present study is to identify the agricultural risks and to chart Estonian agricultural enterprises decision makers' preferences of risk management strategies on the basis of a web-based questionnaire survey. This study contributes to the growth of risk awareness and provides suggestions for extension of knowledge about sources of risk and risk awareness. The outcome is of practical importance for the farmers, the agribusinesses, and for policy-makers when evaluating the demand for or specifying a product or policy instrument that addresses

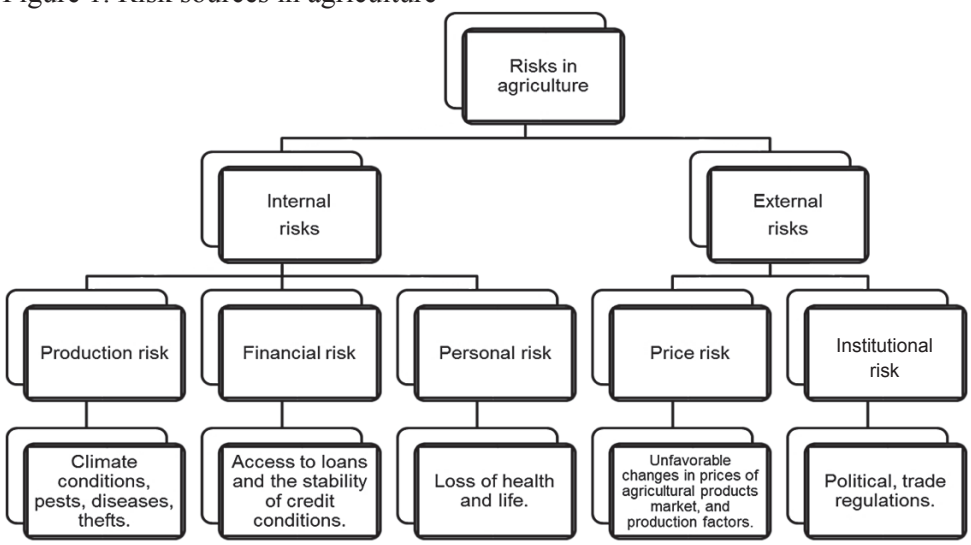
risk. Knowing farmers' awareness of risks enables extension educators to help them to understand the consequences of risk.

The paper is organized as follows. The next section provides insight into the risk management, opening theoretical background of the risk management through the relevant prior literature. Then the method and research design is described, the results of the conducted analysis are presented. The final section concludes the study.

4.2. Risk classification and risk management in agriculture

Risk in the agricultural sector has traditionally been classified into the categories of production risk, financial risk, market risk and institutional risk [Hardaker et al., 2004; Boehlje, 2005]. The agricultural risk classification in the EU divides risks as personal, institutional, financial, production and price [Agricultural…, 2006]. The personal risks include loss of health and life; the institutional risks include political, trade regulations, the financial risks include access to loans and the stability of credit conditions, the production risks include causes from climate conditions, pests, diseases, thefts, fires; and the price risks include unfavourable changes in the prices on agricultural products' markets and production factors (Figure 1). Another classification that risk can be categorized into is internal and external. The internal risk sources are production, equipment, personnel, financial leverage. The external risks include market and political risks.

Figure 1. Risk sources in agriculture



Source: authors' compilation using Hardaker et al., 2004; Boehlje, 2005; Schaper et al., 2009; Theuvsen, 2013; Wauters, 2014.

External risk is defined as risk for, or from, customers, market, competitors, regulations, environment, etc. Internal risks can often be managed through internal measures, external risks are not controllable by management [Blanc Alquier and Lagasse Tignol, 2006; Schaper et al., 2009].

Risk management is a decision on the choice of risk management instruments, a means of protecting the survival of the firm from failure due to unsystematic events [Kaen 2005]. The objective of risk management is to monitor and manage the actual risk. Commonly there are three goals for risk management: protection from downside loss, management of volatility, and optimizing risk and return. The risk management process consists of risk analysis, risk management strategy implementation and risk control.

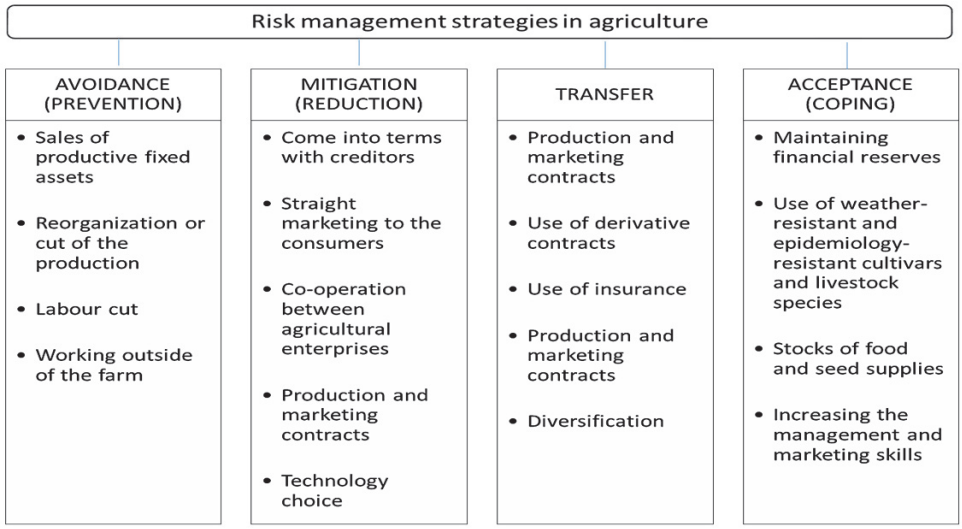
The risk analysis includes risk identification and evaluation. The risk identification outlines various categories of risks faced by agricultural enterprises including production, financial, personal, price, and institutional risks including compliance-related and environmental, political, and safety risks. There are numerous ways to evaluate and analyse the risks faced by agricultural companies. These methods range from highly quantitative techniques, such as computing probability distributions, to subjective procedures, such as those used in risk scorecard techniques [Boehlje and Lins, 1998]. Risk can be evaluated, as each risk category has three dimensions: potential, exposure and probability. Potential (upside risk) is the opportunity that the firm has if it takes a risk. When the outcomes are favourable, the firm may benefit from strategic advantages such as loyal customers, new market, cost-advantage, which create long-term value. Every firm also has the downside risk that can directly or indirectly cause an economic loss. In order to be aware of the dangers of the risk, assessment of the exposure is necessary. Assessment of the exposure enables making informed decisions based on possible exposure. Probability is the chance for potential or exposure event to occur [Detre et al., 2006].

Some risks can be reduced, and several strategies for managing agricultural risks can be implemented. Agricultural risk management strategies can be divided into four main groups: risk avoidance (prevention), risk mitigation (reduction), risk transfer, risk acceptance (coping) [Schaper et al., 2009; Theuvsen, 2013]. Risk avoidance is the process of structuring the business so that certain types of risk are non-existent [Miller et al., 2004]. The sales of productive fixed assets, reorganization of the production, working off-farm, serve as risk avoidance tools. Risk mitigation involves any measure to decrease the probability that adverse events hit the farm, such as the technology choice. Risk transfer is done by strategies that allow the risk to happen, but reduce its impact, such as external strategies like diversification or market based strategies such as insurances or

derivative instruments. Risk acceptance is coping with risk, performed using strategies to restore the damage when it happens, such as the off-farm income, cutting private expenses or selling assets [Wauters et al., 2014]. Figure 2 presents the agricultural risk management strategies and tools.

Risk control figures out whether the risk management strategies implemented have been successful [Schaper et al., 2009]. It includes internal design of the risk management process, regularly supplying decision makers with relevant information about new risks or changing loss potentials [Theuvsen, 2013]. Because of the multidimensional nature of agricultural risks a single risk management tool may have an impact on the effectiveness of other tools. Sometimes it is difficult to control the relative contribution of risk management tools.

Figure 2. Agricultural risk management strategies and tools



Sources: authors' compilation using Meuwissen et al. 2001, Nabradi and Madai 2007, Schaper et al. 2009, Wauters 2014, Shadbolt and Olubode-Awosola, 2016.

The choice of risk management tools is dependent on usefulness of these tools for a farmer. The willingness of farmers to use risk management tools is related to the perceived business risk, subjective probability of loss and expected loss value that may be different from the objective business risk. The individual risk aversion, the farmer's level of debt, the average level of income and the probability of having a very low farm income may also affect the willingness to reduce the farm income distribution [Cordier, 2014]. Risk perception of both upside and downside risk and its likelihood of happening is subjective and bases on the experience, attitude, and awareness of a decision maker.

4.3. Materials and method of risk questionnaire survey

The study aimed to obtain an insight into the risk sources the agricultural enterprises' decision makers are aware of and the ways in which they prefer to manage these risks. The data used in the study was collected by a web-based survey questionnaire conducted in 2015. The list of risk management strategies was compiled for the survey in order to determine how important respondents thought they were. Most of the risk sources and risk management strategies which were included in the survey are the common risk sources that are present in the literature [Schaper et al., 2009; Meuwissen et al., 2010; Wauters, 2014; Shadbolt and Olubode-Awosola, 2016]. The respondents were asked to score the risk sources according to the probability of occurrence and impact, and preferences of risk management strategies on a five-score Likert scale from 1 (minor importance) to 5 (highly important). The respondents were asked about their risk attitude on a three-point scale: risk-averse, risk-neutral, risk-seeking in order to provide an overview about the Estonian farmers' willingness to accept risks.

The questionnaire was mailed to 648 Estonian agricultural enterprises randomly selected from a database of agricultural enterprises located in Estonia. The database is maintained by Statistics Estonia. The agricultural enterprises are of different sizes and they operate in various production types, so the results can be generalized to agricultural enterprises with different sizes and operating in different production types. The survey package included a covering letter explaining the purpose of the research and a link to the web site where respondents could complete the questionnaire. Respondents answered anonymously using the web-based questionnaire. All in all, 136 responses were received out of the 648 recipients, constituting a response rate of 21 percent. The sample size may be sufficient to provide a representative overview of the sector and gives an indication of responses which could form the basis for further research. The evaluation of the data was performed by SPSS 10 and MS Excel 5.0. basic statistics.

4.4. Empirical results and discussion

The sample consisted of 82% of representatives of limited liability companies, 13% of sole proprietors, and 5% of joint-stock companies. The sample represents agricultural enterprises rather than sole proprietor farmers. Of production types, 50% were mixed farms, 26% – livestock farms, and 23% – field crop farms. 49% of enterprises were more than 16 years old, and they were predominantly micro enterprises with 1-9 employees. Table 1 reports the summary statistics of characteristics of the sample enterprises.

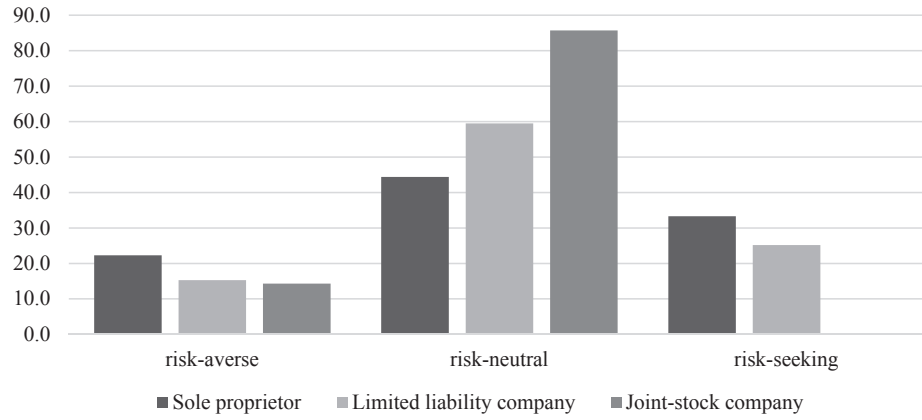
Table 1. Summary statistics of the sample enterprises

Parameter	Type	Statistics, %
Type of enterprise	Limited liability company	82
	Sole proprietor	13
	Joint-stock company	5
Type of production	Mixed	50
	Livestock	26
	Field crops	23
	Other	1
Age of the enterprise (years)	0-5	21
	6-10	13
	11-15	17
	16-…	49
Number of employees	1-9	72
	10-19	9
	20-49	15
	50-…	4

Source: calculated according to the survey.

Farmers' risk attitudes are diverse: from predominantly risk-averse [Khuu and Weber, 2013] to risk-seeking [Roe, 2013]. The respondents' attitudes toward risks were classified into three categories: risk-neutral, risk-averse and risk-seeking. It appeared that farmers were mostly risk-neutral or risk-averse and not very open to risks. Most of the respondents of joint-stock companies (85.7%) represented risk-neutral attitude and none of them was risk-seeking. Of sole proprietor farmers, 44.4% were risk-neutral, 22.3% were risk-averse, and 33.3% were risk-seeking (Figure 3).

Figure 3. Risk preferences of respondents

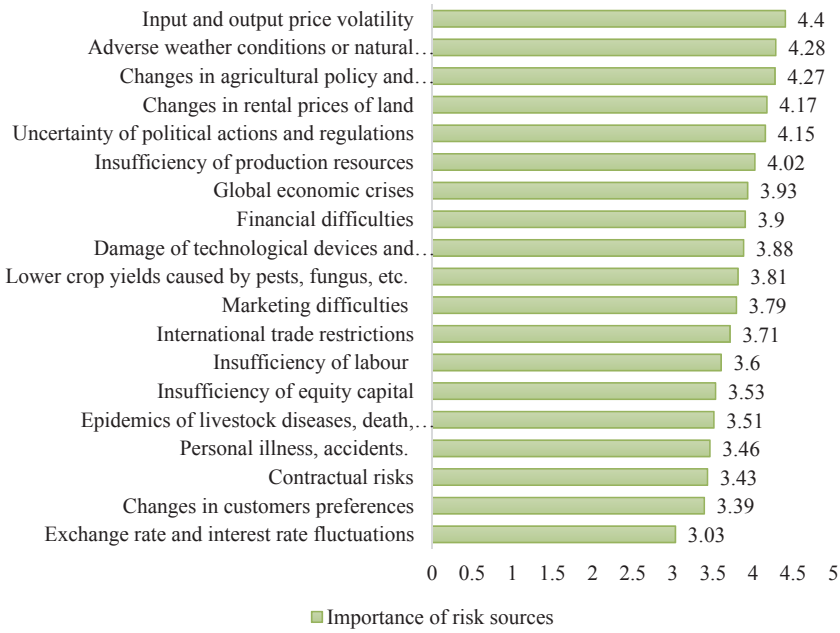


Source: calculated according to the survey.

The results of the survey present risk sources in agricultural enterprises, the managers' main strategies and responses and ways in which these help to maintain the functioning of the enterprises. The results are subjective assessments and provide insights into agricultural enterprise managers' perceptions and subjective evaluation as well as their decision criteria. Figure 4 reports the present risk sources in agricultural enterprises according to their importance.

The results show that the input and output price volatility is considered as the most important risk source with an average score of 4.40. Several earlier studies suggest that price volatility is the most acute problem for agricultural enterprises [Nabradi and Madai, 2007; Meuwissen et al., 2010; Wolf, 2012]. The commodity price volatility impacts both agricultural inputs and outputs and increasing volatility is a remarkable risk source. Adverse weather conditions or natural disasters as source of production risk are uncontrollable by a farmer and also have great importance with an average score of 4.28. Adverse weather conditions are of great importance not only among field crop farmers, but also among livestock farmers.

Figure 4. Importance of risk sources



Source: calculated according to the survey.

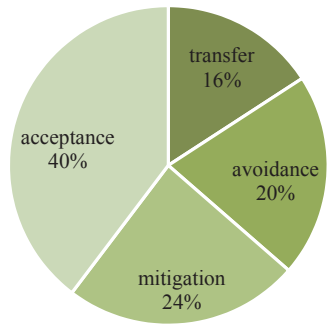
Institutional risk, the changes in agricultural policy and subsidization are important risk sources with average score of 4.27. Most of the agricultural enterprises could not survive without subsidies and to ensure the viability of the farms, the subsidization should remain stable.

From risks arising from new economic environment the contractual risks are considered to be some of the less important risk sources for agriculture with score of 3.43 showing that contractual relations are satisfying between stakeholders. The changes in customers' preferences (3.39), the exchange rate and interest rate fluctuations (3.03) are also of less importance. The fact that 30% of respondents could not estimate the risk arising from exchange rate and interest rate fluctuations is worth mentioning, although 26% of respondents considered it important and 12% very important. The correlation analysis showed that all risks were positively correlated with each other.

According to the relevance, probability of occurrence, and the impact dimension, we can conclude that the input and output price volatility, changes in agricultural policy and subsidization, and adverse weather conditions or natural disasters are the most important risk sources in Estonian agriculture. The exchange rate and interest rate fluctuations, personal illness and accidents are less important. Hence, farmers are more concerned about external risks, which are difficult to control, and less concerned about internal risks.

The following results reflect the risk management strategies of the surveyed decision makers of agricultural enterprises. In the survey, the respondents were asked to estimate the most frequently used risk management strategies. Figure 5 presents the results about the risk management strategies.

Figure 5. Risk management strategies in agricultural enterprises (%)

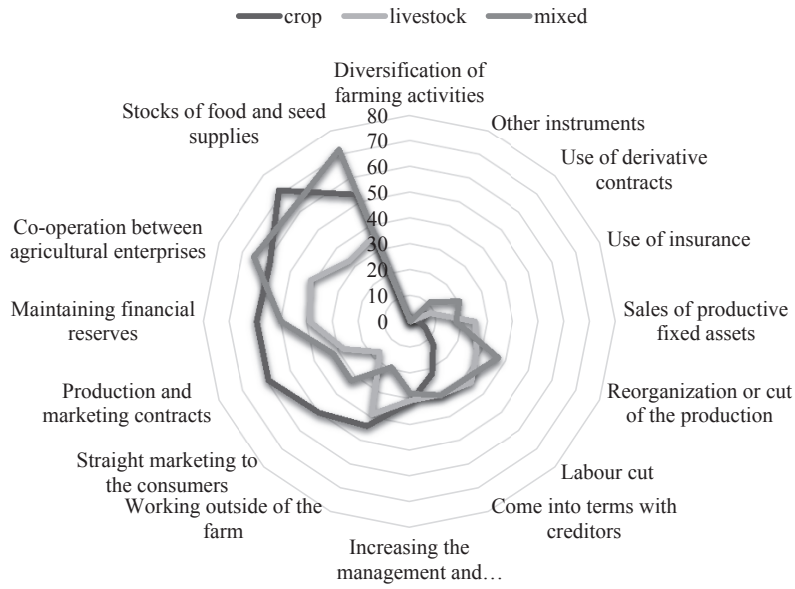


Source: calculated according to the survey.

The results show that the decision makers in agricultural enterprises rely on a wide spectrum of measures that allow to cope with higher market pressures and intensified competition. Stocks of food and seed supplies have got significant preference among the other strategies (58.1%), use of more weather-resistant and epidemiology-resistant cultivars and livestock species (57.4%), and co-operation

between agricultural enterprises (55.9%) are the next most frequently used tools (Figure 6). With regard to risk reduction, the cooperatively organized purchases of input factors, which reduce price risks associated with such purchases, are the favourites among farmers. Co-operation between farmers is relatively differently assessed. A large group of farmers want to strengthen these cooperatives in order to meet future challenges, whereas many other farmers strongly reject the idea of giving up their entrepreneurial freedom. 49.3% of the farmers wish to maintain financial reserves in order to survive the low season and 37.5% of the farmers find production and marketing contracts to be a good risk management tool.

Figure 6. Risk management tools in agricultural enterprises (%)



Source: calculated according to the survey.

The diversification and activities in less price-sensitive niche markets were not mentioned as risk reduction strategies. Generally speaking, diversification as a strategy is of minor importance for farmers. None of the respondents is willing to start up new businesses nor diversify their farm activities. The opinions are more mixed with regard to market niches, such as organic dairy production. Although 54.5% of the dairy farmers are not interested in this type of production, a high standard deviation indicates that some farmers have a different opinion.

The most used risk management measures were adequate stocks of food and seed supplies in warehouses, sustainable plant and animal varieties and co-operation with other farmers. The use of insurance and derivative contracts were less often used in risk management.

4.5. Conclusions

The most risk-neutral decision makers of agricultural enterprises perceive several sources of risks. The results of the questionnaire survey show that the decision makers of agricultural enterprises are the most concerned about extreme adverse market conditions causing both input and output price volatility.

Risk acceptance strategy tools such as maintaining sufficient stocks of food and seed supplies are more preferable among decision makers of agricultural enterprises than risk transfer strategy tools such as insurance and derivative contracts, provided by the private market. The diversification of farming activities was not under consideration as a risk management tool.

Risk management should be carried out in cooperation with farmers, insurance companies, banks and government. Since farmers lack knowledge about specific risk management tools, the authors suggest to pay attention on farmers' consultation, information and training, helping them to understand deeper benefits of risk management.

Given the risk attitude of Estonian farmers, the authors suggest to focus further research on risks and their relations in the context of income stabilization, particularly on specific risks and thier identification, assessment and management.

References

1. *Agricultural Insurance Schemes*, European Commission, 2006.
2. Blanc Alquier, A.M., Lagasse Tignol, M.H., *Risk management in small- and medium-sized enterprises*, Production Planning & Control, vol. 17 no. 3, 2006, pp. 273-282.
3. Boehlje, M., Lins, D., *Risks and risk management in an industrialized agriculture*, Agricultural Finance Review, no. 58, 1998, pp. 1-16.
4. Broll, U., Welzel, P., Pong Wong, K., *Price risk and risk management in agriculture,* Contemporary Economics, vol. 7, no. 2, 2013, pp. 17-20.
5. Cordier, J., *Comparative analysis of risk management tools supported by the 2014 Farm Bill and the CAP 2014-20*, European Parliament, Study IP/B/AGRI/IC/2014-044, Brussels, December 2013, pp. 70.
6. Detre, J., Briggeman, B., Boehlje, M., Gray, A.W., *Scorecarding and Heat Mapping: Tools and Concepts for Assessing Strategic Uncertainty*, International Food and Agribusiness Management Review, vol. 9, no. 1, 2006, pp. 71-92.
7. Girdžiūtė, L., *Risks in agriculture and their assessment methods*, [in:] *Annual 18th International Scientific Conference Proceedings. Research for Rural Development,* ed. by S. Treija, I. Skuja, Jelgava, vol. 2, 2012, pp. 197-203.
8. Hardaker, J.B., Huirne, R.B.M., Anderson, J.R., Lien, G., *Coping with Risk in Agriculture*, 2nd Edition, CABI Publishing, Wallingford, 2004, pp. 332.
9. https://ec.europa.eu/agriculture/sites/agriculture/files/external-studies/2006/insurance/summary_en.pdf.

10. Kaen, F.R., *Risk Management, Corporate Governance and the Modern Corporation*, [in:] *Risk Management: Challenge and Opportunity*, ed. by M. Frenkel, U. Hommel, M. Rudolf, Springler, 2nd edition, 2005, pp. 423-436.
11. Khuu, A., Weber, E.J., *How Australian farmers deal with risk*, Agricultural Finance Review, vol. 73, no. 2, 2013, pp. 345-357.
12. Meuwissen, M., Burger, K., Lansink, A.O., *Resilience of food companies to calamities – perceptions in the Netherlands*, 2010, available at: http://commodity-platform.org/wp/wp-con-tent/uploads/2011/05/resilience-web.pdf (access: 15.07.2016).
13. Meuwissen, M., Hardaker, J.B., Huirne, R.B.M., Dijkhuizen, A.A., *Sharing Risks in Agriculture: Principles and Empirical Results*, Netherlands Journal of Agricultural Science, no. 49, 2001, pp. 343-356.
14. Miller, A., Dobbins, C., Prichett, J., Boehlje, M., Ehmke, C., *Risk management for farmers*, Staff Paper 04-11, Department of Agricultural Economics, Purdue University, 2004, pp. 1-27.
15. Nabradi, A., Madai, H., *Risk and risk management in Hungarian sheep production,* Applied Studies in Agribusiness and Commerce, vol. 1, no. 1, 2007, pp. 61-65.
16. OECD, *Managing risk in agriculture: a holistic approach*, 2009, available at: http://www.oecd.org/agriculture/agriculturalpolicies/45558582.pdf (access: 14.12.2014).
17. Ogurtsov, V.A., Van Asseldonk, M.P.A.M, Huirne, R.B.M., *Assessing and modelling catastrophic risk perceptions and attitudes in agriculture: a review*, NJAS – Wageningen Journal of Life Sciences, no. 56 (1-2), 2008, pp. 39-58.
18. Pontrandolfi, A., Nizza, G., *Perspectives on risk management as climate change adaptation measure in Italian agriculture,* [in:] *Building Resilience for Adaptation to Climate Change in the Agriculture Sector*, Proceedings of a Joint FAO / OECD Workshop, 2012, pp. 317-326, available at: http://www.fao.org/docrep/017/i3084e/i3084e19.pdf (access: 11.12.2014).
19. Roe, B.E., *How Well Do Farmers Tolerate Risk? Comparisons with Nonfarm Business Owners and the General Population*, Choices, vol. 28, issue 4, 2013, pp. 1-5 available at: http://www.choicesmagazine.org/magazine/pdf/cmsarticle_ 335.pdf (accessed on 05.03.2015).
20. Schaper, C., Lassen, B., Theuvsen, L., *Risk Management in Milk Production: A Study in Five European Countries,* Paper presented at the 113th EAAE Seminar: *A resilient European food industry and food chain in a challenging world*, Chania, Crete, Greece, September 3-6, 2009.
21. Shadbolt, N., Olubode-Awosola, F., *Resilience, Risk and Entrepreneurship*, International Food and Agribusiness Management Review, vol. 19, issue 2, 2016, pp. 33-52.
22. Theuvsen, L., *Risk and risk management in agriculture,* Problems of world agriculture, Warsaw University of Life Sciences Press, Warsaw, vol. 13 (XXVIII), no. 4, 2013, pp. 162-174.
23. Wauters, E., Van Winsen, F., De Mey, Y., Lauwers, L., *Risk perception, attitudes towards risk and risk management: evidence and implications*, Agricultural economics – Zemedelska Ekonomika, no. 60(9), 2014, pp. 389-405.
24. Wolf, C., *Dairy farmer use of price risk management tools*, Journal of Dairy Science, no. 95(7), 2012, pp. 4176-4183.

5 An index-based margin insurance for agriculture – the example of wheat production in Austria[1]

Franz Sinabell[1], Karin Heinschink[2], Thomas Url[1]
[1] Austrian Institute of Economic Research, Vienna, Austria
[2] Federal Institute of Agricultural Economics, Vienna, Austria
Franz.Sinabell@wifo.ac.at, Karin.HEINSCHINK@awi.bmlfuw.gv.at, Thomas.Url@wifo.ac.at

Abstract

This paper presents an overview of institutions governing risk management in Austrian agriculture and reports on recent developments in the market of crop insurances. A novel framework to manage agricultural risks more comprehensively is also presented. The major features of this margin insurance tool are shown using wheat production as an example. Ways to address moral hazard are explored in more detail. Limitations of the presented approach and ways to overcome them are discussed in the concluding section.

Keywords: agricultural risk management, income insurance scheme, insurance product, gross margin, wheat production

JEL Classification: G22, G32, Q12, Q18

5.1. Motivation and problem statement

In recent years, the portfolio of insurance products for agriculture has expanded significantly in many EU Member States. Insurance against damages due to natural hazards like hail, frost, snow pressure, floods are now available for a large number of crops. Recently index-based insurances were introduced to cover losses due to draught for crops and grassland. The acceptance on the market shows that farmers actually need such products and are willing to pay for them.

Representatives of farmers, however, are not yet satisfied with the current product portfolio. Their argument is that a single product that covers both production and market risks is needed. Such a product would reduce transaction cost compared to the current situation where additional contracts are necessary to hedge price risks. A revenue insurance would be an improvement compared to the current situation but farmers are mainly concerned about profits and in-

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

comes and less about yields or revenues. Therefore, an ideal insurance product would cover not only production risk and product price risks but also price risks of inputs, such as fuel and fertilizer.

Moreover, many farms in the EU are relatively small and farmers are typically both managing and operating their business. They would benefit from a simple insurance product since many of them are extremely time-constrained, but nevertheless need to make well-informed choices whether to take up the insurance or go along with their current practice.

These considerations and the fact that index-based products are already well established on the market made it plausible to develop a product that is simple to communicate and that can be implemented at low costs. In order to evaluate the feasibility of such a solution, a prototype was developed for the most important crops and production regions in Austria. The purpose is to identify the elements that are necessary for developing a marketable product that deals with production and market risks and that offers advantages over existing approaches.

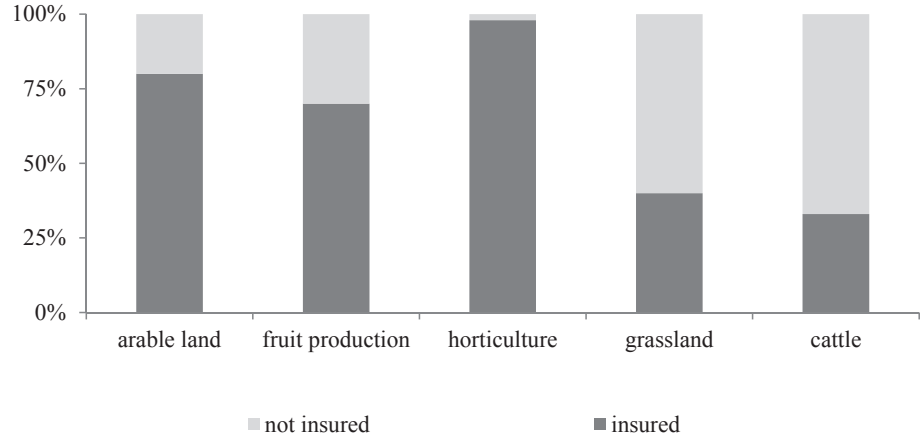
5.2. The state of agricultural production risk management in Austria

The market of Austrian disaster risk management is characterized by the fact that private and the public companies are active but not well coordinated [Url and Sinabell, 2008].

With respect to agriculture, the situation is different: a single company offers a wide range of insurance products to mitigate agricultural production risks. The Austrian Hail Insurance Company (Österreichische Hagelversiche-rung) is a mutual insurer, founded by the Austrian insurance industry in 1947. As a mutual insurer it is not profit-oriented and thus costs can be kept low. The national government has subsidized the hail-insurance premium for all crops since 1995 and the frost-insurance premium for vine-cultures and insurable crops since 1997. The subsidy is shared equally between the federal and Länder governments and amounts to 50% of the total premium.

An overview of the products portfolio offered by this firm shows that insurance products are available for almost all relevant production activities. An overview of the market volume is shown in Figure 1. Statistics on the market for agricultural production risk (Table 1) show that the market has grown significantly during the last decade and that public support has grown in a likewise manner. The annual total volume of production of agriculture in Austria was € 6.7 bn in recent years. The sum of insured values was € 3.7 bn and shows the high market penetration.

Figure 1. Market penetration of production related risk insurance in Austrian agriculture 2014



Source: Österreichische Hagelversicherung VVaG, 2016.

Drought is a severe production risk in Austria. Recently new index insurances were introduced that rely on big data meteorological applications as trigger. Drought index insurance for winter wheat and sugar beet were introduced in 2017. The portfolio was expanded to frost and flood insurance products in the same year [AWI, 2016].

Table 1. Key data on the market for production related risks in Austrian agriculture

Items	**2000**	**2005**	**2014**
clients	71,897	67,866	n.a.
area, 1,000 ha	913	1,079	1,209
premium volume, € mn	45.9	53.1	96.3
Farmer's losses, € mn	64.3	23.3	n.a.
premium subsidy, € mn	22	24	40
sum insured, € bn	n.a.	n.a.	3.7

Hint: The decreasing number of clients is due to structural change.
Source: Österreichische Hagelversicherung, VVaG; BMF various years.

5.3. Weaknesses of agricultural risk management in Austria – state of affairs and remedies

For production related risks there is a broad portfolio of insurance products available and the rate of innovations (e.g. index-based insurances) is very satisfying from the farmers' perspective. However, price volatility has increased dramatically since 2005 and farmers are more and more concerned about price risks as well.

Until recently there were no products available that a typical Austrian farmer would use to reduce price-related risks. Only few farmers are employing brokers for the hedging of futures contracts or are buying options or similar financial products. Several years ago, grain trade companies started to introduce price hedging products as a service for their suppliers. One of the motivations has been to strengthen the ties to suppliers and another one was to make price negotiations easier. Several big trade companies in Austria are co-operatives and therefore are interested in negotiating high prices for their members.

Such products are available only for a few crops (wheat, rapeseed, maize). Many producers of piglets, pigs or milk who have gathered experience with the new products as well. The decline in agricultural prices in 2014 has raised the awareness among farmers for price hedging instruments further.

Farms in Austria are small, by European standards, and a typical farmer has little time for managing the business since most of the time is consumed by working in the field or stable. Therefore, there is an entry barrier for farmers who wish to get involved in price hedging because the learning curve is felt to be very steep. Farmers wish to have price hedging instrument at their disposal that are standardized, easy to understand and affordable. Eventually farmers are mostly concerned about income stability [Larcher et al., 2015]. Therefore, alleviating production-related risks like frost, hail or drought is improving the situation for those exposed to these risks. But many more were confronted with very volatile income streams during the last years like milk or pig producers.

In a study on risk management in Austrian agriculture, Sinabell et al. [2010] analysed a general income insurance / margin insurance for Austrian farms. The idea was to switch the EU farm payments from hectare-based premiums to support premiums for such a product. Livestock producers and fruit producers would have benefited considerably from such a policy at the cost of farms with large amounts of land. This proposal was not implemented. However, the discussion to insure income losses in Austrian agriculture has been going on in a small group of persons in administration, insurance business and research.

The farm bill of 2014 introduced an insurance in the US which resembles such an approach [Orden and Zulauf, 2015]. The Dairy Margin Protection Program (U.S. DMPP) was established on the market in 2015 and is available for milk producers in the US to cover part of losses in income which are a result of low milk prices or high feeding costs. A minimum coverage is guaranteed by a government funded premium support. The prototype of an insurance product presented in the next chapter some features with the U.S. DMPP. The two commonalities are (1) that indexes are used to identify losses and (2) that the insurance covers a certain share of the margin (margin = revenues – costs). Scharner

and Pöchtrager [2016] recently presented a version of this scheme adapted to the Austrian situation. Because the general concept is not limited to milk production we demonstrate a similar insurance product for wheat.

5.4. Necessary conditions for an income insurance scheme in agriculture to work

Income insurance schemes are widely used in the Austrian economy but only very few of them are offered by the private market. Such products cover the payment of daily allowances in the case of illness or annuity payments for reduction in earning capacity.

The coverage of income losses is offered by the unemployment insurance which is offered by the state for all employees. Self-employed persons have the option to buy such an insurance as well. The premium is 6% of gross income.

Contrary to employees and the self-employed population, an income insurance does not yet exist for farmers in Austria. However, the experience from the other schemes can be used to identify necessary conditions that must be met in order to get working:

1. *Cost of administration:* In order to keep premiums low, administrative processes have to be highly automated, information has to be transparent and available swiftly at low costs to all involved parties.
2. *Moral hazard:* The farmers' behaviour should not have impact on the outcome. Easily observable variables should trigger indemnities automatically.
3. *Adverse selection:* The characteristics of potential buyers of a gross margin insurance have to be known well. Contracts need to be designed in a manner that self-selection supports a smooth operation of the insurance system.
4. *Concentration risks:* Livestock production (milk and pig production) is more important than crop production in Austria. If only milk producers bought an income insurance and crop producers did not, risks for the insurer would be highly concentrated. Reinsurance premiums would be relatively high in such a case. A diversification of not related income risks would help to reduce the exposure of the insurance company.
5. *Trends in agricultural prices and input costs:* An income insurance should not have impact on structural change and adaptation to unexpected market conditions but help farmers to adjust to new situations without worrying too much about income losses. This can be achieved by adjusting premiums periodically. An alternative is to block access to loss coverage for a certain period for those clients who received indemnities.

A product that is placed on the market and successful over long periods has to have finely-tuned features that address all the elements listed above. For

the prototype of a farm income insurance in Austria these features have not yet been fully developed. The concept presented in the next section addresses the first two elements: cost of administration and moral hazard. It is based on existing data sources that are maintained for other purposes and therefore most of the data are available at low costs. It uses wheat production in Austria as an example, but the method is developed for all major crops, for milk, piglet and pig production. The concept can, therefore, be expanded to reduce concentration risks as well.

5.5. The concept of an index-based income insurance

The core of the new product is a calculation of standard gross margins. Almost every Austrian farmer is familiar with this method and farm advisory services offer sophisticated online tools that implement this concept [AWI, 2016]. In addition, many farmers are organized in working groups promoted by the Chamber of Agriculture where they meet in order to compare the gross margin results and cost break downs of their farm, and to learn from the peers performing above average.

In order to calculate the premiums the volatility of input prices (fuel, fertilizer), output prices, yields and the cost structure needs to be known. Volatility of output prices and input prices can be observed on the market and detailed statistics are readily available. To deal with the production risk is the core business of any crop insurance and therefore it is well known to incumbent insurance companies.

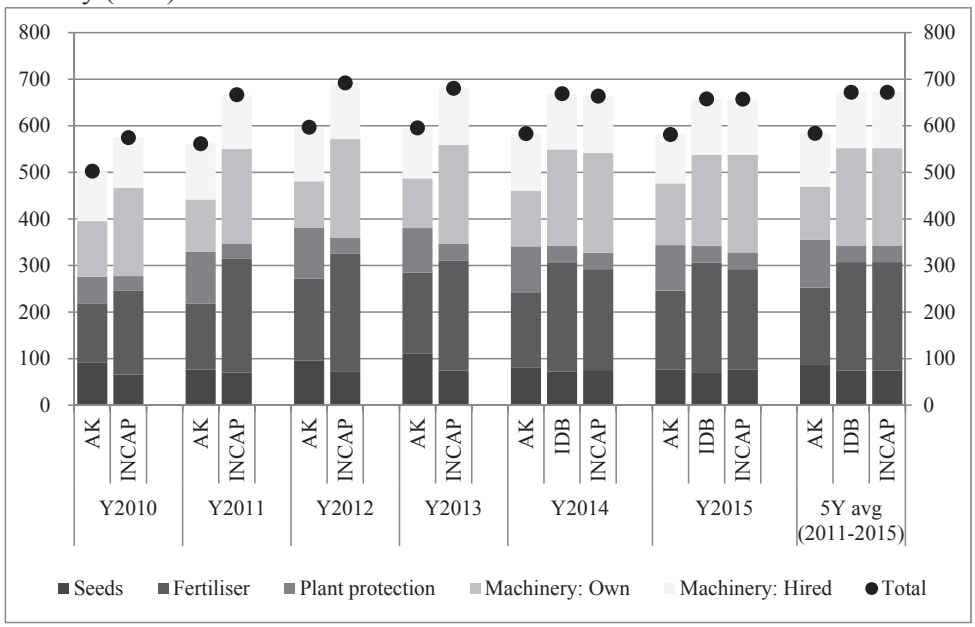
The cost structure and the relative weight of each cost item is not yet understood well. For this purpose, INCAP (index-based costs of agricultural production) was developed. The data set is designed to make such analyses possible by covering all relevant production activities of the Austrian agricultural sector [Heinschink et al., 2016a,b]. Data derived from INCAP can be used as a tool for examining risks in Austrian agriculture, such as fluctuations of activity-specific gross margins. It can also be used to evaluate farm-specific incomes or incomes at sector level [Sinabell et al., 2016].

The data used for INCAP are not based on farm cost accounting data but are derived from many sources. INCAP is originally an engineering data set. The quality of results and their validity is scrutinized using data from farmers in accounting working groups from a major production region [Heinschink et al., 2016a].

Figure 2 shows an example of results derived from INCAP, the gross margin for quality wheat over a period of nine years. Prices of outputs and inputs are from annual statistics and yields are the average of Austria in this example. Like in other index based products, easily accessible observations are used to trigger the incidence of a coverage. The combination of several market observations is used to derive gross margins.

For the example shown in Figure 2, the assumption was made that management is not altered during the period of observation. Revenues range from €452 to €1,010 per ha, total variable costs from €415 to €635 per ha and gross margins from €61 to €449 per ha. The fluctuations in gross margins are easily traced back to the changing yields, output prices and respective cost items.

Figure 2. Gross margin time series for a specific quality wheat production activity (€/ha)



Source: own figure.

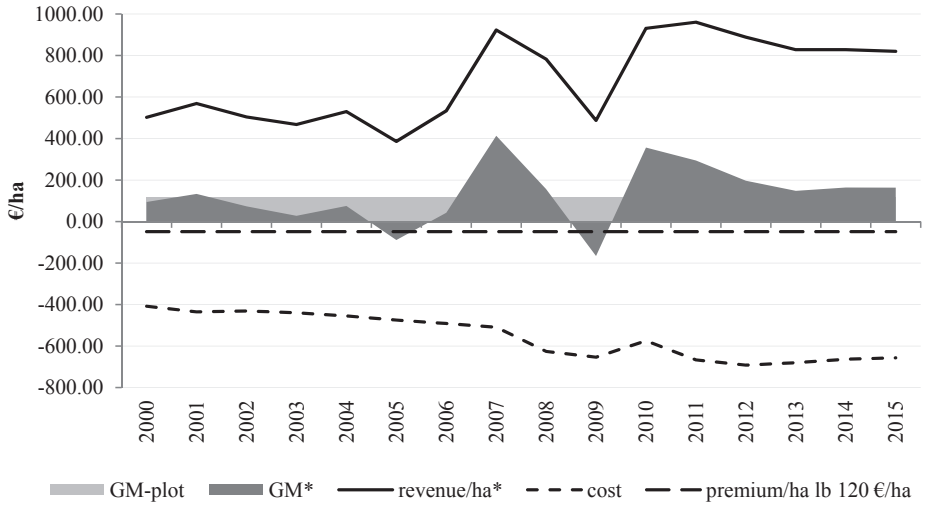
5.6. A prototype of a margin insurance scheme for wheat producers in Austria

The concept developed in the previous chapters is now applied to an example for a gross margin insurance for wheat producers in Austria. The main elements are show in Figure 3. The data are representative for the whole country. Austria is a small country but production conditions are very heterogeneous. Similar calculations as the one shown in Figure 3 can be made for any district and for various production systems (standard tillage, minimum tillage, organic production, etc.).

The pattern of revenues and costs in Figure 2 and Figure 3 are resembling each other but are for different products. In Figure 3 all types of wheat are aggregated and numbers represent weighted averages. The upper line is the average price of wheat in Austria over a period of 16 years. The lowest dashed line indicates the standard production costs (seed, fertilizer, machinery, energy, plant

protection). The dark grey area is the margin (revenue minus costs) before deducting any "margin insurance" premiums. The light grey area represents the insurance benefits that accrue when the margins fall below the lower bound of 120 €/ha. Prices of outputs and inputs are not observed on farms but taken from public sources that are available to anyone.

Figure 3. An *ex post* calculation of an index-based margin insurance scheme (€/ha) with minimum margin of € 120 per hectare



Note: The assumption is made that administrative costs and re-insurance is covered by a farm programme. If government in addition fully supports the premium the total cost per hectare are € 49 per hectare.

Source: own figure.

The fair premium is 49 €/ha per year in this example (Figure 3). In order to keep things simple, the assumption was made that a public fund is sponsoring the insurance by covering administrative costs and re-insurance premiums (together approximately 20%). The premium accrued over the period (indicated by the red dashed line), therefore, it equals the indemnities that are used to compensate any shortfall of margins below € 120 per hectare. This lower bound is chosen arbitrarily and is designed as a choice variable for the farmer buying such an insurance. If government fully supports the premium of € 49 per hectare the question is whether this amount is deducted from the area payment or not. The average direct payment in Austria per hectare of utilized agricultural land was € 258 in 2015.

Figure 3 clearly shows that trends in agricultural prices and input costs are a severe problem for calculating adequate premiums in advance. This may be the reason that such insurance products as the one presented here do not yet exist in Austria.

Apart from trends it is important to have in mind that a margin calculation includes more than one variable. The level of covariance between the time series of different prices is sometimes very high. The stability of the margins under consideration need, therefore, to be explored in detail in order to better understand the underlying data generating processes.

Table 2. Three types of farmers and their economic performance

			A	B	C
			Ø 2000 - 2015		
revenue / t	t / ha		134	140	127
yield	kg / ha		5,145	5,659	4,630
revenue*	€ / ha	1	684	790	585
revenue/ha + indemnity	€ / ha	2	733	839	634
seed, fert., plant prot.	€ / ha	3	273	273	273
machinery	€ / ha	4	280	280	280
premium	€ / ha	5	49	49	49
GM*	€ / ha	1-3-4	130	236	31
GM	€ / ha	2-3-4	130	236	31
Δ to farmer A €/ha	€ / ha			+106	-99

Note: Farmer A is the representative farm which represents the index. Farmer B gets higher prices (e.g. better quality) and higher yields (e.g. better management). Farmer C is performing worse than farmer A, revenues per ha are, therefore, much lower. All farmers pay the same premium and get the same indemnities.
Source: own calculations.

An important aspect of the margin insurance presented here is that moral hazard can be avoided effectively. Regardless of the efforts made by individual farmers, the benefit of being insured is always the same. A premium has to be paid and indemnities are paid out *only* if the representative index farm falls short of the defined minimum gross margin. An example of two farms (B and C) which deviate from the index farm (A) is show in Table 2. Farmer C, which is assumed to be very careless and therefore gets lower prices and harvests less wheat, gets the difference to the insured minimum only in years when farmer A gets benefits as well. The example shows the fair premium of 49 €/ha which is by definition equivalent to the losses over the period of interest.

5.7. Discussion and outlook

This paper presents core elements of an insurance product that allows farmers to insure against price risk of both input and output prices. Several additional steps need to be made before a product can be developed that is placed on the market. After concluding the data validation phase it is necessary to define the

details of the sub-indexes that enter the formula and the details of premium calculations and the specification of the product that shall be placed on the market. To evaluate the acceptance on the market for such a product is probably the most important step before its launch. The European Innovation Partnership would offer a chance to support its development because it supports cooperation between science, industry and farmers in order to develop new products and services.

It is important that margin insurance presented here is that it can be seen as a partial substitute of production risk insurances. Only very risk averse farmers are likely to buy a combination of a margin insurance and a drought insurance.

An important aspect not discusses in this paper is the legal one. It is not yet examined if the national or the EU legislation limits the scope of detail or any variant of implementation of such a product. It also has to be checked whether public support for such an insurance may be granted or not. It may be advisable to do this in order to save re-insurance premiums at least during the phase of gaining experience and building up the necessary reserves. In such a case it will be necessary to check conformity with WTO commitments. Given the fact that a very similar scheme is operated in the USA there is a certain likelihood that conformity is given.

The results shown in this paper are based on the assumption that technology (apart from yield increases due to genetic improvements) does not change. Such an assumption may be justified for some short periods but is certainly inadequate for longer ones. In order to account for technological changes, it will be necessary to show technology assumptions transparently and explicitly and to explore their change over time.

Acknowledgements

The work on this publication was supported by the project 'Adaptation in Austrian cattle and milk production' of the Austrian Climate and Energy Fund (contract no. KR13AC6K11112). Support was granted by the BMLFUW Project 101114 – FACCE Knowledge Hub MACSUR 2: Modelle zur europäischen Landwirtschaft unter Berücksichtigung von Klimawandel und Nahrungsmittelsicherheit.

References

1. AWI (Federal Institute of Agricultural Economics), *IDB Deckungsbeiträge und Kalkulationsdaten* (Internet gross margins and data), 2016 (URL: http://www.awi.bmlfuw.gv.at/idb/default.html, date of access: 01.07.2016).
2. Heinschink, K., Sinabell, F., Tribl, C.*, An index-based production costs system to evaluate costs of adaptation and mitigation in dairy and cattle farming*. *Advances in Animal Biosciences*, no. 7(3), 2016, pp. 242-244 (DOI:10.1017/S2040470016000285).

3. Heinschink, K., Sinabell, F., Lembacher, F., *Crop production costs in Austria: Validation of simulated results using farm observations,* 26th Annual Conference of the Austrian Society of Agricultural Economics, Wien, 2016a.
4. Heinschink, K., Sinabell, F., Tribl, C., *Index-based Costs of Agricultural Production (INCAP) – a new risk analysis tool for Austria,* Paper presented at the Agricultural Economics Society Annual Conference 2016, 4 April 2016, University of Warwick, England, 2016b.
5. Larcher, M., Schönhart M., Schmid, E., R*isikobewertung und Risikomanagement landwirtschaftlicher BetriebsleiterInnen in Österreich – deskriptive Befragungsergebnisse 2015, No. 592016*, Working Papers from Institute for Sustainable Economic Development, Department of Economics and Social Sciences, University of Natural Resources and Life Sciences, Vienna, 2015.
6. Orden, D., Zulauf, C., *Political Economy of the 2014 Farm Bill,* American Journal of Agricultural Economics, no. 97 (5), 2015, pp. 1298-1311.
7. Scharner, M., Pöchtrager, S., *Ökonomische Betrachtung von Einkommensversicherungen für österreichische Milchproduzenten. Tagungsband*, 26, Jahrestagung der Österreichischen Gesellschaft für Agraröknomiie, Wien, 2016.
8. Sinabell, F., Heinschink, K., Tribl, Ch., *Explicit cost accounting for analyses on climate change adaptation, mitigation and ecosystem service provision in agriculture,* [in:] Sauvage, S., Sánchez-Pérez, J.M., Rizzoli, A.E. (eds.), *Proceedings of the 8th International Congress on Environmental Modelling and Software*, July 10-14, Toulouse, France, 2016 (ISBN: 978-88-9035-745-9).
9. Sinabell, F., Url, Th., Kniepert, M., Strauss, F., *Agrarpolitische und betriebswirtschaftliche Optionen zum Risikomanagement in der österreichischen Landwirtschaft*, Studie des Österreichischen Instituts für Wirtschaft-sforschung im Auftrag des Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Wien, 2010.
10. Url, Th., Sinabell, F., *Flood risk exposure in Austria – options for bearing risk efficiently*, Schmollers Jahrbuch: Journal of Applied Social Science Studies / Zeitschrift für Wirtschafts- und Sozialwissenschaften, vol. 128 (4), 2008, pp. 593-614.

6 Demand and supply in delivering public goods in agriculture: South Central Planning Region in Bulgaria case study[1]

Dimitre Nikolov[2], Ivan Boevsky[2], Petar Borisov[3], Teodor Radev[3], Adriana Mihnea[4]
[2]Institute of Agriculture Economics, Sofia, [3]Agrarian University, Plovdiv, [4]Bucharest University of Economic Studies,
dnik_sp@yahoo.com, adriana.agapie@yahoo.com

Abstract

Facing the global climate change and the structural shifts in the world economy, for issues like the social polarization and economic sustainability in agriculture, determining convenient monetary values associated with specific public goods on both demand- and supply-side is of a particular importance in the optimal design of the Europe's Common Agriculture Policies. This paper focuses on implementation of the most relevant methods concerning demand-side valuation assessments of public goods/bads (PGBs) provided by agricultural and forestry systems (AFS) with the scope of achieving comparable monetary values for distinct degrees of improvements. Following previous studies on combining contingent valuation and the analytical hierarchy process, benefits, opportunities cost and risks are structured in a complex Analytical Network (ANP) Model in which the control hierarchy is providing overriding criteria for comparing each type of interaction that is intended by the network representation of the demand for public goods in agriculture in the South Central Planning Region in Bulgaria.

Keywords: public goods, agriculture, demand and supply, CAP

JEL Classification: Q18, H41, O13

6.1. Introduction

The concept of public goods was developed by Samuelson [1954] and Musgrave [1959]. These authors state that markets are not suitable mechanism for trade of some goods. The society demands certain goods which are not measured by prices. This is caused by inherent qualities of public goods (PG) – non-excludability and non-rivalry in consumption. The market mechanism is in-

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

sufficient in such cases so provision of these goods needs a different approach. Economists work on a normative approach, in order to consider when public or state intervention on markets may overcome this problem.

Public goods are used as a term in socio-political contexts: things which are "for the common good". Development of the PG concept is a core concept in debates about the future policy concerns, maintenance of their availability and usage. We adopt the neoclassical economic approach in consideration of PG.

Public good is an item whose consumption is not decided by the individual consumer but by the society as a whole. A public good (or service) may be consumed without reducing its amount available for others, and cannot be withheld from those who do not pay for it. Cornes and Sandler [2003] give a clear exposition of the economic meaning of "public goods". These goods have the two key intrinsic features non-rivalry and non-excludability, as mentioned earlier. Non-rivalry means that more than one person can consume the good at the same time. Non-excludability means that the good is provided to everyone at the same place. These two characteristics make up for an inadequate supply and pricing of these goods on conventional markets and, therefore, they are often described as examples of market failure. To overcome market failure it is proposed to consider some kind of collective action or public intervention, to correct it.

There are relatively few examples of pure public goods. These examples include flood control systems, public water supplies, street lighting for roads and motorways, lighthouse protection for ships and also national defence services.

The OECD, in its analysis of public goods in farming and forestry [OECD, 2013], suggests to use various ways to ensure adequate provision of public goods according to the social norms and the level of private provision. The public financing is just one among them. Other authors have found similarity between PGs and private goods. They include both tangible goods and less tangible services demanded by the society. Bureau et Mahé [2008], Bureau [2010] and Poux [2012] describe social and environmental elements of public goods. Dwyer and Hodge [1995] have explored the phenomenon of non-profit provision, where goals other than profit maximisation drive production choices. It is the so-called socially responsible production where economic and wider social and environmental goals are combined, in specific types of farming and forestry practice [e.g. Grouiez, 2014; SFSCC, 2015]. In these situations, traders in markets would be motivated to maintain PGs, due to the broader mix of drivers to which they respond.

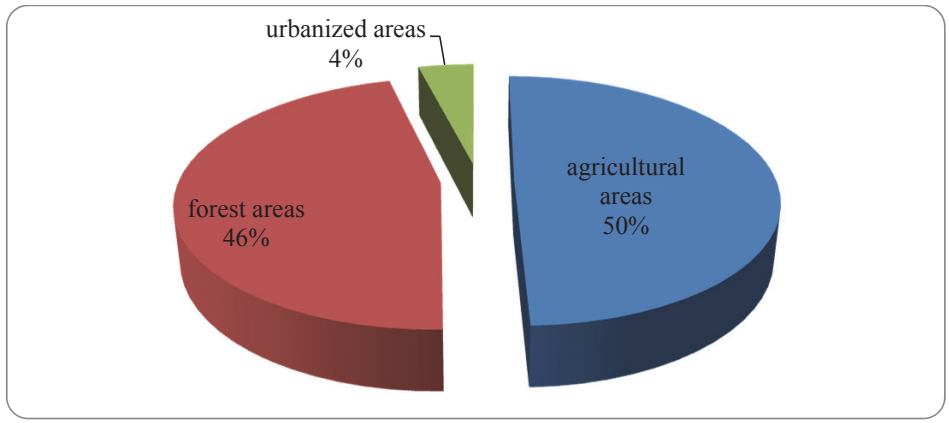
Market failure stimulates economists to search appropriate tools in order to correct the situation. Three kinds of recommendations are usually suggested: intervention by the state to provide the goods directly (e.g. compulsory purchase and management of a nature reserve); the use of market instruments to influence

provision (e.g. tax or incentive payment/subsidy to decrease private generation of public bads or increase private supply of public goods in the production of private goods); or regulation in order to re-define property rights, so as to place public duties upon private actors (e.g. prohibition on certain types of land use or management, for sites or assets of specific public value).

6.2. The main public goods in the South Central Planning Region

South Central Planning Region (SCPR) is located in the southern part of Bulgaria. In the northern part, bordering on the North Central Region and the main ridge of Stara Planina, is a natural northern boundary of the area, to the South it borders with Greece and Turkey, to the East – with the South Eastern Planning Region and to the West – with the South West region. There are five areas: Pazardzhik, Plovdiv, Smolyan, Haskovo and Kardzhali. The area covers the western half of the Upper Thracian Plain, southern Central Stara Planina, part of the Central forest – Balkan fields and much of Rhodopes. The area of the region is 22 365 square kilometres or 20.1% of the country.

Figure 1. Structure of territory (South Central Planning Region)



Source: own calculations.

Arable land in Central South Bulgaria represent 20.3 per cent of the arable land in the country. This is one fifth of the area suitable for agricultural production. Crop areas are less than a fifth. However, areas under permanent crops are nearly one third of the plantations in the country. Natural grass associations occupy 17.8% of the meadow grazing land in the country. Soil and climatic conditions in the region favour the cultivation of all crops. The largest share in the structure of crop areas belongs to wheat – 38.0% of the total area in the region. The areas ranked second is under sunflower cultivation. Although cotton occupies only 1.5 per cent, the region is the main cotton producer, as it provides

89.5% of the areas of this crop in the country. Tobacco in the region occupies a small area – 0.8% to 2.3%, but this is more than half of tobacco production areas in the country.

Yields of most crops are larger than average crop yields in the country. This especially prominently features cucumbers – 149.8 per cent, beans and plums – 146.7%-132.3%. Lower yields are noted by sunflower and some fruit trees.

Livestock breeding in the region is well developed. A little more than one third of cattle breeding in the country takes place in the region – 35.4 per cent. Sheep, goats and birds are one fifth of the total number of these categories of animals in the country. The smallest is the share of pigs. The region produces more than one third of the total quantity of milk in the country – 34.8 per cent. In the region sheep provide more than a quarter of milk in Bulgaria. Slightly less developed is poultry production. Regional animal productivity in the region is close to the national average.

Soil cover in SCPR is closely related to the specific combination of bedrock, the peculiarities of the relief, the direction of the radial movements of the earth crust, climatic conditions and human activities that determine the considerable diversity of soils in the region. They can be characterized as deep soils in lowland areas with the following soil types: typical cinnamon forest soils, leached cinnamon forest soils, leached vertisols, pseudopodzolic soils, alluvial (diluvial) meadow soils, swamp (hydrogenated) soils, saline (halomorfni) soil; and shallow soils in the hilly and mountainous areas with soil types, humus carbonate soil (shallow and lithosols), shallow cinnamon forest soils (rankeri), brown forest soils (rankeri), brown soils with humus-carbonate soils.

Forests are an important resource of the SCPR, which far surpasses the forest resources in other areas. They occupy 46% of the territory of the SCPR. Serious differences are observed within the region itself, as Smolyan and Pazardzhik region are significantly larger than other forest areas. Here, public goods are represented by improved air quality, water quality, soil functionality, climate stability, resilience to flooding and fire. In the distant past the valley of Arda was one of the most forested in Bulgaria, but because of exploitation of forest resources (the majority of forests are cut down), today large areas of the valley are deforested.

The region is also characterised by many other social public goods, including food security, rural vitality and farm animal welfare and health, a healthier lifestyle, better quality of life – more environmentally friendly life.

The terrain is extremely diverse. The area covers a large part of the Balkan and Rhodope Mountains and Sredna gora and Sakar Mountain. Lower parts of the area covering the Upper Tracian Valley and Sredna valleys that are formed around the catchment areas of the River Maritsa and Tundzha River.

Kardzhali and Smolyan districts are located in the mountains, while others combine high mountains with farmland valleys. The landscape suggests significant differences in the climate of parts of the region.

Larger rivers that flow through the territory are Maritsa, Tundzha, Arda, Stryama, Sazliyka and others around which are farmland valleys. There are many dams /reservoirs in the territory of the region – Krichim, Pyasachnik, Koprinka, Jrebchevo, Kardzhali, Studen Cladenec, Ivaylovgrad, Beglika, Belmeken, Batak, Dospat, Shiroka Poliana, etc. In South Central Planning Region there are many mineral springs of national importance. The better known ones are Hisar, Banya (Karlovo), Velingrad, Devin, Bratsigovo Mihalkovo, Strelcha, Merichleri, Narechen, Krichim, Panagyurishte, Haskovo mineral baths and others.

Natura 2000 is a European network made up of protected areas designed to ensure long-term survival of the most valuable and threatened species and habitats for Europe in line with basic international agreements in the field of environmental protection and biodiversity. Natura 2000 is central to the policy of the European Union and it is a testament to the commitment of all Member States to work for the preservation of biodiversity. It is based on two key EU agreements relating to environmental protection and biodiversity conservation – Directive on the conservation of wild birds and the Directive on the conservation of natural habitats and of wild flora and fauna. They were transposed in Bulgarian legislation through the Biodiversity Act.

The SCPR area covers many protected areas of the "Natura 2000" network:

- Sheltered areas to protect wild birds – Birds Directive: protected zone "Maritza Plovdiv", protected zone "Hatcheries Plovdiv", Dam Konush, Rice paddies Tsalapitsa, Central Balkan, Reservoir Sandstone, Persenk, Maritza – Plovdiv, Maritsa Parvomay, Hatcheries Plovdiv, Dobrostan Average forest, Central Balkan buffer, Besaparski Hills, Hatcheries Zvanichevo, Western Rhodopes, Maritza – Plovdiv, Rila and Central Forest.
- Protected areas for conservation of natural habitats and wild fauna and flora under the Habitats Directive: Protected zone "Maritsa River", protected zone "River Sandstone", Chaya River, Besaparski Hills, Garden forest Trilistnik, Forest-Shishmantsi, Vacha Thrace Stryama and Kayaliyka River, Bear River, River Cherkezitsa, Chinarder River, River Omurovska, River Sandstone, Central Balkan, Maritsa River, Brestovitsa, Rhodopes and West Rhodopes environment, Popintsi, Average forest Central Balkan buffer and others.

Protected zone "Rice paddies Tsalapitsa" (BG 0002086) is a complex of land used for rice production, it is watered area surrounded by low dikes and canals and grasslands located in the immediate vicinity. It is part of the whole territory of the rice fields located on part of the land of the compound of a town

and villages Tsalapitsa, Radinovo Voysil, Plovdiv district with a total area of 36 ha. The area includes rice paddies, other extensive cereals production area, including rotational crops, arable land and water areas, including internal standing and flowing water. The protected area is declared by order of the Minister of the Environment and Water. Its aim is the protection and maintenance of habitats mentioned in the subject of the protection of bird species to achieve their favourable conservation status, and restoration of habitats of species for which it is necessary to improve the conservation status.

Rice paddies Tsalapitsa territory is located in a densely populated area and is under strong pressure of the intense human activities. The main habitats are formed as a result of human activities and their existence largely depends on the active use of the land primarily related to rice production. Business activities in significant part include the growing of crops, 50% of the land in the project area are occupied by rice (Oriza sativa). Corn (Zea mays) represents 16% of the crops, alfalfa (Medicado sativa) is 18%, cereals (Poaceae) are 8% and sunflower (Helianthus annuus) is 2%. The remaining 2% included temporarily or permanently uncultivated areas. Key bird species are the subject of conservation in the protected zone. Article 6, paragraph 1 point 3 of the Law on Biological Diversity gives types of birds subject to conservation and monitoring which are the same as those included in Annex II of Directive 2009/147/EC on the conservation of wild birds and their habitats. On the territory of the protected area there are 17 species subject to protection – Little Bittern, Little Egret, Great Egret, Black Stork, White Stork, Glossy Ibis, Marsh Harrier, Northern Harrier, Long-legged Buzzard, Great Spotted Crake, Little Spotted Crake, Kokilobegach, Pratincole, Barnacle Tern, Kingfisher, Calandra Lark, Red-backed Shrike. The types of biodiversity found in protected areas covers 11 types – Grey Heron, Mallard, Garganey, Common Buzzard, Kestrel (Kestrels), Moorhen, Lapwing, Redshank, Large Wood Sandpiper, Caspian Gull. Significant is the protection of areas in which large amounts of bird species listed in Annex II of the Birds Directive gather during reproduction, moulting, wintering or migration.

Agriculture is an integral part of the business in the South Central Planning Region, half of its territory is used for agricultural production. While the main result of this activity is the production of raw materials for the processing industry and food as secondary effect. It produces effects on the environment. It has the character of extensive farming with predominantly small farms.

6.3. Method of study to analyse PGs in the region

The required data for estimation of PGs were collected by conducting focus groups, which covered in depth discussions of study subjects, thanks to the benefits of developing group dynamics and effect. During spontaneous discus-

sions of the predetermined range of issues clear categories and definitions were formulated, which helped to better explain and understand quantitative studies of the phenomena. The discussions were led by a moderator who put matters for discussion, monitored equal participation of persons, focused on interesting new guidelines spontaneously expressed by the participants. In leading the discussion the moderator used the following projective techniques: association and complementarity techniques. The discussions were attended by 14 people – farmers, representatives of agricultural associations, local public authorities and consultants. The participants were divided into two groups of 7 persons. Each group received natural-geographic map of the area and a list of ten potential PGs. Each participant was asked to determine distribution of public goods in the region using 3 colourful sticky notes (red = available; white = neutral; blue = no). The most important public goods / bads in the region are: Water Quality, Food Safety, and Scenery and Recreation.

In the methodology which we used it is necessary to formulate and evaluate governance mechanisms for delivery of public goods in SCPR. We made valuation assessments, from point of view of the supply- and demand-side. By carrying out valuation assessments we usually aspire to measure welfare changes upon changes (actual or potential) in the condition of the system. In the context of the research, welfare changes to be measured will be those of landowners / managers (farmers / foresters) for supply-side assessments and of the whole society (or just beneficiaries) for demand-side assessments related to changes in the levels of provision of PGBs by Agro Forest System.

We use valuation method (VM) and the procedure for implementation used for the supply-side valuation assessment is based on Cost (accounting) which includes: avoided cost, replacement cost, mitigation / restoration cost and income forgone. The demand model behind the determination of the priority weights of importance associated with the three selected public goods, namely Water Quality, Food Security, and Scenery and Recreation is Benefits, Opportunities, Costs and Risks (BOCR) template in the context of the Analytic Network Processes (ANP). Results were built on a large scale regional survey. The survey was developed in two formats. The former consists in asking questions about preference and pairwise comparisons as in the original framework of the ANP theory, using the 1-9 Saaty's fundamental scale. As the responses need a throughout perspective and timely attention, this survey was delivered to a focus group constituted by highly skilled experts in the domain, to be individually completed. Answers were aggregated following the group decision technique appropriate in the ANP context, namely through the consideration of the geometrical mean of alternative choices regarding the same pairwise comparison,

followed by the synthesis of the group decision resulted model. The second format, designed to assess the demand for the previously mentioned three public goods by a large group of stakeholders is asking questions about preference and intensity of preference on an increasing nominal scale from 1 to 9. These results were imputed using the SuperDecisions software framework in the Direct Mode. This Direct Mode allows for the computation of the priority weights and the synthesis of the model comparable to the one in which pairwise comparison is performed, as well as for similar sensitivity analysis. Contingency valuation concludes every individual survey.

The evaluation is aimed at assessing how a mix of collective actions, Agro Environment Schemes (AES) and quality product certification can safeguard the provision of PGs in a low intensity agricultural area. Water quality is typically the subject of a variety of policy instruments in Europe, being affected by different regulations (Nitrate Directive, Water Framework Directive). Quality product certification encourages membership by farmers, who can help build consumer confidence and gain new market opportunities, to produce in line to required standards. Maintaining the landscape provides added value of scenery and recreation.

6.4. Results

I. Supply-side

To study the provision of public goods by agriculture 30 farmers from the SCPR were interviewed at the end of 2016. Their production activity was focused on the cultivation of beans, potatoes and sheep that are typical for the region, and agricultural production formed almost the entire agricultural income of the region and it has built its image. Appropriate conditions for production and traditions in these proceedings popular only among locals, make the consumers evaluating the products manufactured here as of high quality and natural. These industries also have a strong influence on the formation of rural landscapes and the provision of public goods for the local population and visitors.

Responding farmers were asked to assess the contribution of agriculture to provide three public goods – quality and availability of water; food safety; scenery and recreation. The results show that farmers determined that agriculture plays an important role in shaping food security and creating attractive landscapes and opportunities for recreation (Figure 1). This is because the region is famous for its agricultural products (lima beans, potatoes Momchilovtsi, sheep's milk and lamb), which can be defined as typical and which have a positive impact on the overall image of the region. It is noteworthy that there is no similar opinion about the impact of agriculture on the quality and quantity of water. It explains that farmers do not develop irrigated agriculture and use of fertilizers is limited. Also

the size of production plots is small, suggesting an inability to concentrate chemical compounds that have a significant impact on water sources.

Respondents identified which public goods should be a priority financed through the mechanisms of the Common Agriculture Policy. They rated 10 public goods. The following five were identified as the most important – improving the sustainability of floods, landslides and fires; food safety and quality assurance; mitigation of climate problems; maintaining the vitality of rural areas and communities; improvement of air quality. They all received assessments between 80-90 which is the possible maximum. These public goods correspond to the fundamental problems of rural areas whose solution can hardly be achieved only through market mechanisms. Three other public goods – maintaining the quality and quantity of water; maintaining the functionality of the soil; ensuring local supplies are valued at between 70 and 80 points. Creation of attractive rural landscapes and maintaining farmland biodiversity was evaluated as the least important. Also, all respondents found the amount of €80 of annual payment per household as sufficient to encourage provision of public goods.

II. Demand-side

Twenty costumers from SCPR were interviewed to study the provision of public goods by agriculture at the end of 2016. If the control criteria: Benefits (B), Opportunities (O), Cost (C) and Risk (R) were weighted as equally important in measuring the weights of importance under the Economic, Social and Environmental strategic criteria, then the weights of importance for the three previously mentioned PGs were shown in Table 1.

Table 1. Weights of importance for PGs

Name	Normals
Food security	- 0.407464
Scenery and public recreation	0.065043
Water quality	- 0.527493

Source: own calculation.

This can be interpreted that under an equal overall assessment of the aspects involved in the demand decision, the importance of the water quality demand is underestimated with 52 per cent, the importance of food security demand is underestimated with 40 per cent, while the demand for scenery and public recreation is only slightly important.

On the other hand, if the importance of the Benefits in achieving PGs is emphasized and increased with only ten percent, the synthesized new weights of importance for the three PGs are the next ones.

Table 2. Importance of the PGs

Name	Normals
Food security	0.271
Scenery and public recreation	0.429
Water quality	0.300

Source: own calculation.

The three selected public goods to be considered for a priority weight determination in the context of the AHP/ANP methodology were analysed under some strategic criteria, namely Economic, Social and Environmental divided under some control criteria represented by Benefits, Opportunities, Costs and Risk (BOCR). The BOCR merits model was aimed to capture different aspects in the demand for public goods and is able to point to meaningful sensitivity analysis in order to design efficient environmental policies for supporting a certain chosen public good.

The individual responses collected among the stakeholders will be aggregated in two ways. The first and simplest one is to average over the synthetized resulting priority weights of the three public goods under consideration. The disadvantage of this approach is that it does not allow for the sensitivity analysis. To overcome this aspect, opinions of the stakeholders will be averaged for every question and the results will be imputed in a BOCR averaged model. Thus, through the synthesis of this last model, it will also be possible to perform synthesis analysis and to make comparisons with the results delivered from the expert group decision. If B, O, C and R have the following weight of relative importance:

Name	Normalized
1. Benefits	0.526
2. Opportunities	0.1307
3. Costs	0.2785
4. Risks	0.06415

Then the contingency valuation applied to the derived vector of relative importance of the associated PGs yielded the next values.

This network of strategic and control criteria, having as alternatives the three PGs, can be contrasted with further spatial econometrics estimations and sensitivity analysis. Yet, for the two techniques to yield comparable and meaningful results, the comprised control parameters should be similar. Further on, regarding the BOCR model, further estimations using other numerical scales but Saaty's could be tested.

Table 3. Values of PGs in SCPR

PGs		4	20.6	**EUR**
Food security	0.331363	1.325452	**21.92545 BGN**	**11.24**
Scenery and recreation	0.367993	1.471972	**22.07197 BGN**	**11.31**
Water quality	0.300644	1.202576	**21.80258 BGN**	**11.17**

Source: own calculation.

To analyse the relationship between water quality and food security, and scenery and recreation, it should be checked how the first two impose on the last one. Spatial analysis in different regions in the SCPR will show consumer attitudes towards the three public goods. The closed results for the three PGs show that from the demand-side preferences will increase in the future. To analyse protest events associated with failure to pay for the improvement of public goods provided by AES provided by taxes.

6.5. Conclusions

The paper explores interactions between use of fertilisers and AES payments. Results show statistically significant interaction at 95% between using less fertiliser in plant production and received AES payments. Use of fertilisers, represents that higher WTA for participation in AES, including a low use of fertilisers (meaning joint provision of water quality, and scenery and recreation). Collective actions and producing groups play an important role on farmers' decision-making as regards to the provision of the PGBs mentioned in the study.

The construction of a network comprising control and strategic criteria, like the BOCR ANP model, allows for integration of the results regarding the evaluation of the demand for public goods in the context of the existent environmental and agricultural polices at both country / regional level as well as in the context of the European CAP. These aspects were embedded in the existent model through the inclusion of some nodes representing categories of influence as recognized in the main stream of scientific papers. Furthermore, this model can be extended by articulating it on several strategic criteria detached from the European CAP. Sensitivity analysis is an instrument with two main functions. One is to study the stability of the demand preferences for the three above-mentioned PGs, the second is to design a mix of policies through the emphasis of certain nodes of influence so that the desired weight of importance is achieved for a certain chosen public good.

Scenery and recreation should focus much on the efforts from the regional governance institutions. The Food Security has influenced on attention of consumer preferences to buy local foods which can stress development of direct marketing and short chain, also marketing cooperatives and collective actions.

Acknowledgements

The research reported in this paper was funded by the European Commission within the project "Providing smart Delivery of public goods by EU agriculture and forestry" Grant Agreement Number 633838" (PROVIDE), HORIZON 2020 Programme (http://www.provide-project.eu/).

References

1. Bureau, J.-C., *La Politique Agricole Commune après 2013, les enjeux et la position des acteurs*, Futuribles, no. 369, 2010, pp. 47-61.
2. Bureau, J.-C., Mahé, L.-P., *La réforme de la PAC au-delà de 2013. Une vision à plus long terme*, pour "Notre Europe", 2008, consultable sur: http://www.notre-europe.eu/media/Etud64-PAC-propostions-fr_01.pdf.
3. Cornes, R., Sandler, T., *The Theory of Externalities, Public Goods and Club Goods*, 2nd Edition, Cambridge University Press, 2003.
4. Dwyer, J., Hodge, I.D.H., *Countryside in Trust: land management by conservation, amenity and recreation organisations*, John Wiley and sons, Chichester 1996.
5. Grouiez, P., *Farming strategies regarding "social responsibility" in the Russian agricultural sector*, Economics and Business, vol. XVII, no 1., 2014.
6. Musgrave, R., *The theory of public finance: A study in public economy*, New York McGraw-Hill, 1959.
7. OECD, *Providing Agri-environmental Public Goods through Collective Action,* 28 June 2013, OECD, Paris 2013.
8. Poux, X., *Justifier les aides environnementales à l'agriculture sur le concept de biens publics et de services rendus?,* Ecorev, no. 38, 2012, pp. 59-63.
9. Samuelson, P.A., *The Pure Theory of Public Expenditure*, The Review of Economics and Statistics, vol. 36, Iss. 4, 1954, pp. 387-389.
10. *Sustainable Food Supply Chain Commission. Final report: The long and the short of it: sustainable food supply chains*. Industry and Parliament Trust, London 2015.

7 Analysis of the competitiveness of Serbia in terms of attracting investments in agriculture and rural development[1, 2]

Drago V. Cvijanovic[1], Željko M. Vojinović[2], Vojin Cvijanovic[3]
[1] University of Kragujevac, Vrnjacka Banja, Serbia,
[2] University in Novi Sad, Subotica, Serbia, [3]Em Teh MMV, Belgrade, Serbia
drago.cvijanovic@kg.ac.rs, zv@inbajmok.com

Abstract

Serbia should use in the best possible way its comparative specificities and advantages in regard to the surrounding countries, some EU countries and the Russian Federation, for the development of agricultural and other activities, especially the compatible activity, such as rural tourism. It should not only follow the global trends in this production, but also invest significantly in new technologies, specialize, organize and cooperate with mutual interests, in order to meet the demanding world market for agri-food products. Besides these manufacturers, there are also numerous small agricultural manufacturers, whose agricultural productions are not specialized, but are recognizable as high-quality, very specific and healthy-safe food. At the same time, they have capacity, with relatively small investments, to receive visitors in their holdings and provide them with additional economic activity – render tourist services. These holdings, by expanding their economic activities in beautiful Serbian rural areas, make significant incomes, besides accommodation income, from meals for tourists and sale of very specific local products. It would increase employment of numerous workers, both unskilled (cleaning women) and qualified (waiters, cooks, craftsmen, tourist guides, etc.) labour. Therefore, Serbia has the other comparative advantages, too. All these comparative advantages are the subject of the research described in this paper. Regarding the methodology, three groups of factors which affect both the competitiveness and the accelerated investments in agriculture and tourism will be analysed: current resources, sector competitiveness and other competitiveness factors.

Keywords: competitiveness, agricultural manufacturers, investments, agriculture, rural tourism

JEL classification: D9, D24, J2, Z30, Z32

---

[1] Paper is a part of research within the project no. 46006 III "*Sustainable agriculture and rural development in the function of accomplishing strategic objectives of the Republic of Serbia in the Danube region*", financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.
[2] Article prepared for International Conference "*Competitiveness of the economy in the context of social policy measures*" organised by IAFE-NRI (www.ierigz.waw.pl), 22-24 June 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/jachranka2016/program-koferencji.

7.1. Introduction

The term *competitiveness*, derived from the word *competition*, can be defined as a competition between two men or among men, formal and informal groups, economic units, other institutions, sports or other clubs, states, regions, continents, and also plants and / or animals for space, and / or inputs, and / or positions, and / or a market. In the narrow sense, *competitiveness* is an ability of an individual, an economic unit, a state or a group of states to realize commodities and / or services on the targeted market, surely, in free and equal market conditions. The competition by itself is a result of a struggle between two or more individuals (subjects) for the item, which cannot be divides.

The competitiveness becomes the most important condition of modern business of every state economy and it represents the most significant present time law. Many institutions (World Bank, World Economic Forum, Heritage Foundation, European Bank for Reconstruction and Development, etc.) analyse and make public their analyses, studies, reports, indexes, and everything in terms of ranking states, i.e. their position on the world market.

The competitiveness of agricultural products manufacturing is a changeable category and very hard to measure. Numerous factors affect competitiveness of these products, starting from direct, which affect the production (weather, prices of inputs, labour price, etc.), and indirect, which are not directly linked to this production (RSD exchange rate, customs, harvest achieved in another country, etc.). Competitiveness can be measured with some and/or the surrounding countries, the countries from the specific continent, with the most serious world manufacturers, and/or with every country in the world. The price competitiveness is the most common form of observation, but the quality of products is also very important, especially regarding the agricultural products.

Serbia, although a small country, as a part of Europe and the world, must analyse its position on and share in the world market. In the transitional period of Serbian economy, the structure of economic subjects and the structure of agri-food production significantly changed. Newly-established young and successful agricultural manufacturers, besides the land and climate, are the competitive advantage of Serbia, and it is especially expressed in the north of the country, in the AP Vojvodina. At the same time, central Serbia has changed its primary agricultural production structure in favour of more intensive cultures, primarily raspberry, blackberry, plum, and other fruit with significant diversity of agricultural manufacturers. These successful agricultural manufacturers, along with the food sector, follow the world market trends, use very modern techniques and technologies in the production, and shift to specific lines of agricultural production specialization. All of this requires financial resources, for them to become larger investors.

Considering that the modern world markets require a permanent Quantity, stable Quality, clearly defined Continuity, permanent Control, clearly defined Competitiveness and necessary Capital, our successful agricultural manufacturers become a significant and very reliable partner for larger world companies, while they fulfil exactly the "6 K (2Q+4C)"conditions.

Besides all of the mentioned competitive advantages (agricultural manufacturers, high-quality land and climatic conditions), the agriculture of Serbia disposes also has other competitive advantages, such as: favourable geo-strategic position – access to navigable river Danube; high-quality agri-food products; still underdeveloped domestic market – around 7 million inhabitants; favourable trade agreements with the Russian Federation, Belarus, Turkey, the CEFTA and EU countries; good example of repro- and market-chains in some regions – raspberry from Arilje, cabbage from Futog, peach from Grocka, paprika from Leskovac, etc.; a chance for pre-accessing IPARD funds as a chance to become the EU member; still undeveloped land market, etc.

A special competitive advantage of Serbia is unused potentials of rural areas for the development of rural tourism, which represents, with the specific agricultural production, the biggest chance for employment and investments in this region.

In order to attract investors, it is necessary to perceive really the indicators which point out to the competitiveness in the specific production. Three groups of indicators were analysed here: the existing resources Serbia has, the sector competitiveness and other competitiveness.

7.2. Expected trends

Processes, changes and relations in the world are becoming more global and less local. Serbia becomes more and more an integrated country, so its agri-food production, prices and turnover are under the impact of global trends. Thanks to fast changes, new technological processes and new relations on the market, everything, and therefore the agri-food production too, adjusts to the new requirements of consumers, completely new standards and new markets, and all of this causes a new way of production and adjustment of manufacturers to these requirements. This means that the manufacturers have to follow the world trends, the trends in surrounding countries and the trends in their own countries, so they have to adjust to all changes in macro and micro environment, in order to face the competition.

Characteristics of long-term trends of agricultural development in the world and the EU can be classified in seven groups. These are: distribution of global competitiveness, decrease of agricultural population, drastic change of climate, significant productivity increase, economic crisis, increase in agri-food products prices, changes in consumers demand [Cvijanović et al., 2011].

In the new EU Member States (NMS of the EU), the long-term trends of agricultural development are characterized by: change of production structure, and increase in agri-food products trade. The NMS of the EU, which had managed new measures and used new markets, subsidies and predictability in production, attracted new investments, used their comparative advantages, had been more successful in adjusting to new relations, processes and had adjusted easier to the new business measures.

The trends of agricultural production in the CEFTA region go through transformation from socialistic into the capitalistic way of production, which implies profound structures and legislative reforms. Unfortunately, significant transitional reform measures have not been finished, yet. Taking into account the experiences of all countries which had passed preparations to access the EU, the hardest was for the agriculture and agricultural manufacturers to access the EU. At the same time, the agricultural manufacturers expect an important enhancement after the accession.

The agricultural manufacturers in Serbia, regardless of the significant results achieved in Vojvodina, Macva, Stig and Morava Region, still lag behind the producers in the EU in many segments of competitiveness. This stagnation has especially been expressed regarding the realized income and export per an area unit, and then by yields in crops and weight gains in livestock production, applied technology, realized production per a farmer, achieved level of processing, etc. Slow and unclearly defined reforms, frequent changes of ministers, negative influence of tycoons, import lobby, impoverished agriculture and village, devastated and elderly village, destroyed cooperative sector, etc., are the main reasons of this stagnation [Cvijanović et al., 2015].

Although the Republic of Serbia has the Strategy of Agriculture and Rural Development [SARD, 2014], the agricultural manufacturers still have no clearly defined developmental policy of this activity by the government. Privatization of factory-farms (combines) has not been finished yet or was done badly, price policy is still undefined, the agrarian policy measures are still undefined, especially in terms of stimulation of agricultural holdings increase – which represented an important factor of competitiveness, the agrarian policy measures for small holdings (there are plenty of them), which provided their food safety, have not been defined [Zakić et al., 2014]. Unfortunately, the measures of agrarian policy are short-term which prevents serious predictions regarding the investments in the specific production lines, as well as adjustment of production to the market requirements. These problems are reflected especially in time of picking, harvesting, collecting and / or delivery of the primary agricultural products to processing capacities and / or directly to the market (large retail chains, wholesale markets and green markets).

Along with all of the above-mentioned problems, the Republic of Serbia is a small and poor country, so the agricultural manufacturers have less state support than the manufacturers from the competitive countries. While the agrarian budget decreases in the Republic of Serbia, the agrarian budgets in the EU countries stay the same, and in the countries covered by CEFTA Agreement they even increase. Serbia has subsidies of EUR 70 per hectare to the agricultural manufacturers. In other countries in the region the amount of subsidies is similar, except for Croatia, which keeps up with some of the EU countries. However, that support is susceptible to change from year to year, which generates problems for the manufacturers while planning and starting agricultural production.

The agrarian structure of agricultural holdings in Serbia in the past several years has started to change. That is to say, the number of holdings which cultivates 50-100 hectares increased, especially in Vojvodina, and there are fewer holdings which cultivate 200-300 hectares of land. These holdings rent or purchase land and increase their property. This is caused, first of all, by the introduction of new technologies and techniques and the development of credit market and lease of state land and land of uncommercial holdings. However, the Republic of Serbia bases its agricultural production on family holdings, along with a small number of factory-farms. According to the Census of Agriculture of 2012, Serbia has 631,552 agricultural holdings (AHs). An average economic size of an AH amounts to EUR 5,939, and according to the organizational-legal form of AHs, this indicator amounts: in the sector of family holdings to – EUR 4,990; in the sector of legal entities and entrepreneurs – EUR 204,755. As of the regions, the Belgrade region has 33,244 AHs, the Vojvodina region has 147,624 AHs, the region of Sumadija and West Serbia has 262,940 AHs, and the region of South and East Serbia has 187,744 AHs [Cvijanović et al., 2014].

7.3. The significance of agriculture in the economy of Serbia

The Republic of Serbia is an agrarian country, and it has a significant share in creation of GDP. Besides different turbulences in the transitional period, the economic structure of Serbia has not changed significantly. In the beginning of the 21st century, the share of agriculture in GDP has constantly decreased, since non-production sectors had increased faster (especially in trade). If we observe the share of agriculture in GVA of Serbian economy, then we can see its high share, especially if compared with the EU (27 Member States). At the same time, Serbia has a high share of GVA of agricultural sector in the total GVA and lower share of the service sector.

This high share of agriculture in basic macroeconomic aggregates (Table 1) in regard to other EU countries can be explained by rich natural resources, favourable climatic conditions for agricultural production and sluggish structural reform of other economic activities.

Although the employment in agriculture of Serbia, absolutely observed, records a reduction, the share of agriculture in total employment is still extremely high. It is among the highest in Europe with over 20%. This explains how this activity is dependent on temporary and odd (seasonal) jobs, which are very sensitive to market fluctuations of labour during crisis.

Agri-food products in foreign trade exchange of the Republic of Serbia have a significant role, and it is important to say that the export is higher than the import in past several years. The Republic of Serbia imports less of agri-food products than it exports, and the coverage of import by export is higher than 76.8% in 2008, and up to 94.2% in 2009.

In the import structure of agri-food products dominates the primary agricultural products of around 62-65%, and then around 30% of agricultural products imports, and finally imports amount around to 5-8% of fish and fish products. It is good for every country to import less, but it is disastrous to import agri-food products, which can be produced by the Republic of Serbia. Unfortunately, the share of these products in total import increases and ranges from 4.6% in 2008 to 8.4% in 2014, when their share in total import was the highest.

In the analysed period (2008-2015) the share of these products in the total import ranged from the lowest 18% in 2008 to the highest share of 23.2% in 2009. Unfortunately, the export structure of agri-food products of the Republic of Serbia is not satisfying, because exports cover mostly the primary agricultural products (fresh or frozen raspberry, blackberry, strawberry, plum, sour cherry and mercantile maize) and they make around 75%. The export of processed agricultural products, with several stages of processing, is small, except for sugar and oil.

In the past several decades, the conditions for export on the world market have become more favourable (increase in agri-food products prices, opening new markets – crisis and sanctions between the EU and the Russian Federation, etc.) However, the causes why the Republic of Serbia fails to export more of agri-food products should be sought in reckless plundering privatization in food industry, agricultural factory-farms (combines) and foreign-trade enterprises, in lack of a clear developmental strategy of this activity, bad measures of economic and agrarian policy, lack of the national developmental bank, etc. Unfortunately, in the Republic of Serbia (with a few honourable exceptions) there is no organized, specialized and interests-related agri-food production, while the system of cooperative societies was also destroyed.

Table 1. Macro-economic indicators of agricultural contribution to the economy of the Republic of Serbia

No.	Description	2008	2009	2010	2011	2012	2013	2014	2015
1.	GVA of agriculture, forestry, hunting and fishery (RSD million)	238.478	231.680	261.510	306.608	269.999	305.520	302.226	-
2.	Share of GVA in agriculture in the total GVA (%)	8.7	8.0	8.5	9.0	7.5	7.9	7.7	-
3.	Employment in agriculture, forestry, hunting and fishery (000 persons)	706.0	622.7	533.0	478.1	467.1	491.9	507.5	-
4.	Share of agriculture in total employment (%)	25.0	23.8	22.2	21.2	21.0	21.3	19.9	-
5.	**Foreign trade exchange**								
6.	Export of AFP (EUR million)	1,336	1,385	1,688	1,937	2,106	2,104	2,317	2,579
7.	Share of agriculture in total export (%)	18.0	23.2	22.8	22.9	24.1	19.1	20.8	21.4
8.	Import of AFP (EUR million)	755	713	903	1.010	1.160	1.229	1.305	1.342
9.	Share of agriculture in total import (%)	4.6	6.3	7.3	7.1	7.9	7.9	8.4	8.2
10.	**Trade balance of AFP (EUR million)**								
11.	Coverage of import by export (%)	176.8	194.2	186.9	191.8	181.6	171.2	177.5	192.2

Source: Statistical Office of the Republic of Serbia and data calculated by the authors.

The produced autochthonous products, which are produced on small holdings in rural areas of the Republic of Serbia, cannot be exported, and cannot fulfil the "6K (2Q+4C)" or they have different standards or various customs and / or non-tariff customs barriers as obstacles. However, when tourists from any part of the world try these specific products, they seek information where and when can they buy them, or they come again in those rural areas and seek for the autochthonous traditional dishes and / or drinks. It can be concluded that these autochthonous or traditional agri-food products could be a very interesting subject of the so-called "invisible export", through the supply of rural tourism products.

Natural resources of Serbia with attractive relief, diverse flora and fauna, favourable climatic and hydrological conditions, extremely rich cultural heritage and national traditions provide numerous developmental opportunities, especially in the field of tourism [Katić et al., 2011]. Unfortunately, the unfavourable migrations continue, the villages are getting old and wither. Infrastructural and other life conditions of rural population are bad. The development of rural tourism and agricultural production, with preservation and improvement of the environment, is one of the solutions which would reconcile the above-mentioned opposites, and along with the appropriate economic, infrastructural, organizational and educational incentives would enable multiple positive effects [Cvijanović and Vuković, 2011].

7.4. Competitiveness of the Serbian agriculture

Serbia still has relatively high share of agriculture in total gross domestic product (GDP), around 12%. The share of agriculture in GDP of a country determines its development, i.e. its competitiveness. As the share is higher – a country is less developed. From this indicator point of view, the countries are divided into: agrarian, transitional, urban and developed. The share of agriculture in GDP of the Republic of Serbia is over 10% which classifies it into the transitional country.

Agricultural production of Serbia is significantly diversified, with broad lines and branches of production, from cereals, industrial plants, fodder-forage crops, vegetables, fruit, grapes to milk and dairy products. Extremely small level of specialization in production, with a large number of AHs, fragmentize agricultural production, modest production by AHs, with short market chain, low level of integrity into the world market.

Serbia has significant area of arable land. With around 3.3 million hectares, it is ahead of many EU countries (Denmark, the Czech Republic, the Netherlands, Croatia, etc.), and especially it is ahead of the region countries (Bosnia and Herzegovina, Montenegro, Macedonia, Albania). If we look at the average areas per an inhabitant in the region, Serbia takes the first place with

0.56 ha/inhabitant, then comes Bulgaria with 0.46 ha/inhabitant, Romania with 0.43 ha/inhabitant, Bosnia and Herzegovina with 0.40 ha/inhabitant, Croatia with 0.33 ha/inhabitant, Montenegro with 0.30 ha/inhabitant, and Macedonia with 0.26 ha/inhabitant. According to these data, it can be concluded that Serbia, in regard to the region countries, has a significant comparative advantage, considering it has significantly larger area of arable land per an inhabitant in regard to them.

As it was told before, there are 631,522 AHs in the Republic of Serbia, according to the data of the Census of Agriculture of 2012. They use 3,437.000 hectares of agricultural land, i.e. the average size of used land per an AH is 5.4 ha. Of a total number of registered AHs, 99.6% of them are family agricultural holdings (FAH) which use 82% of the total agricultural areas. The average FAH size is 4.5 ha and it varies from 2.1 ha in Jablanica region to over 10.0 ha in Mid-Banat region of the Republic of Serbia. The rest 0.4% of the totally registered AHs are legal entities and enterprises, which use 16% of agricultural land and have the average size of a holding of 210 ha. It means that the Republic of Serbia has a significant number of agricultural manufacturers per a hectare, which points to low productivity and competitiveness.

Besides relatively small average sizes of the utilized agricultural land per an AH, a significant limitation for the efficient land use is also the fragmentation of property. There are six parcels per an AH in Serbia. As for consolidation of fragmented holdings and readjustment of farm boundaries, it goes very slowly.

When it comes to the sector competitiveness, Serbia is an important producer of agri-food products in regard to the region countries, but it is modest in regard to the EU countries and the world production. The significant share Serbia has in the production of soy, over 40% of the European production, at the same time the share of all industrial cultures in the European production is modest, thanks to a small production of rape. In the production of stone fruit and berries, Serbia participates with over 10%, and its lowest share is in cattle breeding and dairying. Serbia has the share of over 3% in the production of cereals in regard to the EU level, i.e. 0.5% in regard to the world production. In vegetable production, Serbia has relatively significant share, around 3.6%, but this production is directed to satisfaction of own needs and not for the market. When we observe the share of Serbia in the EU production, the highest share belongs to raspberry, plum, sour cherry, and the lowest to: barley, potato, wheat and carrot.

If we observe the CEFTA region, Serbia has the highest resources, it is the largest producer of food and it has the largest market. Of the total production in the CEFTA region, Serbia produces more than a half of industrial plants and fruit. The highest share, regarding grains, has maize, then wheat, and the lowest share – barley and oats. Buckwheat has been back lately on the Serbian fields.

From the global point of view, Serbia is the most competitive in the production of some fruit species, such as raspberry, cherry, sour cherry, plum and quince. Right after come maize, sunflower and sugar beet. Serbia is less competitive in the production of walnut and paprika. In regard to other products, unfortunately Serbia is not competitive. On a global scale, Serbia is not competitive in poultry raising and the situation is slightly better regarding Europe. Hog raising is not competitive in Europe (although it used to be very recognizable), while it has a better position in the CEFTA region.

In the production of soy, Serbia has built its high competitive position on a high-quality and on non-GMO soy, while it loses primacy due to genetically modified soy, which is produced in the USA, Brazil and Argentina. Serbia occupies the fourth place in the CEFTA region, the seventh place in the EU, and the sixth in the world. The production of milk in Serbia is not competitive, although it occupies the third place (right after maize and pork), in the total value of production. Sheep and goat breeding in Serbia has been recovering in past several years, although it is a small production and poorly competitive.

7.5. Some advantages of Serbia in attracting foreign investments

Besides favourable conditions for the development of agricultural production and rural tourism Serbia has, there are also some advantages by which Serbia significantly increases the capacities for attracting investments and investors. These are: *qualified agricultural manufacturers and good hosts; numerous empty residential, production and other buildings in rural areas; free and unpolluted soil; food quality and the possibility to increase the healthy-safe food production*; *the EU funds*; *regional specialization in agriculture and rural tourism*; *favourable trade agreements with Russia, the USA, the EU, Turkey, and the CEFTA countries; Danube, etc.* All of these factors would significantly influence to the increased employment [Mihailović et al., 2015].

Some factors are favourable for investing in agricultural production to ensure the domestic market (food safety of the Republic of Serbia) and for export on those countries which have been permanently deficient, like Russia, some EU countries and the countries covered by the CEFTA Agreement. Those are the products which must comply with the requirements of the modern market. *Major agricultural manufacturers*, i.e. farmers who have the sufficient amounts of agri-food products for picky world market belong to this group. The possibility of *specialization in agricultural production, favourable trade agreements especially with Russia, the EU funds and the river Danube* belong here, and they allow to export these products at relatively low costs.

The other factors are favourable for instantaneous investment in agricultural production and rural tourism, especially on *small agricultural holdings*, which have no large areas, and have favourable natural and other conditions for the development of rural tourism. *Good hosts*, who are engaged in agricultural production on their holdings, can successfully deal with the additional activity, such as the rural tourism. *Empty residential and production building*s, which could be very interesting, with minor adaptations and renovations, for tourists from urban areas of the EU countries and other developed countries. *Unpolluted soil* is a basic condition for the production of healthy-safe food, more and more often demanded in the highly developed and wealthy countries, and tourist can be showed "on-the--spot" how this food is produced. Serbia has significant areas of arable land, which have been cultivated at one time, and neglected now. There are also those agricultural areas which have never been cultivated, which could be put in order for agricultural production with small investments, especially for the production of healthy-safe food. The Republic of Serbia has *top-quality autochthonous products*, which are not in large quantities for export, but it has and might offer them through meals for tourists in rural areas. These products are primarily *kaymak* (type of Serbian cream), various pies, fritters, cured meat (delicatessen), roast lamb and roast pork, paprika-flavoured sausage, aivar, jams, various preserves, etc.

Economic structure of a country, especially rural and the most backward areas of the Republic of Serbia would change significantly by investing in agricultural production and rural tourism. Besides, this would reduce the pressure on urban areas, and even result in significant comeback of a certain number of workers from urban to rural areas.

7.6. Conclusions

The Republic of Serbia should look for its comparative specific features and advantages in regard to other countries, some EU countries and the Russian Federation in the development of agricultural production and rural tourism. Besides land and climatic conditions, as the significant comparative advantages, the agricultural manufacturers have been a very important comparative advantage in this production in past several years. Especially big agricultural producers follow the global trends in this production and invest significantly in new technologies; they specialize, organize and connect in interest, in order to respond to the demanding world market for agri-food products. However, there is a large number of small agricultural manufacturers, which has not specialized their agricultural production, but have been recognizable by a high quality, very specific and healthy-safe food. They have the capacities, along with relatively small investments, to receive guests in their holdings and it represents the addi-

tional economic activity to them – providing the tourist services. These holdings, by expansion of economic activities in their holdings in beautiful Serbian rural areas, make significant incomes, except for accommodation income, from meals for tourists and the sale of very specific local products. In this way would increase the employment of a significant number of unemployed work-capable populations. In other words, Serbia has also other comparative advantages for attracting investments, which would significantly change the current economic structure, especially of rural areas.

References

1. Cvijanović, D., Simonović, Z., Mihailović, B., *Težišta i ciljevi novijih reformi agrarne i regionalne politike Evropske Unije*, Economics of Agriculture, no. 3, 2011 [ISSN 0352-3462].
2. Cvijanović, D.,Vuković, P., *Agritourism in Serbia as a chance for food export,* International Conference *Food and Rural economy competitiveness under the global crisis,* Edition II, Bucharest, Romania, 23-25 September 2010, pp. 433-438 [ISBN 978-606-505-374-8].
3. Cvijanović, D., Mihailović, B., *Međunarodni marketing kao faktor razvoja izvozne konkurentnosti*, Institut za ekonomiku poljoprivrede, Belgrad, 2012 [ISBN 978-86-6269-002-9].
4. Cvijanović, D., Trandafilović, S., Imamović, N., *Marketing concept in terms of agricultural enterprises development in transitional countries*, Economics of Agriculture, vol. LX, no. 1 (1-216) [ISSN 0352-3462].
5. Cvijanović, D., Subić, J., Paraušić V., *Poljoprivredna gazdinstva prema ekonomskoj veličini i tipu proizvodnje u Republici Srbiji*, Republika Srbija, Republički zavod za statistiku, Belgrad, 2014 [ISBN 978-86-6161-129-2].
6. Cvijanović, D., Mihailović, B., Čavlin, M., Čavlin G., *Impact of marketing consulting on performances of agrarian clusters in Serbia*, Sustainability 2015, no. 7(2) [ISSN 2071-1050, http://www.mdpi.com/2071-1050/7/2/1099].
7. Paraušić, V., Cvijanović, D., Mihailović, B., *Izvozni potencijali plasmana poljoprivredno prehrambenih proizvoda iz R.Srbije na tržište Ruske federacije*, Ekonomski pogledi, vol. 16, no. 3, pp. 155-167.
8. Katić, B., Cvijanović, D**.**, Pejanović, R., *The agriculture as a real assumption of regional and rural development in Serbia,* Rural areas and development, vol. 8, Institute of Agricultural and Food Economics – National Research Institute, Warsaw, 2011, pp. 77-90 [ISBN 978-83-7658-195-8].
9. Mihailović, B., Cvijanović, D., Simonović, Z., *Role of business ethics in management of human resources*, Ekonomika, Godina LXI, I-III 2015, vol. 61, no. 1, pp. 85-96 [ISSN 0350-137X].
10. *Strategija poljoprivrede i ruralnog razvoja Republike Srbije za period 2014-2024*, Godine, "Sl.glasnik RS", no. 85, 2014.
11. Zakić, N., Vukotić, S., Cvijanović, D., *Organisational models in agriculture with special reference to small farmers*, Economics of Agriculture*,* vol. LXI, no.1 (1-268), 2014 [ISSN 0352-3462].

8 An approach based on state-space models for the agricultural production risk assessment[1]

Cristian Kevorchian, Camelia Gavrilescu
Institute of Agricultural Economics, Romanian Academy, Bucharest, Romania
ck@fmi.unibuc.ro , cami_gavrilescu@yahoo.com

Abstract

The traditional approaches of the hazard analysis and production system resilience are based on static analyses of the risk factors that influence the farm economy. This category of approaches exhibits a limited conceptual capacity of modelling the dynamics of production systems that are in a permanent interaction with the multitude of factors that influence the profit dynamics. Reducing the complexity of interactions to simple linear causality relations leads to an assessment with great approximation of production risk and farm resilience. Many studies made by international institutions as well as academic studies have proposed solutions for production risk assessment through yield adjustment policies, and by means of financial products like "futures contracts" and contracts with "options" acting in a coupled way with production diversification, crop insurance, production contracting, etc. as instruments limiting the production risk. The Dynamic Bayesian Networks are a generalization of hidden Markov models as the space of states is represented in a factored form instead of a single discrete random variable. In their turn, the Dynamic Bayesian Networks are a generalization of Kalman filters [Kevorchian and Hurduzeu, 2000] by the fact that the Gaussian distributions can be replaced by any probability distributions. By combining the causal analysis associated to Bayesian inference with the stochastic approach on agricultural production risk assessment, a unitary theoretical context is provided for the approach of risk assessment and mitigation by means of an index acting as a proxy for the forecast losses. Our approach is based on using the Selyaninov (SHR) index, as bi-dimensional indicator (rainfall / temperature). The weather risk coverage category can supply an on-line insurance scheme to be implemented with low transaction costs on the background of low "risk appetite". The class of Markov models helps us in modelling the Selyaninov index dynamics, being an important instrument in the management of production risk dynamics.

Keywords: Bayesian space-state, risk assessment in agriculture, structural modifications, Hidden Markov Model

JEL Classification: Q11, Q02

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

8.1. Introduction

In Rasmussen et al. [2013], the production risks are considered the main risk sources in agriculture, mainly due to the lack of consistency of weather conditions predictability, diseases and other unfavourable production conditions, which are very difficult to forecast, as well as to price volatility on the agricultural produce markets and to market risk by the difficult access to the market. These add to the financial risks resulting from agricultural business funding conditions, as well as to the institutional risks generated by the agricultural policy volatility at government level, and the technological risk. One of the important strategies for reducing exposure to production risk, which was analysed in other papers [Hurduzeu et al., 2014; Kevorchian et al., 2013], was related to its marketing by means of certain products such as futures contracts, weather derivatives and financial derivatives.

The studies of the World Bank, OECD and FAO recommend the following solutions as risk mitigation modalities: insurance of harvests and incomes, utilization of financial instruments of "futures" and "options" type, production diversification, debt management and credit availability, as well as the creation of alternative jobs. Each of these methods is based on the utilization of certain instruments for risk assessment and management. The main problem in selecting the best risk management instrument is to obtain the highest possible risk diminution level at the lowest costs possible.

All these measures imply the utilization of decision-support technological platforms that should facilitate the increase in farm business management performance in the conditions of farmers' low risk appetite as well as of a limited openness to the computational technologies that accompany the risk mitigation procedures. The purpose of implementing such technological platforms is to support farmers in their effort to efficiently manage the production risk on the basis of data supplied as service, both from cloud computing and from certified sources, which, on the basis of machine learning solutions, to substantiate systems from the "predictive analytics" category, meant to integrate and exhibit as output the support information for the management of risks specific to crop production.

We must highlight that this approach raises a series of ethical problems in the sense that the policy of collection and exploitation of huge amounts of data is developed, on the basis of technology stacks from the "big data" category, which generates an asymmetrical situation between the farm that uses services of this type and the suppliers of services such as *The Climate Corporation*, a Monsanto company that manages key information for business management in agriculture and which, practically, by the utilization of a huge computation capacity, makes Monsanto become a powerful company that acts in the technological area [Carbonell, 2016].

The Bayesian networks that we shall investigate are inscribed in the context of machine learning utilization in the area of big data, with the purpose to investigate the generating factors of production risk by means of alternative risk management tools.

The predictive models are used for the identification of patterns in the farm historical data, for the identification of both risks and business opportunities on the farm. For modelling the non-supervised learning processes applied to pattern generation, clustering algorithms are used, of the type: k-means, HMM (Hidden Markov Model), SOM (Self Organization Map), ART (Adaptive Resonance Theory), etc.

By the HMM (Hidden Markov Model) utilization in the continuous assessment of weather risk and by the application of certain advanced computational mechanisms, the risk phenomena that induce risks in farm production can be assessed with improved accuracy. The randomness that characterizes the dynamics of weather factors determines the agricultural production size, quality and price implicitly and includes the weather risk in the agricultural production risk at farm level. Wheat production variability in Romania in the period from 2005 to 2009 ranged from 50% to 130% [Rutten, 2012]; the same source quotes Swiss Re, which estimates for Ukraine 80% risk for extreme weather events, in 2010, against only 20% political risk. The performance of insurance schemes mainly for the production risk leaves room for significant improvements in particular in the emerging economies.

Starting from a risk assessment and identifying a special risk (e.g. weather risk), a risk management strategy is chosen under the conditions in which an agricultural insurance product cannot be identified on the insurance market. The insurance index is a simplified insurance form in which the compensation payment is based on the value of an index that acts as proxy for losses and not on the estimated losses according to the individual insurance policy. The sum insured is based on the cost of production based on the agreed value (established in advance), and the payments are made on the basis of a grid pre-established in the insurance policy.

In a World Bank study [2011], the Weather Index Insurance (WII) is presented, originating in the weather derivatives market, in a scenario in which speculative funds take over the weather risk. The interest in WII in agriculture has grown on the background of non-performance of certain traditional insurance products, mainly in countries considered as emerging economies, where the limited marketing and the small farm size are major obstacles to the sustainable development of certain performant agricultural production insurance products. In Hurduzeu et al. [2014] and Kevorchian et al. [2013], a risk marketing form is used that is based on the Selyaninov weather index (for wheat):

$$SHR_{wheat} = \frac{\sum_{15\ April}^{30\ June} daily\ rainfall}{0.1 * \sum_{15\ April}^{30\ June} average\ daily\ temperature}$$

The relation between the weather factors (humidity, temperature) reflected in SHR_{wheat} and the production gain / loss level is determined by the analytical formula:

$$I(SHR) = \begin{cases} \max\{M, (1 - SHR) * \theta\} & SHR \in [0,1) \\ 0 & SHR \in [1,1.4] \\ \max\{M, (SHR - 1.4) * \theta\} & SHR \in (1.4,2) \end{cases}$$

where: M – is the contract value, and θ is a tabulated variable [Kevorchian et al., 2013] as index value. The daily value modelling in the vegetation period can be described by a Markov model.

Starting from the Markov model described by Kannan and Farook [2015], we considered that the stochastic modelling of the time series associated to the dynamics of Selyaninov indices is an important conceptual instrument for the analysis of the dynamics of conditions in which crops grow in the vegetation period, with implications in the farm production economy for a given crop. In other words, we use stochastic models to describe the crop development process throughout the vegetation cycle. At the same time, it is known that a HMM is a particular case of Bayesian network [Ghahramani, 2001]. An essential element in the work with Bayesian networks are the conditioned probabilities for the stochastic variables modelling the risk factors associated to a given crop. The distribution of conditioned probabilities related to the production risk is calculated on the basis of the history of farm accounting records as well as on the basis of FADN data (Farm Accountancy Data Network). *RiBay* is an example of network, described by Rasmussen et al. [2013]. HMM is a subclass of Bayesian networks (dynamic Bayesian networks) for modelling the time series [Ghahramani, 2001]. In the time series modelling, it is presumed that an event can determine (in a causal sense) another future event, but not vice versa.

8.2. Material and method

Markov chains

A stochastic process with Markov's property is called Markov chain. A Markov chain is a particular case of a finite automaton whose associated transition graph is weighted, and the entry sequence indicates the transition states of the automaton. Formally we have:

$$S = \{s_1, s_2, \dots, s_n\}$$

which is the state of a family, and the transition probabilities matrix a_{ij} from state *i* to state *j* is:

$$A = \begin{pmatrix} a_{01} & \dots & a_{0m} \\ \vdots & \ddots & \vdots \\ a_{n1} & \dots & a_{nm} \end{pmatrix}$$

with $\sum_{j=1}^{n} a_{ij} = 1$ for any *i=1...n*, while s_0 and s_F are the initial and respectively final states associated with the Markov chain.

In a first order Markov chain, the probability of a particular state depends only on the previous state from the states sequence:

$$P(s_i|s_1, s_2, \dots s_{i-1}) = P(s_i|s_{i-1})$$

For any transition probability a_{ij}, a probability $p(s_j|s_i)$ is associated, with $\sum_{j=1}^{n} a_{ij} = 1$ for any i$\in \{1,2..n\}$.

A Markov chain provides the probability associated with a sequence of observable events. In the current practice, the analysed events are not always observable. For instance, the production losses on a farm are not observable when a variation of weather factors associated with a Selyaninov index dynamics occurs. Practically, the state associated with "production losses" is hidden (non-transparent) because it is not directly observable. The objective is to use these observations in estimating the losses due to climate factors.

The architecture of Bayesian networks

A Bayesian network is a representation through acyclic oriented graphs of *conditional independence* over a family of random variables [Ghahramani, 2001].

We consider four random variables *W, X, Y* and *Z*. According to the classical theory of probabilities, the common probability is a product of conditional probabilities:

$$P(W, X, Y, Z) = P(W) \cdot P(X|W) \cdot P(Y|W, X) \cdot P(Z|W, X, Y)$$

This factorization does not provide useful information about the distribution of the common probability. Practically, any variable may depend on another variable.

Let us consider the following factorization:

$$P(W, X, Y, Z) = P(W) \cdot P(X) \cdot P(Y|W) \cdot P(Z|X, Y) \quad (*)$$

The factorization implies a family of conditionally independent relations. Variable *A* is conditionally independent from a variable *B* providing a variable *C* if and only if:

$$P(A,B|C) = P(A|C) \cdot P(B|C)$$

for all *A, B* and *C* so as $P(C) \neq 0$. From this factorization, we can obtain:

$$P(W,Z|X,Y) = P(W|Y) \cdot P(Z|X,Y)$$

A Bayes network is a graphical way to represent a given factorization of the common probability distribution. Each node of the Bayesian network is conditionally independent from the non-descendants associated with the parents. The absence of arches in a Bayesian network implies the existence of a conditional independence relation that can be used to obtain some efficient algorithms for calculating the conditional and marginal probabilities.

The architecture of dynamic Bayesian networks

HMM are part of a class of Bayes networks named dynamic Bayes networks that are destined to modelling time series. In modelling time series, we assume that an event may cause another event in the future, but not the opposite. By associating an index *t* for each variable, one of the simplest causal models for a data sequence $\{Y_1, Y_2, \ldots, Y_t\}$ is a first order Markov model, for which each variable is directly influenced by the previous variable only:

$$P(Y_{1:T}) = P(Y_1) \cdot P(Y_2|Y_1) \ldots P(Y_T|Y_{T-1})$$

Given $\{Y_1, Y_2, \ldots, Y_T\}$, the model will use only Y_t in predicting Y_{t+1}. Expanding the Markov model to a higher dimension is reduced to the expansion of the variable interaction such as generating arcs from $\{Y_{t-n}, Y_{t-n-1}, \ldots, Y_{t-1}\}$ to Y_t. Another method of expanding the Markov models is that observations are dependent on a "hidden" variable, which will be named *state*, and a state sequence will be named *Markov process*. Consequently, in our approach, any state sequence which will result in a production gain/loss is a Markov process. The Markov models in the HMM (Hidden Markov Models) category are included in the dynamic Bayes networks category. Another well-known model category in this class is that of states-space models, known as Kalman filter, which can be seen as continuous variants for HMM.

The architecture of Hidden Markov Models

A HMM (Hidden Markov Model) is a Markov model for representing the probability distributions over observations sequences. HMM can be presented as a dynamic Bayes network. Observations at the time slice *t* are modelled using the variable Y_t. HMM takes its name from two properties. Based on the first property,

we assume that the observation at the time slice t was generated by a process whose state s_t is "hidden". In the second case, we assume that the state of this "hidden" process fulfils the Markov property, based on which the value of S_{t-1}, the current state S_t is independent from all previous states of $t-1$. In other words, the state at a certain time slice "encapsulates" all we can know about the history of the process in order to forecast its future. At the same time, the outputs fulfil the Markov property while respecting the states: given S_t, Y_t is independent of the states and observations associated with all the other temporal indices.

To sum up, we can say that the common distribution of a states and observations sequence can have the following form:

$$P(S_{1:T}, Y_{1:T}) = P(S_1)P(Y_1|S_1)\prod_{t=2}^{T} P(S_t|S_{t-1})P(Y_t|S_t)$$

where we used the notation $X_{1:T}$ to designate the sequence $\{X_1, X_2, \ldots, X_T\}$. The graphical representation of factorization for the common probability is the Bayesian network. We should underline that the hidden states family is discrete: S_t can take K values, noted by $\{1, 2, \ldots, K\}$. In order to build a probability distribution over the observations sequence we should specify the distribution over the initial states $P(S_1)$ together with a $K \times K$ order transition matrix, $P(S_t|S_{t-1})$ and the output model $P(Y_t|S_t)$. For HMM, both the transition matrix and the output model do not depend on time, more precisely is time-invariant, except for the initial state. If the observables are discrete symbols, taking one of L values, the output model can be characterized by the *observations matrix*. HMM can be expanded in order to allow input variables, U_t, so that there is an input dependent on the transition probability to a state

$$P(S_t|S_{t-1}, U_t).$$

The Bayes networks are a framework with a larger generality, which will allow us to implement algorithms for inference and instruction in HMM, and to formulate applications aimed at marketing the production risk.

We present a brief mathematical description of the above, where:

$$S = \{s_1, s_2, \ldots, s_K\}$$

is the states set. The transition probabilities matrix with a_{ij} representing the probability to move from state i into state j and $\sum_{j=1}^{n} a_{ij} = 1$ for any $i=1...n$, and s_0 and s_F are the initial, respectively final states of the Markov chain. The HMM architecture includes a sequence of t observations, each one obtained over V^* associated to the vocabulary $V=\{v_1, v_2, \ldots, v_w\}$:

$$O = o_1, o_2, \ldots, o_l$$

We have a family of probabilities associated to observations, where o_t is generated at the state i level:

$$B=b_i(o_t)$$

The initial state s_0 and the final state s_f are not associated to observations, together with the transition probabilities $a_{01}, a_{02}, \ldots, a_{0n}$, associated to the initial state and $a_{1f}, a_{2f}, \ldots, a_{nf}$, associated to the final state.

An alternative HMM architecture which is not based on the initial and final states, but is using an explicit distribution on their set:

$$\pi = \pi_1, \pi_2, \ldots, \pi_n$$

a distribution of initial probability over the states, π_i, is the probability that the Markov chain will start from the state i. Certain states j may have $\pi_j = 0$, which means that this is not an initial state, and:

$$\sum_{j=1}^{n} \pi_j = 1$$

with:

$$SA = \{s_x, s_y, \ldots, s_z, \ldots\} \subset S$$

this is the set of accepted states.

A first order HMM means that the following conditions are fulfilled:

$$P(s_i|s_1, s_2, \ldots s_{i-1}) = P(s_i|s_{i-1})$$

$$P\left(o_i\middle|s_1, \ldots s_i, \ldots s_p, o_1, \ldots o_i, \ldots o_p\right) = P(o_i|s_{i-1})$$

named the *Markov hypothesis* or the output independence hypothesis, where the output o_i is dependent only on the state s_i in which it is achieved. We can imagine two "hidden" states of the Markov chain (*P,* associated with losses for a certain crop, and *C*, associated with gains for the same crop), and the observations family *O* is corresponding to the Selyaninov index for the vegetation period of the given crop. We should mention that the transition probabilities between the two states will be non-zero, which will result in a transition graph completely connected or ergodic.

Let us consider a HMM formally defined by the triplet $\lambda=\{A, B, \pi\}$ and the following description of the relation between the observation sequence and the states sequence:

i. The states alphabet and the observations alphabet are respectively:

$$S = \{s_1, s_2, \ldots, s_n\}$$

$$V = \{v_1, v_2, \dots, v_m\}$$

ii. The observations sequence built over the alphabet *V* is:

$$y = y_1 y_2 \dots y_t \; under \; y_t \in V$$

iii. *A* is the transition vector; whose components are probabilities to switch from state *i* to state *j*:

$$A = [a_{ij}] \;\; where \; a_{ij} = P(q_t = s_i | q_{t-1} = s_j)$$

where: $q_i \epsilon Q = \{q_1 q_2, \dots, q_n\}$ is the hidden states family.

iv. *B* is the observations vector, whose components are probabilities that observation k to be achieved in state j, independently of t;

$$B = [b_i(k)], where \; b_i(k) = P(x_t = v_i | q_t = s_i)$$

v. π is the initial probabilities vector:

$$\pi = [\pi_{ij}] \; where \; \pi_i = P(q_1 = s_i).$$

We must underline the Markov working hypotheses, where the current state depends only on the previous state (model memory) and on the independence from the previous states and outputs.

The states probability distribution at the time slice *t* is:

$$\gamma_t(i) = P(x_t = s_i)$$

It can be calculated with a complexity algorithm $O(n^2)$. For each object, an application is defined:

$$C: S \to \mathbb{R}$$

used to evaluate the losses cost due to weather conditions, and the risk at the time slice *t* is given by the following formula:

$$R = \sum_{i=1}^{n} \gamma_t(i) \cdot C(i)$$

In this context, the following problems should be solved:

- Let us consider the observations sequence $O = o_1, o_2, \dots, o_T$ and a HMM $\lambda = \{A, B, \pi\}$ for which an efficient calculation algorithm should be provided for the probability of providing a model of the objects sequence $P(O|\lambda)$.
- Let us consider the observations $O = o_1, o_2, \dots, o_T$ and a HMM λ; a correspondence should be identified between the states sequence $S = s_1, s_2, \dots, s_T$ which provides "the best characterization" of the given observations.
- Adjusting the model parameters $\lambda = \{A, B, \pi\}$ in order to achieve the probability maximization $P(O|\lambda)$.

Hidden Markov Models of Bayesian type

The developments in certain fields such as Machine Learning, in the context of the development of technologies based on MLaaS-type services (Machine Learning as a Service), impose approaches which are architecturally modifying the classical aspects of the problem. A couple of aspects linked to "overfitting" and "models selection" are analysed in this section.

The first aspect is concerning a very good adjustment during the learning period of the model, but the generalization fails. This phenomenon is generally due to insufficient data used in the instruction period for large complexity models (large number of parameters). Maximizing likelihood fitting does not structurally have a solution for this category of problems. In our case, the model structure in HMM should include everything, from the number of hidden states to the states transition matrix. In order to "learn" the model structure (in ML sense) it is necessary to compare models of different complexities. An automatization of this process is excluded, at least until now, which sends us to the three classical alternatives of solutions:

- **Cross-validation** – the instruction data are divided in two categories:
  - New instruction data,
  - Validation set,

  but with certain computational disadvantages such as being "*computing intensive*".
- **Regularization** – it improves the objective function in accordance with a penalty term that favours simple models compared to complex models. The regularization implies a sufficiently large subjective estimation in the sense in which the implicit evaluations of parameters must be confirmed by the modeller.
- **Bayesian integration** – a Bayesian approach to the learning process treat all the variables measured as random variables, assigning "prior probabilities" to these and generating inferences in order to obtain posterior probabilities linked to the observed data. For HMM these values can be structural information associated to HMM (e.g. number of states), parameters, hidden states, etc. Unlike the maximum concordance probability and the maximum *a posteriori* probability (MAP) that identify the estimating levels of parameters, different structures of the model can be compared (e.g. parameters, hidden states).

Estimating the conditional probabilities and risk assessment

The Bayesian networks represent an intuitive mode of knowledge representation for uncertainty management. The conditional probabilities associated to the individual stochastic variables, modelling the risk factors in the Bayesian

networks, are essential input data for the model. The probabilities associated to future events are characterized by a high subjectivity level and estimating the conditional probabilities represents an important scientific challenge. The Bayesian network model *RiBay* is structured along four random variables representing the soil, weather, rapeseed production, and cereal production respectively. The significance of the connection of parent-child type, over the random variables mentioned above means that the parent node impacts the child node, and the nodes that do not implement such a relation represent conditionally independent nodes. The soil conditionally impacts the rapeseed and cereal productions, the weather impacts the two productions, but soil and weather are causally independent; soil has three associated states: clayey, sandy and mixed, weather has four associated states "bad", "above the average", "under the average", and "good". The rapeseed production and the cereal production have seven associated states, three states for the negative deviation, one for neutral and three states for the positive deviation. There is a distribution of prior probabilities for weather and soil and the conditional probability distribution for each variable Production Soil and Weather.

The prior probabilities are the following:

- $P(Weather) = (0.25, 0.25, 0.25, 0.25)$,
- *P(Soil)* = (0.5, 0.4, 0.1).

The Bayesian network is an efficient representation of the common probability distribution of the four random variables, enabling us to calculate the marginal *posterior* probability of each variable supplied to any sequence of administered evidence. For instance, *P* (Cereal production | Weather = "bad") = (0.078, 0.096, 0.175, 0.304, 0.175, 0.096, 0.096), for further details see Rasmussen et al. (2013). *RiBay* includes a system of risk management tools.

8.3. Results and discussions

Let us consider the random variables $X_1, X_2, \dots, X_n$ with identical distribution as follows:

$$X_i = \begin{cases} 1 & if\ in\ the\ i-th\ vegetation\ week\ SHR \in [1,1.4] \\ 0 & if\ in\ the\ i-th\ vegetation\ week\ SHR \in (0,2)\backslash[1,1.4] \end{cases}$$

where: $i \in \{1..n\},\ n\ being\ the\ number\ of\ vegetation\ weeks.$ By comparison with the network described in Rasmussen et al. (2013) in which the production variable has seven exhaustive states, three in the negative deviation zone, one characterizing the neutral state and three for the positive deviation, we worked with two states with positive deviation (1) and the negative deviation (0), respectively. Additional research in the agronomic zone is needed for a more comprehensive analysis of the states of a family.

The working hypothesis is of Markov type:

$$P\left(X_n = x_n \middle| X_{n-1} = x_{n-1,} \dots, X_1 = x_1\right) = P(X_n = x_n | X_{n-1} = x_{n-1})$$

where: $x_1, x_2, \dots, x_n \in \{0,1\}$. The probability to obtain a certain level of the Selyaninov index in the week k of the vegetation period depends only on the Selyaninov index level of the previous week. In addition, the event independence from history makes the stochastic process to be of Markov chain type. The associated transition matrix is:

$$\begin{bmatrix} P_{00} & P_{01} \\ P_{10} & P_{11} \end{bmatrix}$$

where: $P_{ij} = P(X_{k+1} = j | X_k = i)$ with $i, j \in \{1,0\}$, $k \in \{1 \dots n\}$și $P_{00} + P_{01} = 1, P_{11} + P_{10} = 1$. P_{11} gives the probability that in a week of the vegetation period the weather conditions favourable to the wheat crop follow a week that is favourable in weather terms to the vegetation period of the crop. A small probability of this situation does not reveal a favourability meant to ensure the phytotechnically foreseen production gain. An index can be generated that can reveal on a more differentiated basis the production loss tendency caused by the not totally favourable weather factors [Jahangir and Alam, 2013]:

$$LPI = P_{11} \cdot P_{01}$$

with $LPI \in [0,1]$. For the defined Markov chain, the calculation of the probability associated to the sequence of observations 1.1 - 1.5 - 1.6 is made only through the intermediary of associated states and the multiplication of probabilities associated to the connection graph. For a sequence of states (of *unfavourable-favourable-favourable* type) we can calculate the probability of output 1.1 - 1.5 - 1.6. Each "hidden" state supplies an observation, hence the sequence of "hidden states" and the sequence of observations are characterized by equal lengths. For a "hidden" sequence of the states $S = s_1, s_2, \dots, s_T$ and a sequence of observations $O = o_1, o_2, \dots, o_T$, we have:

$$P(O|Q) = \prod_{i=1}^{T} P(o_i | s_i)$$

For the calculation of the probability associated to the sequence 1.1 - 1.5 - 1.6 with the unfavourable-favourable-favourable sequence of hidden states we have:

$$P(1.1\ 1.5\ 1.6 | unfavourable\ favourable\ favourable) =$$
$$= P(1.1 | unfavourable) \cdot P(1.5 | favourable)$$
$$\cdot P(1.6 | favourable)$$

but it is necessary to calculate the probability of the event 1.1 - 1.5 - 1.6, weighted by the associated probability:

$$P(O,S) = P(O|S) \cdot P(S) = \prod_{i=1}^{n} P(o_i|\, s_i) \cdot \prod_{i=1}^{n} P(s_i|\, s_{i-1})$$

hence, we have:

$$\begin{aligned} P(&1.1\ 1.6\ 1.6, unfavourable\ favourable\ favourable) \\ &= P(unfavourable|start) \cdot P(unfavourable|unfavourable) \\ &\cdot P(favourable|unfavourable) \cdot P(1.1|unfavourable)) \\ &\cdot P(1.5|favourable) \cdot\ P(1.6|favourable) \end{aligned}$$

Synthesizing the results, the probability associated with the observations is:

$$P(O) = \sum_S P(O,S) = \sum_S P(O|S)P(S)$$

In our case, we have:

$$\begin{aligned} P(&1.1\ 1.5\ 1.6) \\ &= P(1.1\ 1.5\ 1.6, unfavourable, unfavourable, unfavourable) \\ &+ P(1.1\ 1.5\ 1.6, unfavourable, unfavourable, favourable) \\ &+ P(1.1\ 1.5\ 1.6, favourable, favourable, unfavourable) + \cdots \end{aligned}$$

Starting from the fact that an equiprobable distribution displays maximum entropy:

$$H(X) = -\sum_x P(x) log_2 P(x)$$

This intuitively leads us to the idea of constructing a distribution by the continuous adding of properties (obeying the "Occam's Razor" rule). Each property is a function that highlights a subset of learning observations, for instance the "production losses", "production gains" in the context of previously constructed HMM. More precisely, in order to select a model in a set of probability distributions *C* we select the model $p^* \in C$ characterized by maximum entropy *H(p)*:

$$p^* = argmax\ H(p)\ unde\ p \in C$$

Practically the MaxEnt model is a classifier of sequences that assign a class (e.g. "production losses") by the calculation of a probability associated to exponential distribution for a weighted set of properties corresponding to the observation. MaxEnt can be trained by methods related to convex optimization. A MEMM (Maximum Entropy Markov Model) is an extension of MaxEnt that uses Viterbi decoding algorithms.

Application

We presuppose that for a given farm we consider the set of states $S = \{s_1, s_2\},\ where\ s_i \epsilon \{\uparrow, \downarrow\}, i \in \{1,2\}$ generated by the presence or absence of farm profit, with the associated matrix:

$$A = (a_{ij}), i, j \in \{1,2\}$$

where $a_{ij} = P((\ state\ s_j\ at\ t+1 | (\ state\ s_i\ at\ t)$, and $A = (a_{ij}), i, j \in \{1,2\}$.

Matrix $B = (b_j(k)), j \in \{1,2\}, k \in \{1,2,3\}$,

where: $b_j = P(observation\ k\ at\ t | \ state\ s_j\ at\ t)$. A HMM is defined by A, B and π as well as by the size of the set of states and observations and denoted by λ={A, B, π}. Schematically we present a HMM as follows:

Markov process	X_0	$\overset{A}{\rightarrow}$	X_1	$\overset{A}{\rightarrow}$	X_2
B	↓		↓		↓
Observations	O_0		O_1		O_2

where: X_0, X_1 and X_2 are "hidden states".

We shall next consider a four-state sequence $\bar{s} = \bar{s}_0\bar{s}_1\bar{s}_2\bar{s}_3$ corresponding to observations:

$$O = (O_0, O_1, O_2, O_3)$$

By $\pi_{\bar{s}_0}$ we understand the probability of starting from state $\bar{s}_0$, and $b_{\bar{s}_0}(O_0)$ represents the probability associated to the initial observation O_0 and $a_{\bar{s}_0\bar{s}_1}$ is the probability of transition from state $\bar{s}_0$ to state $\bar{s}_1$. The probability associated to $\bar{s}$ is given by the following formula:

$$P(\bar{s})=\pi_{\bar{s}_0} b_{\bar{s}_0}(O_0)\ a_{\bar{s}_0\bar{s}_1} b_{\bar{s}_1}(O_1)\ a_{\bar{s}_1\bar{s}_2} b_{\bar{s}_2}(O_2)\ a_{\bar{s}_2\bar{s}_3} b_{\bar{s}_3}(O_3)$$

We calculate the probability:

$$P(\uparrow\uparrow\downarrow\downarrow) = 0.6 * 0.1 * 0.7 * 0.4 * 0.3 * 0.7 * 0.6 * 0.1 = 0.00021$$

The state transfer matrix is:

$$\begin{matrix} & \uparrow & \downarrow \\ \uparrow & 0.7 & 0.3 \\ \downarrow & 0.4 & 0.6 \end{matrix}$$

For three stratification levels of Selyaninov index associated to the wheat crop, we have the following observation matrix:

$$\begin{matrix} & 0 & 1 & 2 \\ \uparrow & 0.1 & 0.4 & 0.5 \\ \downarrow & 0.7 & 0.2 & 0.1 \end{matrix}$$

where stratum 0 of Selyaninov index corresponds to $SHR \in [0.1]$, stratum 1 corresponds to the interval $SHR \in (1,1.4]$, and Stratum 2 corresponds to $SHR \in (1.4,2]$, and the initial distribution of states is:

$$\pi = [0.6, 0.4]$$

We consider a sequence of four for a set of observations of the type:

$$O = (0, 1, 0, 2)$$

where 0.1 and 2 are the strata associated to the Selyaninov index.

R language utilization for model implementation

The main functionalities of the "Hidden Markov" package, which adds to the depmixS4 and HMM packages, the author of which is David Harte [2016] are quantified into a family of functions for the analysis of:

- Discrete-time Hidden Markov Models,
- Markov-modulated GLM (General Linear Model),
- Markov-modulated Poisson processes,
- Includes parameter simulation, estimation and Viterbi algorithms.

The implemented algorithms are based on Walter Zucchini algorithmics. HMM simulation can be achieved with *simulates*, estimation of parameters with BaumWelch function (Expectation Maximization – EM algorithm). Viterbi algorithm, which we shall use, predicts the most probable sequence of Markov states. The purpose of Viterbi algorithm utilization is to "decode" at global level the hidden Markov state in each time point. This is achieved by the determination of the sequence of states $(k_1^*, k_2^* \cdots, k_n^*)$, which maximizes the common distribution of hidden states, having in view the entire process to be observed:

$$(\mathrm{k}_1^*, \mathrm{k}_2^* \cdots, \mathrm{k}_\mathrm{n}^*) = \underset{\mathrm{k}_1, \mathrm{k}_{2,\ldots}\mathrm{k}_\mathrm{n} \epsilon \{1,2,..,\mathrm{n}\},}{argmax} \mathrm{P}\{\mathrm{C}_1 = \mathrm{k}_1, .., \mathrm{C}_\mathrm{n} = \mathrm{k}_\mathrm{n} | \mathrm{X}^{(\mathrm{n})} = \mathrm{x}^{(\mathrm{n})}\}$$

Argmax is evaluated by means of *which.max* R function. We shall next determine the most probable *a posteriori* state at the moment *i*, which is referentiated as locally decoded:

$$\mathrm{k}_\mathrm{i}^* = \underset{\mathrm{k} \epsilon \{1,2,..,\mathrm{n}\},}{argmax} \mathrm{P}\{\mathrm{C}_\mathrm{i} = k | \mathrm{X}^{(\mathrm{n})} = \mathrm{x}^{(\mathrm{n})}\}$$

Note that the previously presented probabilities are calculated by means of *Estep* function from R, with the output k_i^*.

8.4. Conclusions

The application of stochastic methods in the assessment of agricultural production risk, in the technological context opened by software services (MlaaS) operated in cloud computing context, adds more accuracy to the insurance of the production levels planned by the farmer, as well as the possibility of improved risk management. Either derivative instruments or financial products adapted to agricultural production are used, more accuracy is needed in the assessment of production and market risks at farm level. All these methods can be implemented into complex solutions of production risk assessment and coverage. Our research study attempts to put on a favourable position the online insurance products for production cover-

age, by proposing certain assessment tools which, in our opinion would greatly simplify the farmer's tasks in the difficult risk estimation endeavour. Unfortunately, these risk-limiting methods are still less frequently used in Europe.

References

1. Carbonell, I.M., *The ethics of big data in big agriculture,* Internet Policy Review, no. 5(1), 2016 [https://policyreview.info/articles/analysis/ethics-big-data-big-agriculture].
2. El-Yaniv, R., Pidan, D., *Selective Prediction of Financial Trends with Hidden Markov Models,* Proceedings of the 24th International Conference on Neural Information Processing Systems, Granada, Spain, 2011, pp. 855-863 [http://papers.nips.cc/paper/4301-selective-prediction-of-financial-trends-with-hidden-markov-models.pdf].
3. Ghahramani, Z., *An Introduction to Hidden Markov Models and Bayesian Networks*, International Journal of Pattern Recognition and Artificial Intelligence, no. 15(1), 2001, pp. 9-42.
4. Harte, D., *Package Hidden Markov,* 2016, ftp://ftp.gns.cri.nz/pub/davidh/sslib/r-repo/.
5. Hurduzeu, G., Kevorchian, C., Gavrilescu, C., Hurduzeu, R., *Hazards and Risks in the Romanian Agriculture Due to Climate Changes,* Elsevier, Procedia Economics and Finance, vol. 8, 2014, pp. 346-352.
6. Jahangir Alam, S.R., Sayedur Rahman, M., Saadat, A.H.M., *Monitoring meteorological and agricultural drought dynamics in Barind region Bangladesh using standard precipitation index and Markov chain model*, International Journal of Geomatics and Geosciences, no. 3(3), 2013, pp. 511-524.
7. Kannan, S.K., Farook, J.A., *Stochastic Simulation of Precipitation Using Markov Chain – Mixed Exponential Model,* Applied Mathematical Sciences, no. 9(65), 2015, pp. 3205-3212.
8. Kevorchian, C., Gavrilescu, C., Hurduzeu, G., *Qualitative Risk Coverage in Agriculture through Derivative Financial Instruments Based on Selyaninov Indices,* Financial Studies, 17(3), 2013, pp. 19-32.
9. Kevorchian, C., Hurduzeu, G., *O abordare a analizei contractelor futures valutare prin utilizarea retelelor neuronale si a filtrelor Kalman,* Romanian Economic Journal, no. 12.III(6-7), 2000.
10. Rasmussen, S., Madsen, A., Lund, M., *Bayesian network as a modelling tool for risk management in agriculture,* IFRO Working Paper 12/2013, Department of Food and Resource Economics, University of Copenhagen, 2013 [http://okonomi.foi.dk/workingpapers/WPpdf/WP2013/IFRO_WP_2013_12.pdf].
11. Rutten, L., *Innovative agricultural finance and risk management Strengthening food production and trade in the transition region,* FAO Investment Center, 2012.
12. World Bank, *Weather index insurance for agriculture: guidance for development practitioners*, Agriculture and rural development discussion paper, no. 50. Washington, DC: World Bank, 2011.

9 Price transmission in dairy industry in Bulgaria[1]

Bozhidar Ivanov
Institute of Agricultural Economics, Sofia, Bulgaria
bozidar_ivanov@yahoo.co.uk

Abstract

The dairy industry in Bulgaria is characterized by a heterogynous structure in terms of producing farms, dairies and the entire organization of the chain. Over the last 15 years, the dairy industry has been subject to incessant and tangible changes at all stages of production. The drivers of those transformations are external competition, which forces farms, dairies and middlemen to adjust to the market pressure, and endogenous behaviour of producers to embrace actions dealing with price risk and uncertainty. The goal of the paper is to study the price mechanism in the dairy chain and transmission of milk price from the farm to the final products delivered by dairies. Finding price relationship (price co-integration) between different stages of production will facilitate making conclusions that there is no price mechanism bias. Otherwise, it will open the room for studying the causes underlying the existence of price transmission asymmetry.

Keywords: dairy industry, price transmission, farms, dairy plants, market organization

JEL Classification: C22

9.1. Introduction

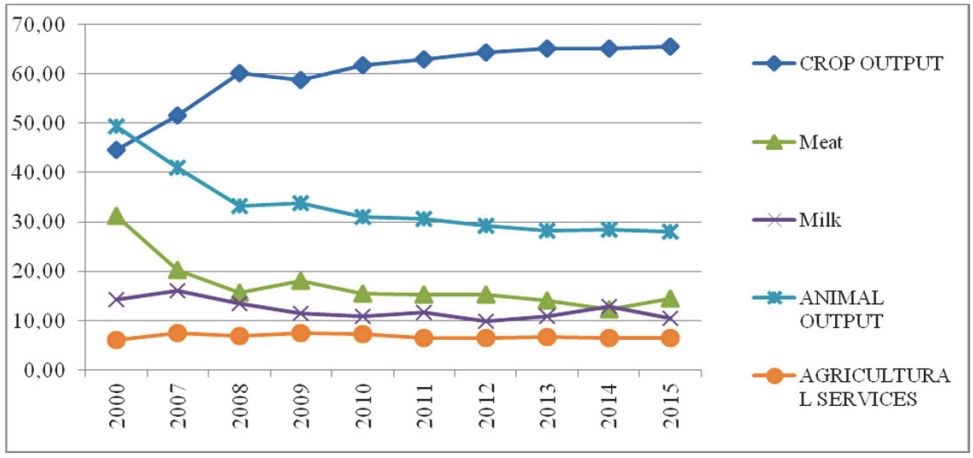
The dairy sector in Bulgaria operates in a quite changed economic environment due to the membership in the EU, quota removal as of April 2016 and the entire socio-economic transformations set out since the beginning of 1990s. Nowadays, the livestock in Bulgaria composes for around 30% of the gross agricultural output. In comparison, 15 years ago, the share of livestock production in the agricultural output consisted up to 52-55%. The general picture in Bulgarian agriculture shows that for almost 15 years, the livestock is subject to a gradual and constant reduction, while the dairy industry manages to withhold its position within the agricultural gross output.

Moreover, the dairy output viewed solely from the perspective of livestock production, denotes a slight increase in the period after 2000. For example,

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

the dairy livestock in the last decade spurred its outcome in the livestock output balance, as its share rose from 35% to 45% in 2014. The main reason for such evolution is the price growth in the years before 2014 contrarily to lowering meat prices [Stoychev and Ivanov, 2015]. In addition, the heightening feeding prices during the cereal price spike period of 2011-2014 affected more the livestock industry than dairy production, which in Bulgaria is to a great extent rather grazing feeding than to barn husbandry.

Figure 1. Share of dairy production in agricultural output (%)



Source: Eurostat.

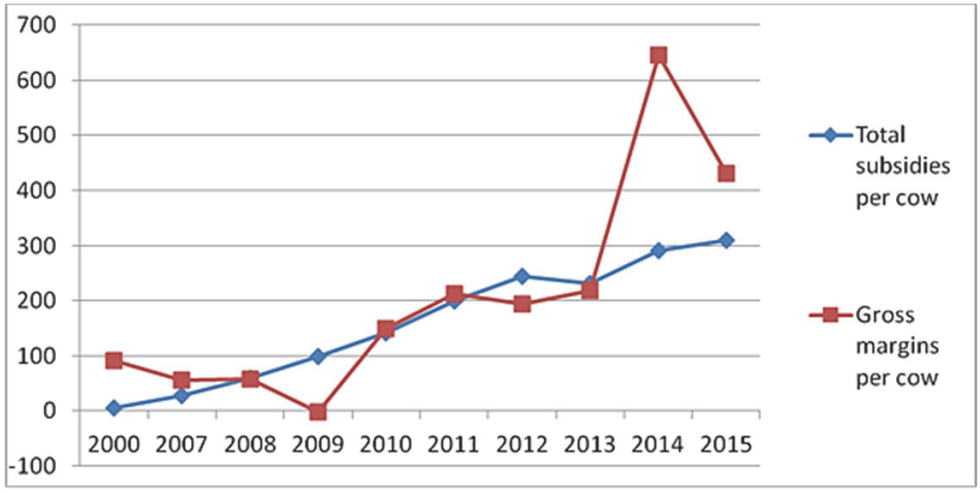
Regarding the numbers illustrating the dairy performance in the agricultural annual output, it cuts from about 15% in 2000 to 10% in 2015, whereas the physical volumes of milk drop by about 27%. However, the reason for downward decrease in the dairy output in the recent years is attributed to a reduction in production so to omnipresent plunge in milk prices. Since August 2014, the milk price in the EU tumbles, threatening the sustainability of dairy farms. The factors inducing that situation pertain to Russian embargo, quota removal and overrunning supply upon demand. For example, as of the beginning of 2016, milk delivered in the EU is 2.6% higher than in 2015, which stands for a peak in the last 5 years.

Whereas the EU represents the largest milk producers in the world by 140 MT followed by the USA with 95 MT. Since summer of 2016, the milk volume delivered to dairies in the EU steadily fell by an average of 3%, as the biggest drop is noted by one of the largest producer countries – Germany, France and the UK. As a result of the slow drop in the milk production, it is seen not only in the EU, but is identified also in production of other high production regions, such as Oceania. The only region, which stands for a major share in the world milk production – the US persists to increase the production, which on annual base marks up by 2%. Moreover, the cow herd rises up by 21K – tallying up to 9.34 million heads.

Along with the market pressure on the dairy prices in Bulgaria, which challenges the producers, the dairy sector faces other problems of internal origin. Those problems are attributable to structural challenges, as despite consolidation of farm size in dairy industry, the average number of cows in farms is merely 17% of the average cow number in the EU in 2015. The average productivity per dairy cow in Bulgaria is less than 60% of the EU average, which poses Bulgarian dairy farmers in more vulnerable position [Stoychev and Ivanov, 2015]. For almost 10 years of quota implementation in Bulgaria, it turns out that the quota was not a setback for development of farm structures because over the period from 2007 to 2015, it had never been overrun. The highest achievement was in 2008/2009, for both produced milk – 88.5% and direct deliveries – 71.2%.

Contrarily to the structural challenges and dairy quota impediments, the accession to the EU creates opportunities for farmers to obtain public subsidies, distributed on the scheme of area-based payments. The distribution of payments based on area brings disadvantages for livestock farmers, which develop sometimes their activity without land or with small portion of land; hence they have a limited ability to benefit from subsidies. Apart from subsidies, it proves the gross margins, comprising revenues from sale of production less variable costs without labour costs, fluctuate on low level of about EUR 100 per head. It should be underlined that in the period of 2006-2010, the feeding prices raised up by 22%, as the price of raw milk lagged, which severely squeezed the return of dairy farmers.

Figure 2. Gross margins and subsides per cow (EUR/head)



Source: CAPA.

Eventually, the financial results of dairy farms got worse and the state triggered the opportunity to complement the direct payments by national compensatory payments, which were designated to dairy farming. Since 2011, the

national payments along with coupled aids to dairy cows jumped substantially by 34% compared to 2010 and by 106% against 2009, which brings about an enhancement in the gross margin per cow in farms.

Besides, it should be stated that after 2011, the purchase price of milk in Bulgaria also scored an increase by 21% compared to previous 2010, which reinforced the incomes per cow. The gross margins almost doubled in the period of 2011-2014 compared to 2007-2010. The price of raw milk in the period of 2011--2014 climbs up to EUR 310-315 per ton, while in the period of 2007-2010, the average milk price was about EUR 250 per ton. After August 2014, the price of milk not only in Bulgaria but all over the EU started to fall, as the average EU price slipped by about 25% between November 2014 and 2016. For the same period, in Bulgaria, the fall was on average at 17%. The average EU raw milk price over the span of January 2007 – October 2010 was EUR 32.9 per 100 kg, while in Bulgaria is EUR 29.7 per 100 kg characterized by a wide deviation – 18%.

The price question not only in the dairy industry is a key issue that economists are looking to elucidate, as the current study aims to analyse the price mechanism in the dairy chain and transmission of milk price from the farm to the final products delivered by dairies. The topic is relevant and important implying to reveal how and to what extent the Bulgarian dairy market is integrated to the EU market, i.e. by price mechanism, and taking the answer of this question traces up the opportunity to insight what will be the competition pressure on dairy farming and how dairy farming may react.

This goal constitutes several objectives, namely: analysis of BG cow milk price transmission to the EU price, the estimation of BG milk price elasticity and investigation of the situation with the price vertical cointegration between raw milk and cheese.

9.2. Methodology

The study deals with the price issues, exploring the price mechanism in dairy industry and chain. It comprises the methods and tools used to analyse the price cointegration and to estimate the price elasticity. The price integration is the property of two prices to move by the same vector and by close values, which is assumed by Law of one price defined by Marshall [1890]. It has been used quite loosely indicating the degree of co-movement shown by prices across spatially separated markets [Goodwin and Piggott, 2001; Fackler and Goodwin, 2001].

To test whether the market is cointegrated, it is essential to test the series for stationarity. In theory, different models are applied, the most popular and basic one is Dickey-Fuller and Augmented Dickey-Fuller tests [Hill, Griffiths and Lim, 2011]. The DF and ADF provide a way to check the dynamic series for

presence of unit error, which means the persistence of the stochastic error characterized by random wander, free drift, which makes the stochastic error in the model arduous for handling. In the DF and ADF test, to approve and reject the hypothesis for immanence of unit error, respectively the null and alternative hypothesis is used the t-statistics of Student for β parameter. When the β parameter is lower compared to the critical t-stat value, it provides justification for rejecting H_0 and accepting the alternative H_1 for lack of unit error and stationarity of the series under different level of significance.

The DF and ADF tests in the study are applied in a modified form from the traditional mode, where those methods mainly illustrate the stationarity status of the price series. In the study, both prices are not treated separately, as they are merged, receiving the price spread, which further is employed to run tests.

$$Y_{PS} = Y_{p1} - Y_{p2} \tag{1}$$

where: Y_{PS} is the price spread obtained by the difference between both prices (Y_{p1} and Y_{p2}) afterwards subject to a co-integration test. The DF and ADF tests are autoregressive test by nature, as the distinction between both tests is that the ADF test includes the lag variables. The ADF test renders possibility to disclose the relevance of lags in movement of the dependent variable (ΔY) as well as to reinforce the model stationarity and cut off the unit error.

$$\Delta Y = \alpha_0 + \alpha_1 * Y_{t-1} + \varepsilon \tag{2}$$

$$\Delta Y = \alpha_0 + \alpha_1 * Y_{t-1} + \alpha_2 * \Delta Y_{t-1} + \varepsilon \tag{3}$$

In the ADF test, the coefficient before the lagged price spread variable (Y_{t-1}) is derived as an equation of:

$$\alpha_1 = \beta_1 + \beta_2 - 1 \tag{4}$$

where, the coefficients α_1 and α_2 are taken over from the ordinary least square regression and $\alpha_2 = -\beta_2$.

To run a correct ADF test it is important to judge whether in the dependent variable array exists a trend and a constant value. The check for trend is done, by fulfilling different to classical method of variations approach, representing the method of two group averages (TGA) [Ivanov and Sokolova, 2016]. The TGA way for trend determination is equated as:

$$T_r = \frac{\Delta Y_i^1}{\Delta Y_i^2}, \tag{5}$$

where ΔY_i^1 must be always bigger than ΔY_i^2 hence if:

$$\frac{T_r - 1}{\sqrt{N}} \geq 0.005 \quad (6)$$

than we accept the pertinence of trend and mark it in the Excel programme function, when the ADF test is run.

The study applies some of other methods for price co-integration, as Engle-Granger test, whereas the error correction model (ECM) and vector autoregressive test (VAR) are not practiced, regardless sometimes they go together. More or less those tests use the technique embedded in the Dickey-Fuller test.

The next theoretical item is the price elasticity. The price elasticity is an important issue crucially implanted in the econometric modelling, when transforming a linear model function into a non-linear, through elasticity, measuring the reaction of certain dependent variables on the movement of the independent variables. Elasticity measures the percentage reaction of a dependent variable to a percentage change in an independent variable [Marshall 1890]. According to Holt and Samuelson [1946], the arc elasticity of demand shall be equal to that constant value regardless of the size of step, therefore, the equation for elasticity measure is:

$$-\frac{\log q}{\log p} = -\frac{\log q_2 - \log q_1}{\log p_2 - \log p_1} \quad (7)$$

In the same paper is assumed that the elasticity curve does not have the same elasticity in each point of the curve, which conjectures the existence of upper and lower curve segments. The first or "upper" measure of elasticity always lies between unity and the "true" elasticity. The "true" measure always lies between the unity and the second "lower" measure [Holt and Samuelson, 1946].

Elasticity in the study represents the change of BG milk price at any movement of the EU price. Assumption is that the price elasticity is not the same at any point of the curve, as the calculation of the elasticity is done through logarithm of the annual BG and the EU prices, similar to demand elasticity in equation (7).

$$E_{PR} = \log\left(\frac{\Delta PR_{BG}}{\Delta PR_{EU}}\right) \quad (8)$$

The price elasticity between Bulgarian cow milk and the EU cow milk average annual prices provides knowledge not just on the presence of cointegration between both prices and linear function of the parallel movement, but also it sheds light on the reactivity of Bulgarian price caused not only by the change of the EU milk price but due to the EU price level in relation to the price average.

9.3. Results

The question about dependency of Bulgarian cow milk price is very crucial and inquisitive. Since the kick-off of negotiation process for integration to the EU, Bulgarian cow milk price was around 45-55% out of the EU average price. It has always been thought that dairy farmers in Bulgaria are not symmetrically rewarded compared to the EU farmers. The reasons for this were found either in the market flaws or in the weak integration of local market to the EU market and a relative separate dairy industry development. The milk is considered a commodity with some little divergences, therefore, in a free market with free movement of goods, the prices in adjacent markets should be approximately square.

However, the raw milk is not a homogenous commodity, as an EC Regulation 853/2004 and preceding regulations dealing with the food hygiene, i.e. Directive 93/43/EEC, etc., deter the export to the EU and curbed before the accession the integration of BG dairy industry to the EU market. Bulgaria was hindered to sell on the EU market due to those non-tariff constraints in the first year of the new century. Thus the price transmission generated by free trade was suppressed and the price setting in local market was driven by local demand and supply, consumers' incomes, the export trade to third markets, etc.

Table 1. Correlation of BG and the EU cow milk prices

Correlation monthly EU-BG milk prices	EU-BG milk prices without lag	EU-BG milk prices without lag – 1 month
Multiple R	0.87	0.90
R Square	0.76	0.81
P-value	0.00	0.00
Standard Error	1.90	1.68

Source: EU, DG Agri.

The difficulties with the access of Bulgarian milk products to the EU market was nearly overcome at the beginning of Bulgarian membership due to achieved standards and enhanced incomes. The EU dairy import to Bulgaria gradually climbed up, delivering diversity and different quality, and prices slowly started to switch. Table 1 shows the correlation between both prices in the period January 2007 – October 2016, as R and R^2 are fairly robust. The correlation statistics is done for current and 1 month lag of Bulgarian price, which is assumed to depend on the EU price, as in both variants, the correlation and deterministic coefficients are high.

The relative similar correlation of prices under different lags spells for some stationarity, which means even though the prices vary over time, there are frontiers of those variations. The ADF test is run for the stationarity of the Bulgarian and the EU milk prices. The ρ values of the lagged price differences are less than 0.05 and the calculated critical values are less than theoretical ones (for BG prices – -3.56, EU prices – 3.17), which demonstrates the lack of unit errors in two series and likeness of co-integration.

Table 2. Running DF and ADF Test on the EU and BG monthly average prices

Regression Statistics and Test Statistics	DF Test	ADF Test
Multiple R	0.26	0.28
R Square	0.07	0.07
P-value	0.005	0.007
t Critical Stat α = 0.05, Constant	-2.89	-2.92
Observations	118	116

Source: EU, DG Agri.

The DF and ADF tests run for the price spread stationarity shows the lagged difference of the price spread variable is less than the critical t-statistics thus, the H_0 can be rejected and the H_1 admitted, whereof asserts for absence of a unit root error in the series.

$$\Delta Y_{MI} = \frac{0.37}{2.15} - \frac{0.13}{-2.87} * Y_{t-1} + \varepsilon \quad (9)$$

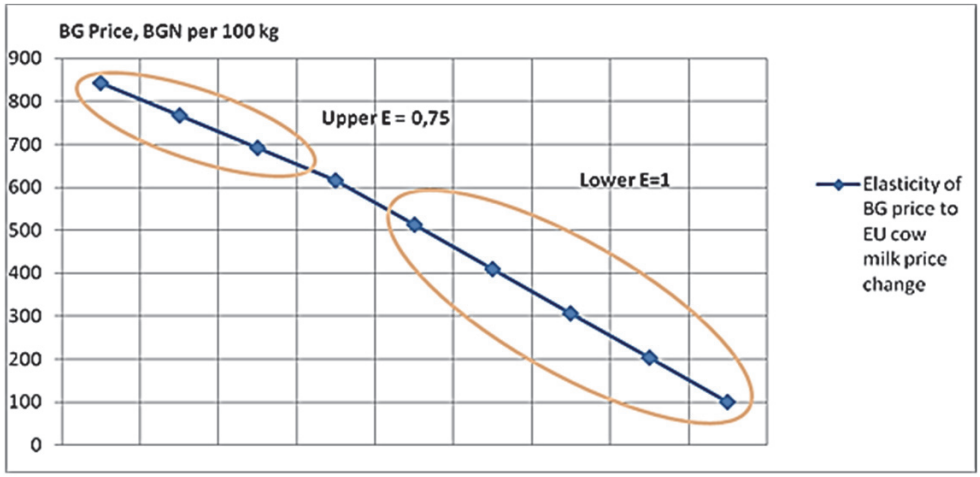
$$\Delta Y_{MI} = \frac{0.31}{2.14} - \frac{1.23}{-2.97} * Y_{t-1} + \frac{0.11}{-1.14} * \Delta Y_{t-1} + \varepsilon \quad (10)$$

Along with the DF and ADF tests, a KPSS test is run, which stands for a complementary analysis purported to check if once the price spread is proven to be stationarity whether the trend is varying around a constant mean or otherwise, exposed as a time trend. The t-coefficient of the parameter is estimated up to 0.91, which is higher than the critical t-values of t=0.462 (confidence level of 95%). Herein, the H_0 is that the time series is stationary around a mean, while the alternative hypothesis is that the time series is stationary, representing a linear trend. Since, the calculated t-statistics is higher than the critical value, we can deny the null hypothesis and the price spread is concluded as a stationarity, with a linear trend. The results from the milk price co-integration testify that the EU

and BG prices are tightly connected and the price spread fluctuates as a time trend, closing over time.

The study of elasticity of BG and the EU average annual prices is to clarify the consistency of the curve and elasticity value in the lower and upper part of the curve. The assumption is related to the neoclassical concept – "the one price theory" that the price of milk in BG and the EU would at least move in the same direction by the same magnitude (regression coefficient 1). It turns out the BG price reacts by different elasticity in separate cases to the EU price change. The elasticity is found out to be perfect (E=1) when the EU price is in the lower segment of the curve mid and it diminishes going up on the curve to 0.75 when the EU price is at the upper price zone.

Figure 3. Elasticity of BG milk price to the EU average price change



Source: CAPA on EU database.

As higher is the EU price and always it goes above the mid over some period, the BG price starts to respond inertly, which means that BG price is unlikely to catch up to the average EU price, when the latter one rises significantly. The opposite is found, when the EU price during some market oversupply or another crisis is subject to decline, the BG milk price is quite responsive to the price fall, as the BG price may go down with the same speed as the EU steeping. Dairy farmers face a bigger risk – strong likeness to experience low price, when the EU market is plummeting and slower price recovery when the market climbs.

One of the crucial issue for dairy industry development is the vertical price transmission. The analysis is done on the monthly cow milk price and monthly cheese price, as the presence of relationship between both prices is a key preposition to judge the upstream prices relationship to the input price evolution. The correlation between both prices is low (0.43-0.47) in dependence

on different lags, which implies a weak relationship, as the cheese price does not follow the raw milk price. The dynamic series of prices cover the period of 2012-2015, as in this period the raw milk price approaches closer to the EU average milk price and the import of cheese from the EU expands, which makes the market more competitive and the subtle relationship between those vertical prices is found odd. The weak relationship between milk and cheese prices spells for presence likely of other significant factors influencing the cheese price – import prices, input deflator, price asymmetry.

Table 3. Running DF and ADF test on milk and cheese prices

Test Statistics milk – cheese prices	***DF Test***	***ADF Test***
Multiple R	0.32	0.35
R Square	0.10	0.12
P-value	0.03	0.048
t Critical Stat α = 0.05, Constant	-2.98	-2.97
Observations	47	46

Source: EU, DG Agri and State Agency for Commodity Auctions.

The DF and ADF tests for presence of unit error in milk and cheese prices fulfilled separately, show that either prices have a ρ value for the parameters of the lagged prices over 0.1, which means the null hypothesis for lack of unit error and non-stationarity of data cannot be ignored. The t-statistics of the parameter in front of lagged vertical price gap of cheese and milk does not meet the theoretical t-coefficient (-2.23 and -2.47 at confidential level of 95%), which proves the impossibility to admit the alternative hypothesis for price spread stationary.

$$\Delta Y_{MI} = \frac{0.46}{2.32} - \frac{0.09}{-2.23} * Y_{t-1} + \varepsilon \quad (11)$$

$$\Delta Y_{MI} = \frac{0.46}{2.54} - \frac{0.12}{-2.47} * Y_{t-1} + \frac{0.23}{-1.59} * \Delta Y_{t-1} + \varepsilon \quad (12)$$

The lack of confidence to accept the H_1 that the price of milk and cheese are stationarity is complemented by implementation of Engle–Granger test, which is run once the separate two price series are found non-stationarity in order to re-confirm the non-stationarity status of vertical prices. The second stage of the Engle–Granger test is to run the ADF test of the residuals and if the residual series proves to be stationarity, it is presumed the prices are cointegrated. The t-statistics of the parameter of the lagged residuals in the ADF test is estimated (-2.04) over the critical value as well as the ρ value is higher than the sig-

nificance level (0.27>0.05) and the residual series is assured as non-stationarity. It means, the H_1 milk and cheese prices are cointegrated – must be rejected and it is not found substantially to recognize the relationship between milk and cheese prices over the period of 2012-2015.

Along with the ADF, Engle–Granger test, the KPSS test is also run to check for existence of trend-stationarity of the vertical price gap between cheese and milk prices, which is assumed as H_1. The estimated t-criteria of the parameter is higher than the theoretical value (0.37>0.15 at the significance level of 95%), which implies declining the H_0 and admitting the H_1 that price gap between milk and cheese prices is not stationarity, thus both prices are not integrated.

The finding that between milk and cheese prices there is no cointegration means those prices move discretely and are decoupled signalizing for a dairy chain with a cracked price transmission. The cracked price transmission is understood as a transmission where the downstream is not replicated in the upstream price, which can be attributed to different reasons. The most usually, whenever the upstream price is influenced and is generated powerfully by other cost factors, as production and labour costs, inflation, fixed costs and the share of input costs in the total cost for making the product is relatively low, it can be expected a weaker price integration. However, the price-making mechanism in a free economy is driven by supply and demand and it turns out that milk and milk products operate in distinct markets, assuming the price elasticity at both markets is different.

9.4. Conclusions

The dairy industry sector suffered significant hardships during the 1990s, when the number of cow herd dropped by more than twice. In the last 15 years, the dairy industry met different challenges attributed to the EU membership, related to the quality of milk, compliance of dairy plants with the EU legislation, implementation of CAP policy, where the decoupled direct support is based on area, not immediately benefitting the dairy farms. The market competition from other EU countries presses the sector, triggering farms, dairies, middlemen to adjust to the market pressure and the price risk. The price risk is linked to the price uncertainty, price shocks and falls, which critically threatens the profitability, sustainability and farmers' decision-making.

The price risk is higher always when the local dairy market is not tenaciously integrated with the EU market, whereas, for farmers it is important that the downstream prices are being bound to upstream prices. In those cases, the price risk does not disappear, but it is controlled to exogenous factors. Finding price relationship (price co-integration) between different stages of production

will facilitate making conclusions that there is no price mechanism bias. However, it is found that vertical milk and cheese prices are not symmetrically integrated, which envisages the intervention of other factors.

It was found that there is cointegration between the EU and BG milk price, which means the movement of the EU prices is closely followed by Bulgarian milk price. Meanwhile, the BG milk price and, respectively, the EU milk price are in stationarity, which evidences stable prices with lack of steep falls and spikes. In the studied period between 2007 and 2016, BG price shows a trend, as the price spread is bigger at the beginning and gradually BG price approaches the EU average one at the end of that period.

It should be underlined that the found price stationarity and price approximation occur in the EU dairy market which is quite protective, regulated and publicly supported. The milk supply in the EU until April 2016 was restricted by dairy quota system, while the import of dairy products outside of the EU is safeguarded by quotas and taxes. Hence the internal competition is not enough, the purchase milk prices stand relatively high, which draws up Bulgarian price up and probably is a reason to notice a price disintegration between milk and dairy products' prices. The lack of price symmetry between milk input and dairy products from one side, affects farmers, underpaying them, while from the other hand, costing more to the consumers. The dairy farmers along with the disadvantages from the price disintegration between milk and cheese incur higher risk from the lower elasticity when the EU milk price goes over the average of a period and strong elasticity when the price is below the average. It means farmers are underpaid when prices recover and are vulnerable when prices sink.

References

1. European Commission, DG AGri, *EU Prices for Selected Representative Products* [https://ec.europa.eu/agriculture/markets-and-prices/price-monitoring/monthly-pri-ces_en].
2. Eurostat, http://epp.eurostat.ec.europa.eu/portal/page/portal/agriculture/data/database.
3. Fackler, P., Goddwin, B., *Spatial Price Analysis*, Handbook of Agricultural Economics, vol. 1, part B, 2001, pp. 971-1024.
4. Goodwin, B., Piggott, N., *Spatial Market Integration in the Presence of Threshold Effects*, American Journal of Agricultural Economics, issue 83(2), 2001, pp. 302-317.
5. Hill, R.C., Griffiths, W., Lim G.C., *Principals of Econometrics*, John Wiley and Sons, Fourth Edition, 2011, p. 747.
6. Holt, C., Samuelson, P., *The Graphic Depiction of Elasticity of Demand*, Journal of Political Economy, The University of Chicago Press, 1946, pp. 354-357 [http://www.journals.uchicago.edu/doi/pdfplus/10.1086/jpe.54.4.1827059.

7. Ivanov, B., Sokolova, E., *Price Integration of Wheat and Corn Market in Bulgaria and France,* Proceeding of the National Conference "The Business in the XXI Century – Tendencies and Challenges", UNWE, Sofia, 2016.
8. Ivanov, B., Stoychev, V., *Mid-term Outlook of Dairy Sector. Updated Mid – term projections by 2020*, Centre for Agri-Policy Analysis, 2015, pp. 24 [http://www.capa-bg.com/index.aspx?ZcsLLJ5LpC478RTd6lqzEw].
9. Marshall, A., *The Principle of Economics*, The Online Library of Liberty, 8th Edition, 1890 [http://files.libertyfund.org/files/1676/Marshall_0197_EBk_v6.0.pdf].
10. Ministry of Agriculture and Food, *Livestock Survey and Dairy Production in the Dairy Plants*, Agrostatistics [http://www.mzh.government.bg/MZH/bg/ShortLinks/SelskaPolitika/Agrostatistics.aspx].
11. National Statistical Institute, *Statistical Handbook*, Issues 2007-2016.
12. National Statistical Institute, *Statistical Data. Agriculture* [http://www.nsi.bg/bg/content/809/селско-стопанство].
13. Stoychev, V., Ivanov B., *A study of Bulgarian dairy farms profitability before and after abolition of milk quotas*, Book of proceedings of Sixth International Scientific Agricultural Symposium AGROSYM 2015, 2015, pp. 1862-1867.

10 Measuring production risk in Lithuanian crop farming[1]

Tomas Baležentis
Lithuanian Institute of Agrarian Economics, Vilnius, Lithuania
tomas@laei.lt

Abstract

Agricultural sector requires analysis and management of multiple risks as agricultural production might be affected by a number of unfavourable institutional, economic and environmental factors. This study aims to identify the patterns of production risk in Lithuanian crops farming. Insurance premia are modelled by fitting statistical distributions via the Maximum Likelihood. The research covers the years between 2000 and 2015. The analysis is carried out at the county level and covers 10 counties. The highest probabilities of yield loss were observed for maize, winter barley, and spring triticale. The results indicate that maize, buckwheat, winter barley, and winter rape show the highest production risk as represented by the relative insurance premia. The spatial differences in insurance premia were also observed.

Keywords: risk, insurance premium, LMDI, index decomposition analysis, crop farming, Lithuania

JEL Classification: C13, Q15

10.1. Introduction

As agriculture is an essential activity in terms of meeting food security objectives, governments worldwide encourage support risk mitigation strategies there. Furthermore, agricultural producers tend to increase their scale of operation and degree of mechanization with stronger global integration and competition. These developments require considerable investments into capital assets, which are facilitated by credits. Consequently, farmers, government institutions, and financial intermediaries all have become more concerned over stability of agricultural income.

There are two general types of risk affecting the revenue of agricultural business, namely production and price risks. Production risk is mainly related to random fluctuations in yields due to environmental factors, i.e. yield risk. Among the possible measures for yield risk mitigation, crop insurance plays an

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

important role. Following traditional crop insurance approach, an indemnity is paid out in case crop is damaged by predefined natural events on a farm. In this case information asymmetry needs to be reduced by means of damage assessment, which inflates the operational costs of an insurer. In order to alleviate these costs, governments (e.g., the EU and the USA) have been subsidizing the crop insurance [Goodwin and Mahul, 2004; OECD, 2009, 2011]. One can distinguish between loss insurance (due to hail or other natural hazard) and yield insurance [Vilhelm et al., 2015]. Leblois and Quirion [2013] argued that insurance based on meteorological indices constitutes an alternative to traditional insurance approach as indemnity is paid out due to region-wide meteorological fluctuations in the former case. Bielza et al. [2007] presented a survey of agricultural risk management strategies across the EU Member States. As regards price risk, it has increased due to abolishment of price subsidies [Anton, Kimura 2009]. Consequently, the mitigation of risk has become increasingly dependent on farmers' decisions. Therefore, it is important to combine different strategies for the agricultural risk management depending on prevailing types of risk and attitudes of decision makers.

Once most relevant types of agricultural risk have been identified, the estimation of risk level constitutes the focal issue for research on risk management. Statistical methods are then applied to model the risk. In particular statistical distributions are fitted to observed data on agricultural production. This can be done on farm, regional and / or national level. Indeed, it has been shown that the higher level of aggregation induces lower variation of performance indicators and, in turn, agricultural risk [OECD, 2009]. In order to identify the underlying trends in agricultural risk, it is, therefore, important to apply statistical methods at regional and / or farm level.

Certain aspects for the agricultural risk have been analysed in Lithuania, yet now modelling of production risk has been carried out at the regional level. These studies mainly followed the two strands, namely construction of composite indicators and decomposition of performance indicators. Girdziute et al. [2014] combined multiple indicators by means of factor analysis to gauge the level of agricultural risk in Lithuania. Streimikiene et al. [2016] applied the benefit of doubt model for analysis of financial risk on Lithuanian family farms. The latter research relied of farm level data from Farm Accountancy Data Network. Kozlovskaja [2013] focused on factors affecting revenue for different crops. It turned out that price risk was more important factor if compared to yield risk. The lowest variation in revenue was observed for rape and potatoes. Peleckis et al. [2015] analysed the practice of crop insurance in Lithuania from viewpoints of government, farmers and insurers. Baležentis and Baležentis

[2011] employed LMDI model to decompose the changes in grain harvest. Baležentis and Kriščiukaitienė [2015] applied Shapley value to decompose the changes in milk revenue in Lithuania in terms of milk quantity, fat contents and producer price. Sime important studies mentioned above did not consider such downside risk measures as semivariance [Hogan, Warren 1974]. Furthermore, distribution-based measures of risk were not estimated and, hence, the probability of hazard was ignored. As regards the level of aggregation, there is a need for regional (county-level) analysis.

Measurement of the risk aims to quantify the possibility of deviations from the expected level of an indicator analysed. However, only deviations below expected level of yield and / or price can be considered when estimating agricultural risk. Several types of measures are available for this purpose [Goodwin and Mehul, 2004]. First, the moments of statistical distribution (i.e., average, variance, skewness and kurtosis) can be applied to describe the variation of yield or other variable. Second, statistical distribution can be fitted to observed time series. This can be done by two approaches: parametric and non-parametric. Parametric approach seeks to optimise parameters of predefined statistical distributions via maximum likelihood or other methods [cf. Gerlt et al., 2014; Kobus, 2012; Zhang and Wang, 2010]. Non-parametric approach applies kernel smoothing to estimate underlying distribution without specific assumption regarding its shape. The latter approach was applied by Goodwin and Ker [1998], Ker and Goodwin [2000], Zheng et al. [2014]. Estimation of agricultural risk requires the calculations of expected values yields and / or prices. These can be obtained by applying different estimators. For instance, Finger [2013] used ordinary least squares, method of moments and the Theil-Sen estimators, whereas Zhang and Wang [2010] employed LMA technique. Yet another group of models, relies on mathematical programming and seeks to maximize profit and minimize agricultural risk [Gómez-Limón et al., 2003; Kimura et al., 2010], thereby allowing to account for the risk aversion. In general, Yuan et al. [2015] classify risk measures into probability-based and indicator-based ones.

This study aims to identify the patterns of production and price risk in Lithuanian crops farming. Specifically, we look at two interrelated types of risk and their impacts on farm revenue. The following tasks are, therefore, set:

- to define the methods for the analysis of insurance premium and changes in the revenue;
- to describe the main spatial and temporal trends in Lithuanian crop farming;
- to estimate the insurance premia for main crops and regions;
- to analyse factors influencing revenue change.

10.2. Methodology

In this study, we follow the approach of Zhang and Wang [2010]. Specifically, LMA is applied for the estimation of expected yields and prices. LMA combines linear regression and moving averages approach. Indeed, the use of moving average allows for non-linearity of the resulting trend.

In economic research, HHI is a widely applied measure of specialisation. The normalised HHI [Al-Marhubi 2000] can be used to measure the specialisation of regions in crop production. After dropping time index, we define the normalised HHI for the *j-th* region as follows:

$$HHI_j = \frac{\sqrt{\sum_{i=1}^{m}\left(\frac{a_{ij}}{A_j}\right)^2} - \sqrt{\frac{1}{m}}}{1-\sqrt{\frac{1}{m}}}, \tag{1}$$

where:

A_j – is the total area sown for the *j-th* region,

a_{ij} – is the area sown under the *i-th* crop in the *j-th* region,

m – is the number of crops analysed.

The index approaches zero (resp. unity) in case of low (resp. high) level of specialisation.

Modelling of insurance premium rests on the three key elements: yield loss ratio, statistical distribution and calculation of the insurance premium. Yield loss ratio describes fluctuations in yield with respect to long-run trend. Such a measure can also accommodate price or other variable of interest. Statistical distribution allows to estimate probabilities of decrease in yield or other variable. Once the distribution function is known, insurance premium can be calculated. Each of these elements is discussed below.

Goodwin and Ker [1998] argued that the standard deviation of the detrended yield $y_d(t)$ is proportional to the average yield. Deng et al. [2002] and Zhang and Wang [2010] proposed using the relative stochastic variation as a measure of the risk:

$$y_r(t) = \frac{y(t) - \hat{\hat{y}}(t)}{\hat{\hat{y}}(t)} \tag{2}$$

Therefore, $y_r(t)$ is independent of the average level of the time series and can be used for comparisons across space and time. The latter indicator measures relative deviations from the trend due to short-run shocks.

The normal (Gaussian) distribution is defined in terms of two parameters, mean μ and standard deviation σ.

Its density function is:

$$f(y;\mu,\sigma)=\frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{1}{2}\left(\frac{y-\mu}{\sigma}\right)^2} \tag{3}$$

The logistic distribution uses location parameter μ and scale parameter σ for the following density function:

$$f(y;\mu,\sigma)=\frac{e^{\frac{y-\mu}{\sigma}}}{\sigma\left(1+e^{\frac{y-\mu}{\sigma}}\right)^2} \tag{4}$$

Parameters required for densities given in equations 3-4 are estimated via the Maximum Likelihood. The resulting functions can be integrated to measure the risk of losses. The range of integration can be adjusted in order to estimate the risk of certain scale [Liu et al., 2006].

The actuarially fair insurance premium should equal the expected loss [Goodwin, Mahul 2004]. Mathematically, the expected loss is defined as a product of probability that a loss occurs and the expected loss given that a loss occurs:

$$L=E\left(\max\left[\lambda u-y,0\right]\right)=\Pr\left(y<\lambda u\right)\left(\lambda u-E\left(y\mid y<\lambda u\right)\right), \tag{5}$$

where:

L – is the expected loss,

λ – is the coverage level,

u – is the expected insured yield, and

y – is the observed yield.

Equation 5 considers actual and expected yields, but we seek to model the relative stochastic variation (Eq. 2). Therefore, we follow Zhang and Wang [2010] and assume the indemnity, I, is paid out in case the actual yield loss ratio (Eq. 2) exceeds the guarantee level. Then, the insurance premium, π, is defined as follows:

$$\pi=E(I)=E\left(u\cdot p\cdot\max\left[y_c-y_r,0\right]\right), \tag{6}$$

where:

u – is the expected insured yield,

p – is price per unit of yield,

y_c – is the guarantee yield level, and

y_r – is the actual yield loss ratio.

Given we are interested in relative measures in risk, we ignore prices in further calculations. The relative premium, R, can be estimated as follows [Zhang and Wang, 2010]:

$$R = \frac{E(I)}{u} = \int_{-1}^{y_c} (y_c - y_r) f(y_r)\, dy_r, \tag{7}$$

where:

$f(y_r)$ – is the density function.

We further assume $y_c = 0$, i.e. any deviation in actual yield below the expected one is covered by the insurance. The resulting measure of the risk indicates the expected yield loss. This can be used for the comparisons of risk across crops and regions.

10.3. Appraisal of production risk

Generally, crop yields showed an upward trend in Lithuania during 2000--2015 [Baležentis and Kriščiukaitienė, 2016]. In most cases, this can be explained by improved farming practises and increasing application of agrochemicals (fertilisers, plant protection products). However, there is still a gap in yields in Lithuania and highly developed European countries.

The highest increase in yield was observed for winter barley: it increased by 106% from 2.13 t/ha up to 4.39 t/ha throughout 2000-2015. However, the area sown under winter barley was relatively small and amounted to 1245 ha in 2000 and 3485 ha in 2015. Winter wheat, spring wheat, spring barley, maize, legumes and winter rape constituted the group of crops which saw and increase in yields of around 60%. The latter group of crops, indeed, occupied the largest share of the total area sown. Furthermore, this share (as well as absolute area) increased during the research period. Therefore, yield of these crops have been raised in spite of expansion to new areas, which might be specific to inferior farming conditions.

The yield of winter triticale grew by 47% from 2.77 t/ha in 2000 up to 4.07 t/ha in 2015. Spring triticale, oats, mixed cereals and spring rape showed yield growth rates ranging between 32% and 38%. The share of these crops in the total area sown was rather small: they altogether occupied 10.6% of the total area sown in 2000 and this figure decreased to 9% in 2015. The lowest rate of yield growth was observed for potatoes. Indeed, the values 16.39 t/ha and 16.93 t/ha were observed for 2000 and 2015, respectively. The abundance of areas sown under these crops has decreased in Lithuania as they are associated with lower profitability and animal farming. Therefore, farmers had fewer incentives to increase yields in remaining areas sown.

Notably, crop yields fluctuated due to climatic conditions. As regards the research period, major drops in crop yields were observed during 2006, 2010 and 2013. These periods can be considered as those defining the lowest observable yields and, thus, yield risk. Even though crop yields showed an upward trend in Lithuania during 2000-2015, assessment of agricultural risk is also related to inter-regional differences in crop yields. Indeed, convergence in crop yields among regions would indicate higher possibilities for diversification of crop-mix.

Different support measures and changes in crop prices induce changes in areas sown under specific crops [Baležentis and Kriščiukaitienė, 2016] during 2000-2015. Spring barley was specific with the largest area sown exceeding 350 thousand ha, which accounted to some 30% of the national area sown in 2000. However it has declined by more than 40% until 2015. As a result the share of spring barley fell down to 12% in the national area sown. This can be explained by a decrease in animal population which resulted in lower demand for feedstuff. Winter wheat was the second most popular crop back in 2000 with area sown exceeding 285 thousand ha and accounting 24% of the national area sown. During 2000-2015, area sown under winter wheat increased twofold up to 573 thousand ha (34% of the national area sown). Therefore, winter wheat has become the most popular crop because of the possibility of export to the EU. Spring wheat occupied just 7% in the national area sown in 2000 (85 thousand ha). During the research period this share increased more than twice and reached 16% in 2015 (264 thousand ha). Therefore, spring wheat has become the second most popular crop in Lithuania.

Legumes are also specific with rather high rate of growth in area sown. Specifically, its area sown increased from 40 thousand ha up to 157 thousand ha during 2000-2015. The latter expansion can be attributed to increasing direct payment rates. Area sown under winter rape saw extremely high rate of growth as it went up from just 5 thousand ha up to 123 thousand ha. The demand for rape increased due to expansion for the biofuel production. As a result the share of legumes and winter rape in the national area sown increased from 4% to 17%. The share of winter triticale in the national area sown increased by 3.1 p.p. and stood at 5.6% in 2015. As for other crops their shares in the national areas fell below 5% as of 2015.

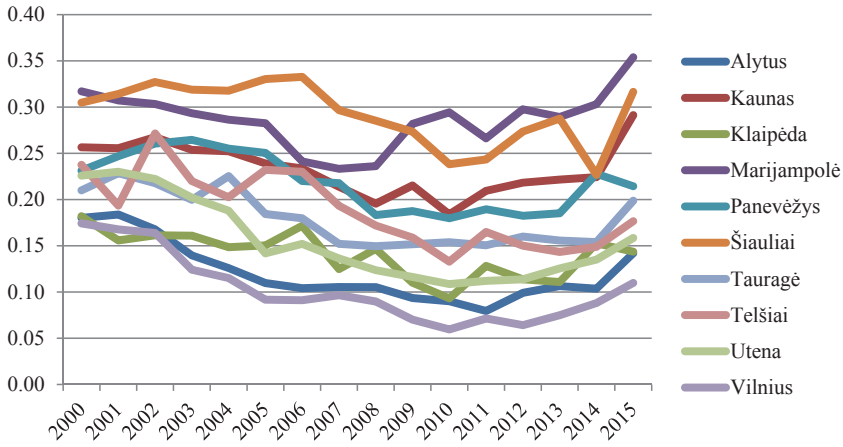
Winter rye, spring rape and potatoes showed particularly steep decreases in their area sown. Indeed the latter crops used to be among the top ones in terms of area sown at the beginning of the research period and had turned into the least popular ones by 2015. Winter rye experienced the most evident decline of 8.9 p.p. (from 11.2% to 2.3%) in the share of national area sown. This can be explained by lower prices compared to other cereals. Similarly, the share of national area

sown for potatoes went down by 7.8 p.p. (from 9.2% to 1.4%). Indeed, the area sown under potatoes plummeted to 24 thousand ha. This is related to increased phytosanitary requirements against potato diseases. The contraction of the area sown under spring rape was not that significant as it decreased from 50 thousand ha to 41 thousand ha (i.e. from 4.2% down to 2.5% of the national area sown).

Even though all the counties showed positive rates of growth in areas sown during 2000-2015, these changes were uneven across counties [Baležentis and Kriščiukaitienė, 2016]. As a result, the importance of different counties changed in different directions. The highest increases in the shares of areas sown of almost 2% were observed for Šiauliai and Panevėžys counties. The total area sown in these two counties amounted to 35% and 39% of the national area sown under crops analysed in 2000 and 2015, respectively. Kaunas county showed somewhat lower rate of change in area sown, i.e. 1.3%. The share of Kaunas county in the national area sown constituted some 17% in 2015. Accordingly, Šiauliai, Panevėžys and Kaunas counties managed to increase their share in the national area sown and maintained growth in absolute terms. The decreasing shares in the national areas sown were observed for smaller counties. The steepest decreases were observed for Tauragė and Utena counties (-1.8 p.p. and -1.2 p.p., respectively). As a result, the share of Tauragė and Utena counties went down from some 12% to 9% during 2000-2015. Counties specific with the highest rate of decrease in the share of the national area sown showed the highest coefficients of variation for this indicator. These results indicate that the counties changed their relative importance in terms of area sown thus contributing to change in aggregate yield due to different soil fertilities, landscapes and resource endowments. Higher level of specialisation of a region might induce higher agricultural risk. The level of specialisation can be measured in terms of shares of areas sown under different crops within a region.

The trends in HHI for each county are presented in Figure 1. As one can note, Lithuanian counties tended to diversify their crop-mixes during 2000-2010, whereas the opposite trend prevailed afterwards. As regards individual counties, Šiauliai and Marijampolė counties showed the highest degrees of specialisation. On the contrary, counties abundant with low fertility lands appeared to be the least specialised ones (e.g. Vilnius and Alytus counties).

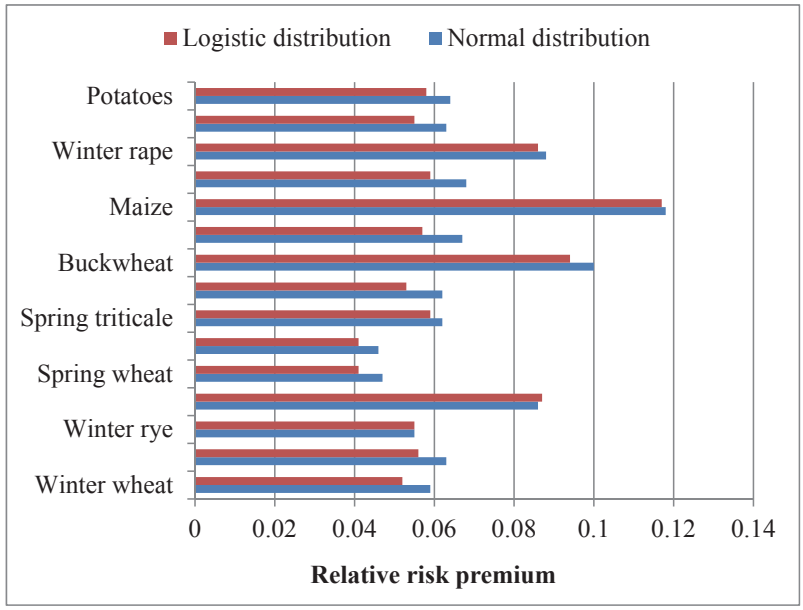
Figure 1. Specialisation of counties (HHI), 2000-2015



Source: Baležentis, Kriščiukaitienė [2016].

The relative risk premia are estimated in accordance with Equation 7. In our setting, it measures the average loss of the expected yield. Comparison of the premium across the crops and regions can show the extent of the expected risk and, therefore, provide with insights on differences in the need for risk mitigation measures and insurance effectiveness. Figure 2 presents the average insurance premia for each crop (averages were calculated across the counties).

Figure 2. Average relative risk premia

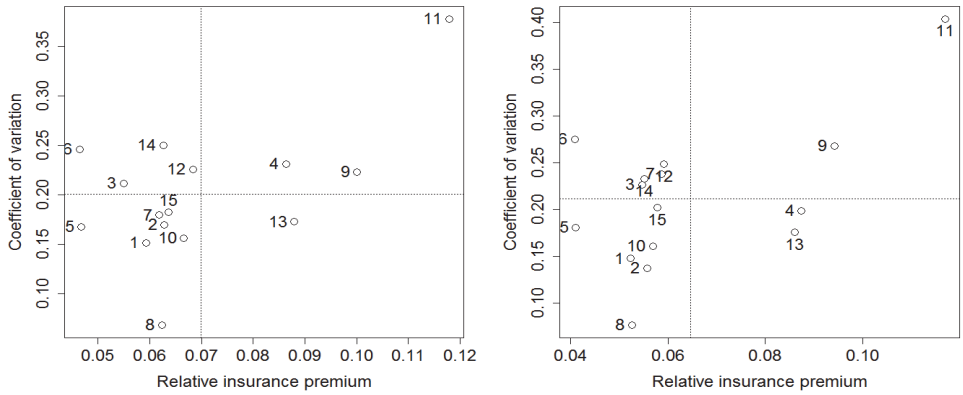


Source: Baležentis and Kriščiukaitienė [2016].

The average insurance premia are rather similar across the normal distribution and the logistic distribution. Maize, buckwheat, winter barley and winter rape show the highest production risk as represented by the insurance premium. Indeed, the average risk premia for the latter crops exceed 8%. Spring wheat and spring barley are the least risky crops with insurance premia of less than 5%.

In order to relate production risk to its spatial variation, Figure 3 presents a scatter plot for the average insurance premium and its coefficient of variation. Considering the average values of the latter two variables, the crops analysed can be grouped into the four categories.

Figure 3. Relationship between relative insurance premium and its spatial variation



a – normal distribution *b – logistic distribution*

Labels correspond to the following crops: 1 – winter wheat, 2 – winter triticale, 3 – winter rye, 4 – winter barley, 5 – spring wheat, 6 – spring barley, 7 – spring triticale, 8 – oats, 9 – buckwheat, 10 – mixed cereals, 11 – maize, 12 – legumes, 13 – winter rape, 14 – spring rape, 15 – potatoes.

Source: Baležentis and Kriščiukaitienė [2016].

First, buckwheat and maize exhibit the highest production risk along with the highest valuation thereof. Accordingly, areas sown under these two crops need to be distributed across the counties in order to minimize production risk. Otherwise, additional measures of crop insurance would be required in order to manage the resulting increase in production risk. Second, winter rape appears as a high-risk crop with relatively low spatial variation in production risk. This indicates that the varieties of winter rape currently cultivated in Lithuania are only partially suitable for Lithuanian meteorological conditions. Winter barley shows relatively high risk, however, its regional variation depends on the distribution assumed. Specifically, spatial variation increases under the normal distribution, if compared to the logistic distribution. Third, barley, winter rye, legumes and spring rape feature relatively low average production risk and relatively high spatial variation. This finding implies that certain regions require more intensive

application of risk management measures. Fourth, winter wheat, winter triticale, spring wheat, oats, mixed cereals and potatoes exhibit the lowest risk and its variation across the counties. Spring wheat shows low risk level, yet its regional variation depends on the distribution applied for the analysis. The varieties of crops specific to low level of production risk can be considered as properly selected for Lithuania.

10.4. Conclusions

Production risk was estimated by means of normal and logistic distributions. In addition, linear moving averages technique was applied in order to smooth the time series. The highest probabilities of yield loss were observed for maize, winter barley, and spring triticale. These crops require introduction of improved varieties in order to accommodate them to the weather in the Lithuanian climate. However, the probability of yield loss does not take into account the extent of loss.

The relative insurance premia were estimated for each crop in order to quantify the production risks. The results indicate that maize, buckwheat, winter barley, and winter rape show the highest production risk as represented by the relative insurance premia. The spatial differences in insurance premia were also observed. Indeed, maize showed the highest spatial variation in insurance premia, whereas the lowest variation was observed for oats. The comparison of the aggregate advantage index and insurance premia across the counties showed that the inverse relationship between the latter two variables existed for most of the crops. Potatoes and spring triticale can be given as the contrasting examples, i.e. counties with higher production risk exhibit higher shares of areas sown under respective crops.

References

1. Baležentis, T., Kriščiukaitienė, I., *Production and Price Risk in Lithuanian Crop Farming*: *Scientific Study*, Vilnius: Lithuanian Institute of Agrarian Economics, 2016, pp. 74 (ISBN 978-9955-481-59-1).
2. Bielza, M., Stroblmair, J., Gallego, J., *Agricultural risk management in Europe*, 101st EAAE Seminar: *Management of climate risks in agriculture*, Berlin, 2007.
3. Deng, G., Wang, A.S., Zhou, Y.S., *Grain yield risk level calculated by probability distribution*, Journal of Nanjing Institute of Meteorology, no. 25(4), 2002, pp. 481-488.
4. Finger, R., *Investigating the performance of different estimation techniques for crop yield data analysis in crop insurance applications*, Agricultural Economics, no. 44(2), 2013, pp. 217-230.

5. Gerlt, S., Thompson, W., Miller, D.J., *Exploiting the relationship between farm-level yields and county-level yields for applied analysis*, Journal of Agricultural and Resource Economics, no. 39(2), 2014, pp. 253-270.
6. Girdziute, L., Slavickiene, A., Vaitkevicius, S., *Integrated risk assessment at Lithuanian farms*, Transformations in Business & Economics, no. 13(1), 2014, pp. 143-154.
7. Gómez-Limón, J.A., Arriaza, M., Riesgo, L., *An MCDM analysis of agricultural risk aversion*, European Journal of Operational Research, no. 151(3), 2003, pp. 569-585.
8. Goodwin, B.K., Ker, A.P., *Nonparametric estimation of crop yield distributions: implications for rating group-risk crop insurance contracts*, American Journal of Agricultural Economics, no. 80(1), 1998, pp. 139-153.
9. Goodwin, B.K., Mahul, O., *Risk modeling concepts relating to the design and rating of agricultural insurance contracts*, World Bank Policy Research Working Paper, no. 3392, 2004.
10. Hogan, W.W., Warren, J.M., *Toward the development of an equilibrium capital market model based on semivariance*, Journal of Financial and Quantitative Analysis, no. 9(1), 1974, pp. 1-11.
11. Ker, A.P., Goodwin, B.K., *Nonparametric estimation of crop insurance rates revisited*, American Journal of Agricultural Economics, no. 82(2), 2000, pp. 463-478.
12. Kimura, S., Antón, J., LeThi, C., *Farm Level Analysis of Risk and Risk Management Strategies and Policies: Cross Country Analysis*, OECD Food, Agriculture and Fisheries Papers, No. 26, OECD Publishing, Paris, 2010 (DOI: http://dx.doi.org/10.1787/5kmd6b5rl5kd-en).
13. Kozlovskaja, A., *Kainų kaitos kaip rizikos veiksnio vertinimas Lietuvos augalininkystėje*, Žemės ūkio mokslai, no. 20(3), 2013, pp. 211-221.
14. Latruffe, L., Davidova, S., Douarin, E., Gorton, M., *Farm Expansion in Lithuania after Accession to the EU: The Role of CAP Payments in Alleviating Potential Credit Constraints*, Europe-Asia Studies, no. 62(2), 2010, pp. 351-365.
15. Leblois, A., Quirion, P., *Agricultural insurances based on meteorological indices: realizations, methods and research challenges*, Meteorological Applications, no. 20(1), 2013, pp. 1-9.
16. Liu, R., Zhu, Z., Fang, W., Wang, Y., Xu, P., Shi, L., *Risk regionalization of yield loss caused by drought for winter wheat in North China Plain*, Chinese Journal of Ecology, no. 25(9), 2006, pp. 1068-1072.
17. OECD, FAO, OECD-FAO Agricultural Outlook 2016-2025, OECD Publishing, Paris, 2016 (DOI: http://dx.doi.org/10.1787/agr_outlook-2016-en).
18. OECD, *Managing Risk in Agriculture: a holistic approach*, OECD Publishing, 2009 [http://www.oecd.org/tad/agricultural-policies/managingriskinagriculture-aholisticapproach.htm].
19. OECD, *Managing Risk in Agriculture: Policy Assessment and Design*, OECD Publishing, 2011 [http://dx.doi.org/10.1787/9789264116146-en].

20. Peleckis, K., Peleckienė, V., Peleckis, K., *Crop yield insurance-negotiating between government, farmers and insurance companies*, Economic Science for Rural Development, no. 37, 2015, pp.15-25.
21. Povilaitis, V., Lazauskas, S., Feizienė, D., Kukujevas, A., Feiza, V., *Maize productivity as influenced by different nitrogen levels and climate change*, Journal of Food, Agriculture & Environment, no. 11(2), 2013, pp. 803-807.
22. Statistics Lithuania, 2016 [Official Statistics Portal: http://osp.stat.gov.lt/en/home].
23. Streimikiene, D., Baležentis, T., Kriščiukaitienė, I., *Benefit of the Doubt Model for Financial Risk Analysis of Lithuanian Family Farms*, Economics and Sociology, no. 9(1), 2016, pp. 60-68.
24. Supit, I., Van Diepen, C.A., De Wit, A.J.W., Wolf, J., Kabat, P., Baruth, B., Ludwig, F., *Assessing climate change effects on European crop yields using the Crop Growth Monitoring System and a weather generator*, Agricultural and Forest Meteorology, no. 164, 2012, pp. 96-111.
25. Vilhelm, V., Špička, J., Valder, A., *Public Support of Agricultural Risk Management – Situation and Prospects*, AGRIS On-line Papers in Economics and Informatics, no. 7(2), 2015, pp. 93-102.
26. Wu, H., Zhang, Y., Yuan, Z., Gao, L., *Phosphorus flow management of cropping system in Huainan, China, 1990-2012*, Journal of Cleaner Production, no. 112, 2016, pp. 39-48.
27. Ye, T., Nie, J., Wang, J., Shi, P., Wang, Z., *Performance of detrending models of crop yield risk assessment: evaluation on real and hypothetical yield data*, Stochastic Environmental Research and Risk Assessment, no. 29(1), 2015, pp. 109-117.
28. Yuan, X.C., Tang, B.J., Wei, Y.M., Liang, X.J., Yu, H., Jin, J.L., *China's regional drought risk under climate change: a two-stage process assessment approach*, Natural Hazards, no. 76(1), 2015, pp. 667-684.
29. Zhang, Q., Wang, K., *Evaluating production risks for wheat producers in Beijing,* China Agricultural Economic Review, no. 2(2), 2010, pp. 200-211.
30. Zheng, Q., Wang, H.H., Shi, Q.H., *Estimating bivariate yield distributions and crop insurance premia using nonparametric methods*, Applied Economics, no. 46(18), 2014, pp. 2108-2118.

11 Risk and uncertainty management in agricultural holding

Boris Kuzman[1], Radivoj Prodanovic[2], Jonel Subic[3]
[1,3] Institute of Agricultural Economics, Belgrade, Serbia;
[2] University Business Academy in Novi Sad, Novi Sad, Serbia
kuzmanboris@yahoo.com, rprodanovic@fimek.edu.rs, jonel_s@iep.bg.ac.rs

Abstract

The goal of the paper is to present improvements in decision-making processes under conditions of risk and uncertainty. The identification of the risk source and uncertainty, which affects the decision-making of farmers, is an important activity on which depends the achievement of better financial effects. Many decisions in the agriculture have the outcomes which are realized through the longer period, after the decision is made. The sources of risk and uncertainty in agriculture are varied, but it can be summarized in five areas of management: production and technology, prices and market, finance, legislation and employees. Risk management in agriculture is engaged in reducing the possibilities of unfavourable outcomes or alleviating its negative effects. Not every decision will be right every time, but decision-making under uncertainty is difficult. The decision can be improved by identification of possible events, assessment of values of its outcomes and variability. Decision tree, matrix profitability and cumulative distribution function can be used in choosing between the risky variants.

Keywords: agricultural holding, risk, uncertainty, management

JEL Classification: D81, Q12, Q14

11.1. Introduction

The agriculture is a risky business. Usually, there is uncertainty about the price, yield and financing conditions. In this paper, some of the procedures for improvement of the decision-making process under conditions of risk and uncertainty are defined, and the techniques are reconsidered, as well as strategies for reducing the risks which are hidden in agricultural production.

The hypothesis is that all necessary information about the input and output prices, yields and other technical data are available and exact, but in practice when it comes to agriculture, it is a rare case [Kahan, 2013].

Many decisions in agriculture have the outcomes, which are being realized for months or years after the original decision had been made. Managers consider that their decisions are the best, and often it turns out that they are not, due to changes, which occur between outcomes and the time when the decisions are made.

The farmers, who are engaged in agriculture, have to make decisions at the beginning of the agri-economic season what crops to sow and to what extent, what should be the level of fertilisers and other inputs, which will be used. The final yield and prices will not be known and secured, but it will be known after several months or even several years, in the case of perennial crops.

The farmer, who has decided to expand the herd of cows by extension and replacement of heifers, must wait for several years before he receives the first income from calves of heifers, which he keeps as a herd for expansion. Unfortunately, the farmers can do little in order to accelerate biological processes in plant and livestock production or to make them more predictable.

When the outcome is more favourable than expected, manager can apply more aggressive deciding or implement decisions to a larger scope. In that situation, financial status is improved and there is no threat to the business. Real risk comes from unexpected outcomes with undesirable results, as lower prices, huge drought or disease. Risk management in agricultural holdings deals mainly with reducing the possibilities of unfavourable outcomes or at least alleviating them.

11.2. The source of risk and uncertainty in agriculture

Risk is a term that is used for description of situation in which the possible outcomes and opportunities are known for each of them. It means that there is more than one possible outcome of a previously made decision [Piggott et al., 2006]. On the other hand, uncertainty characterizes the situation in which the possible outcomes and their probabilities are unknown. The sources of risk and uncertainty in agriculture are varied, but it can be summarized in five areas: production and technology, prices and market, finance, legislation and employment [Aditto et al., 2012; Kay et al., 2012].

Usually, there is a correlation between different forms of risk in agriculture. The risk of yield and the risk of price have a tendency to be in negative correlation [Tangermann, 2001].

11.3. Production and technical risk

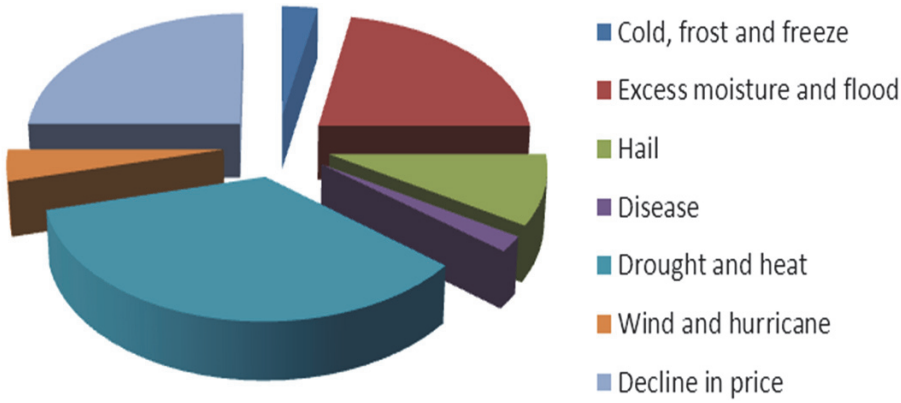
In the non-agricultural organizations, the use of certain amount of input almost always results in the same quantity and quality of production, with a very small difference. This is not a case with most of processes of agricultural production. Agricultural production, both in terms of quality and quantity, is determined by biological processes, climatic conditions, diseases, insects, weeds, metabolism, genetics and other. These factors cannot be predicted with certainty [Boskovic and Prodanovic, 2016].

Climate change (extreme events such as hurricanes, tsunamis, extreme temperatures) for now present small risk for agricultural production, they have small influence on the variability of the yields of agricultural crops, respectively, and only in some areas [Anton et al., 2012].

Contamination of organic production by genetically modified organisms and other contaminants present significant risk in production, which disproportionately increases at the global level [Hanson et al., 2004].

Figure 1 shows different causes of relative significance of losses of insured arable crops. Almost all realized losses are associated with the weather.

Figure 1. The causes of insured crop losses



Source: U.S. Department of Agriculture, Risk Management Agency [2008].

The producers of livestock also have to face risks. Cold, wet weather in the spring or dry weather during the summer can cause the catastrophic losses in some types of production. Incidence of diseases can force producers to liquidate the whole herd [Kay et al. 2012].

The second source of producing risk is new technology[1], which presents that the way of production changes [Chavas and Shi, 2015]. Risk is reduced to expected performance, expenses and other issues that must be considered before introducing new technology [Boskovic and Prodanovic, 2016]. However, failure to adopt new technology can mean that producer will miss extra profit and become uncompetitive [Aditto et al., 2012].

[1] Genetically modified types of maize have built resilience to European moth, thus the risk of loss of yield is reduced. The risk shows the quality of the grain and the acceptance by the market [Chavas and Shi, 2015].

The new sorts or hybrids can have high profit potential. However, if the conditions of productions significantly deviate from those in which they are tested (drought, insects) for the market, they can be unreliable and risky [Boskovic and Prodanovic, 2016].

11.4. The price and market risk

The price variability is a source of uncertainty for agricultural producers. The product prices vary from year to year, from day to day, and they are unknown for individual producer [Broll et al., 2013]. The governments have impact on the prices and producing decisions of farmers through agricultural policy. The demand affects the prices and is a result of the customers' habits, incomes, export policy, living standards and the price of competitive products. Some price movements follow seasonal or cyclical trends, which can be predicted, but even these trends manifest high instability. The customers impose quality standards or quantitative restrictions, which are difficult to be met for the producers and thus present a market risk [Kahan, 2013].

The prices of raw materials have a tendency to be less changeable from output prices, but still enter in the zone of uncertainty. Several times during last decades, oil scarcity caused a sudden increase in the cost of energy, fertilizers, pesticides, etc. Likewise, livestock producers, who buy animals or / and food, are under uncertainty due to changes in the price of raw materials [Tangermann, 2011].

11.5. Financial risk

Financial risk arises with lending money to finance the production. This risk is caused by the possibility of change in interest rates, the willingness of lenders to continue lending, unpredictable changes in market values of credit, as well as business capability to generate cash flows, necessary for reducing debt [Kuzman et al., 2007].

Production, marketing and financial risks exist and they are interrelated. The ability to repay the debt depends on the level of production and the price obtained for productions. Financing the production and storage of goods depends on the ability to borrow the necessary capital. Therefore, all three types of risk should be considered together, especially when the plan of risk management in agricultural holding is developed.

11.6. Legal risk

Increased awareness of food safety influences the choice of the mode of production. The conversion of conventional into organic production requires meeting certain rules that are defined by the Law on organic production. The farmers should be aware of the period of weaning from the use of pesticides, anti-

biotics, as well as rules about locating the manufacturing plant and handling fertilizer. Non-respect for the rules can bring expensive penalties and lawsuits, which increases the costs of business. The losses occur when the milk must be dumped because of high level of harmful residues or when the animals must be culled.

The farmers also should be the subject of legal action or invited to responsibility for accidents caused by machinery or livestock or for the law-breaking in the field of health, safety or treatments of engaged workers. Managers should be informed about the current rules and regulations [Kahan, 2013].

11.7. Personal risk

The manager and employee are the most important resources of organization, including the agricultural holding. The risk of accidental injury or illness is real, because the agriculture is traditionally a dangerous occupation. The key employee may be retired, may change jobs or move out of the rural areas. If there is no adequate replacement in the field of engagement of employee that has left, production can suffer significant losses [Kahan, 2013].

Family quarrel or divorces can change the value of property, reduce funding and also bring business into the loss zone.

11.8. Risk management in agriculture

Good risk management does not mean elimination of all risks, but limitation of risks to the level that the managers are prepared and capable to cope with.

Financial reserves play a major role in determining the ability of taking the risk. Farms with huge amount of capital can have higher losses, before they become insolvent. High value of debt, in relation to assets, is alleviated by high scope of production. These farms are also more exposed to financial risks, such as the increase of interest rates [Kay et al., 2012].

Holdings with high fixed costs of living, education, health care are less able to overcome the risks and they should not be overexposed to them. The farmers, who have more than their property in the form of cash or goods, have non-agricultural employment or can address their friends for help in case of financial difficulties, they have greater ability to take the risks. Some of farmers reject to take the risk, although they do not have the debt and have strong cash flow.

Most farmers tend to avoid risk. They are ready to take some risks, but only when they expect return on investment with increase in a long term. Financial obligations and previous financial experience are the most important factors, which influence readiness of producers to take certain amount of risk [Broll et al., 2013].

When the managers are not confident in the future, they often use some kind of average or "expected" values for the yields, expenses or prices. There is no guar-

antee that this value will be real outcome, but decisions must be based on the best available information, experience and judgment of individual [Kay et al., 2012].

In the Table, six possible ranges of wheat yield is shown, together with the assessed probabilities yield. Using probabilistic method, yield of 4-6 t/ha will be selected. During planning, it will be good to use the average point or 5 t/ha. Probabilistic method is especially useful when there is a small number of possible outcomes which are considered. This method can be used during evaluation of future costs and prices, with appropriate modifications.

Table 1. The expected value of wheat yield

Possible wheat yield (t/ha)	Probability (%)
0-2	5
2-3	15
3-4	20
4-6	40
6-8	15
> 8	5
∑	100

Source: own calculation.

Manager, who must select between two or more varieties, should consider the variability of possible outcomes, beside the expected values. For instance, if the two alternatives have the same expected value, most managers will select the one whose potential outcome has lower variability [Kahan, 2013].

11.9. The cumulative distribution function

Many risky events in agriculture have almost unlimited number of possible outcomes. Useful technique for huge number of possible outcomes is cumulative distribution function (CDF). CDF is a graph of values for events with possibility that the real outcome will be equal or lower than the value of each. The outcome with the lowest possible value has the cumulative possibility of almost zero, and the maximum possible value has the cumulative possibility 100% [Kay et al., 2012]. The steps in creating the CDF are the following:

- Make a list of all possible values for events' outcome and assess their possibilities, e.g., data for the yield can be used as a set of possible values. If it is assumed that each of 10 variants have the equal opportunities to be repeated, it presents 10% of total possible outcomes or distribution.
- Make the list of possible values from the lowest to the highest, as it is shown in the next Table.

- Allocation of cumulative possibility to the lowest value is equal to the half of the span during presentation. Every remark presents one segment or it moves from total of distribution, so it can be assumed that observation falls in the middle range. For instance, the lowest yield presents the first 10% of distribution, thus the cumulative possibility of 5% can be assigned.
- Calculate the cumulative possibility (possibility of obtaining that value or minus one) for each of other values by adding the possibility, presented fewer values until the values of own probability. In example, remained observed yields would have cumulative possibilities 15%, 25%, etc. [Kay et al., 2012; Ferris, 2006].

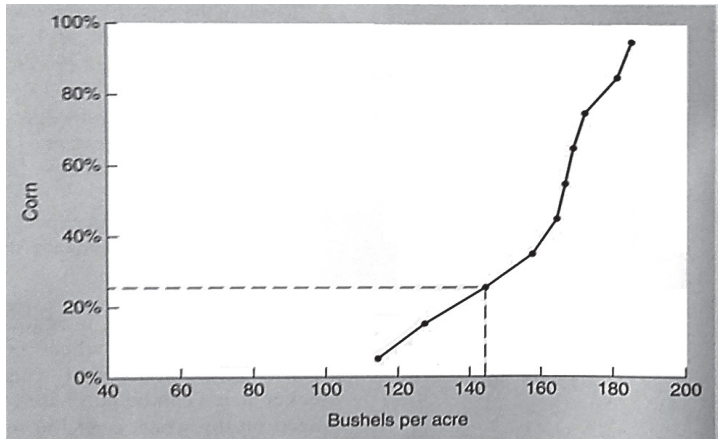
Table 2. The cumulative probability of distribution for maize

Maize (bushels/acre)	Cumulative distribution (%)
115	5
128	15
145	25
158	35
165	45
167	55
169	65
172	75
181	85
185	95

Source: Kay et al. [2012].

Each of the value pair connects the points, as it is shown in the Figure 2.

Figure 2. Cumulative function of distribution for maize



Source: Kay et al. [2012].

Cumulative function of distribution allows the depiction of all possible results for the certain event. At the top of the graph, the difference between the possible outcomes is smaller. The upper parts of the graph are the steeper than the lower parts, which indicates that the dependence on yield of the good weather is not as important as the negative reaction to the poor growing conditions.

11.10. Making decisions under conditions of risk

Making decisions under conditions of risk requires careful consideration of various strategies and possible outcomes. The process can be divided into several steps [Kay et al., 2012; Backus et al., 1997]:

- Identification of the cases that could be the source of the risk;
- Identification of the possible outcomes of events, such as weather or prices and their probabilities;
- Consideration of alternative strategies;
- Determination of the consequences or results of each possible outcome for each strategy;
- Assessment of the risk and expected yield for each strategy and evaluation of relations between them.

For instance, wheat is sown in autumn. Traders avoid to purchase and sell wheat in autumn and in winter in order to sell it at well-known prices from the contract, in spring. The main resource of farmer risk is the weather factor that affects the price. Let us assume that there are possible outcomes for this event due to good, average or poor weather with probabilities of 20%, 50% and 30%. Probability can be evaluated by studying the past weather events, as well as the recent forecasts.

If we avoid too much and buy too little at a favourable time, the opportunity for additional profit will be missed. If we too much buy and weather conditions are poor, there will not be enough fruit, extra food must be bought, and profit will be reduced or a loss will occur [Backus et al., 1997].

The farmer considers three alternative actions: purchase of 300, 400 or 500 beef cattle. Three weather outcomes are possible for each strategy, which creates nine potential combinations of results which should be considered.

When the elements of the problem are defined, it is useful to organize the information and to select some method of action [Kahan, 2013]. There are two ways to do it: a decision tree or matrix profitability.

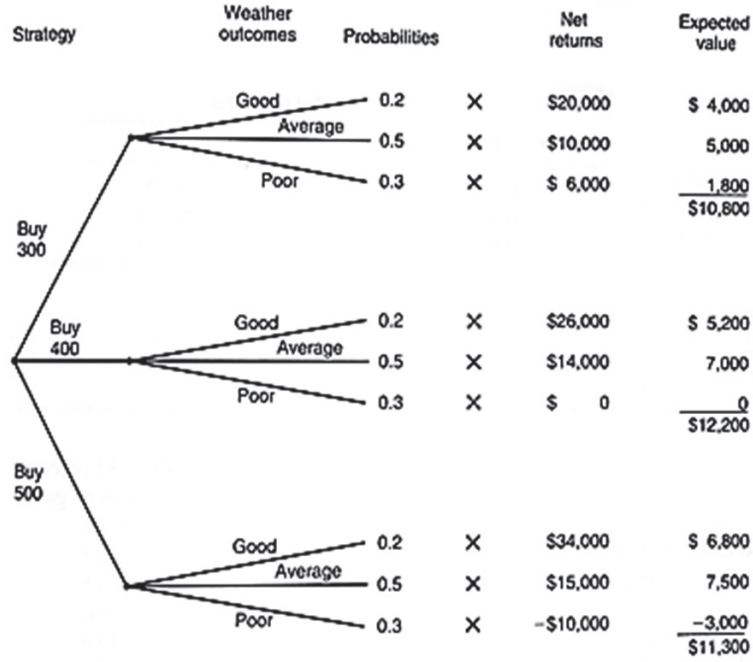
11.11. Decision tree

Decision tree is a diagram which depicts several strategies, potential outcomes of events and their results [Lu et al., 2011].

Figure 3 shows the decision tree for the previous example. It is about three potential strategies depending on weather forecasts, results for each of them, the probabilities for each outcome and assessed net returns for each of nine possible variants. For instance, if 300 beef cattle is bought, net returns is $20,000 with nice weather, $10,000 with average weather forecast, and just $6,000 with poor weather conditions [Kay et al., 2012].

On the basis of the decision tree, it can be expected that the farmer will opt for strategy "Buy 400", because it has the highest expected value, $12,000. However, this strategy predicts possibility of losing profit, in poor weather conditions.

Figure 3. Decision tree for management of heifers purchase



Source: Kay et al. [2012].

11.12. Matrix profitability

Matrix profitability contains the same information as the decision tree, but it is organized in the form of Table. The upper part of Table depicts outcomes of each strategy for each of potential weather outcomes. Expected values, both minimum and maximum values and the range of results, are shown in the lower part of the Table.

Table 3. Matrix profitability for management of heifers purchase

Items	Value of probability	Net return for each purchase strategy		
Weather outcomes	**Probability**	**Buy 300**	**Buy 400**	**Buy 500**
Good	0.2	20,000	26,000	34,000
Average	0.5	10,000	14,000	15,000
Poor	0.3	6,000	0	-10,000
Expected value		10,800	12,200	11,300
Minimum value		6,000	0	-10,000
Maximum value		20,000	26,000	34,000
Range		14,000	26,000	44,000

Source: Kay et al. [2012].

11.13. The rules of decision-making under conditions of risk

When the farmers face with the decision which includes risk, they can use different rules of strategy selection. Appropriate rule will depend on the decision maker with an attitude to risk, on financial status, demands of liquidity and other. Some of the rules of decision-making under conditions of risk include [Kay et al., 2012; Kahan, 2013]:

- The most likely outcome identifies the outcomes which are the most likely to occur and the strategy with the best consequences for that outcome is selected. In the previous Table, average weather forecast has the greatest probability (0.5), and "Buy 500" strategy has the greatest net benefit for that ($15.000).
- The maximum expected value suggests selecting strategy with the highest expected profit.
- Comparison of risk and yield. Each strategy, which has lower expected return and higher risk than other strategies, should be rejected.
- Security at the first place. This rule is concentrated on the worst possible outcome for each strategy and ignores other possible outcomes. Decision maker assumes that there are no serious problems for good expected results, while the real concerns are the unfavourable outcomes. The strategy, which is selected with the best possible result, and has the worst outcome, will be rejected. This rule is adequate for holdings in a bad financial situation, which would not survive any bad year.
- Probability of neither gain nor loss. Knowing the probability that some strategy will result with financial loss, can help decision maker.

11.14. Strategies for risk management

Various strategies of risk management are at the disposition of the farmers, whether it is about reducing the level of risk or mitigating the negative consequences of realized risk. Some strategies for risk management include one risk, and other incorporate more risks and are effective [Huirne et al., 2007; Piggott et al., 2005].

Including and understanding the effects of risk on the agricultural holding will allow the producers to develop appropriate strategies, which can help them to cope with negative consequences of realized risks or to resist the risks [Aditto et al., 2012].

Learning about how to combine the tools for risk management is useful for forming the management strategy, to achieve better results [Piggott et al., 2006].

The following strategies can be used in order to reduce risk [Backus et al., 1997; Kay et al., 2012; Baue and Bushe, 2003]:

- The stability of the enterprise. Modern technology can control the effects of weather on the production, and the government's programmes can control the prices or amounts of goods which can be sold.
- Investing in multiple production lines. If the profit of one product is small, the profit of production and the sale of another product can prevent the decline of total profit below the acceptable level. Diversification of the yield can improve the stability of the family holdings. The intention should be minimizing the surface of risky crops and maximizing the surface of less risky crops [Nguyen et al., 2007].
- The insurance contract is concluded with and insurance association with aim to cover the losses. Without the insurance or financial reserves, natural disasters can cause huge financial losses, which will prevent continuation of business. The farmers can insure the property, crops and the planned gross income. Some farmers purchase newer machines in order to prevent the risks against failures. The EU has a programme of subsidies and *ex-post* aid for covering the damages, which are not insured [Diaz-Caneja et al., 2009; Tangermann, 2011].
- Sharing the yields by lease. Landlord pays part of the expenses and obtains part of crops or livestock in exchange for rent. In that way, risk of poor production, low sales prices or high costs of input is divided. Also, variable rent level can be agreed.
- Due to the risk and uncertainty about the price and yield, some farmers do all jobs for the owner of land in exchange for a fixed amount (e.g. utility fattening). The owner of land takes the whole risk on himself.

- Long-term contract with the suppliers of input decreases the risk of production below the capacity. The Loan Contract labour (for fruit and vegetables harvest) will provide maximum use of capacity.

Several strategies can be used to decrease prices variability (market risk) or to adjust the satisfying price in advance, when the products are ready for sale:

- Expanding the sale. Instead the placement of all products at once, many farmers do that several times during the year. In that way, the sale at the lowest price is avoided and the sale of all goods at the highest prices is disabled [Nguyen et al., 2007].
- The Purchase Agreement before the sowing / planting guarantees to the producer placement of the product, as the future prices. Usually, the Purchase Agreement does not allow the sale at a higher price, if the same in the meantime increases [Broll et al., 2013].
- The investment for reducing the risk is possible before the sowing, during the vegetation or while the products are stored. This strategy can be used to lock the price of input which should be bought in the future [Backus et al., 1997].
- Option of the sale determines the minimum price in exchange for the payment of certain reimbursement, but still provides the sale of goods at a higher price, if it is possible [Tangermann, 2011].
- Market investments are present in some countries due to minimizing the risk on the basis of the price change [Kimura, 2010].
- Some strategies allow changes in the decisions, if there is a change in price or the weather conditions are changing [Nguyen et al., 2007], e.g. planting of annual instead of perennial crops. Renting the certain property, as land or mechanization instead of purchase, is one of examples of maintenance flexibility management.

For the maintenance of liquidity and purchasing power, reducing the financial risk respectively, the following strategies are useful:

- Fixing the interest rate.
- Self-Liquidating Loans are those which can repay the damage. The loans for the purchase of food for cattle and other production inputs are the example.
- Liquid reserves (cash or other resources which will be easily converted to cash) will help the farm in case of realization of risk.
- The credit reserves. Many farmers do not borrow the credit to its final limit. This unused part of the credit means that additional resources can be obtained in case of an unfavourable event.

- Equity capital or net value of the job provides the purchasing power and larger part of liquidity [Kuzman et al., 2007; Backus et al., 1997].

Appropriate legal and institutional framework can empower the ability of farmer to adopt the approaches of collective risk management [Tangermann 2011]. Strategy for legal risks management can be:

- Agricultural holdings can be organized through different legal forms. Some of them, such as limited liability companies and cooperatives, offer more protection from legal obligation than others.
- The insurance of responsibility protects from the claims by third parties for injury or property damage, and for which the insured or employee can be responsible. The demands of responsibility on the farm can occur when the livestock wanders on the road and causes an accident, or when someone gets hurt on the farm [Kay et al., 2012].

The risks, related to the employees, can be minimized through the health insurance, life insurance, safety precautions, backup management, etc. The key persons should know managerial activities in order to be included in case when the top manager is not able to continue the jobs.

Other strategies of risk management in the agriculture are in use, which includes more possible risks, and it can cover:

- work as usual, which means that there is no special strategy for risk management;
- crop insurance;
- diversification of crops and activities;
- reclaiming the risk by paying in cash [Bauer and Bushe, 2003].

11.15. Conclusions

The agriculture is a risky work where the outcomes of decisions are unknown or variable. The decisions must be thought-over, using the updated information and available techniques.

Risk management in agriculture is engaged in decreasing the possibilities of unfavourable outcomes or alleviating their negative effects. Not every decision will be right each time, but deciding under conditions of uncertainties difficult. The decision can be improved by identification of possible events, evaluation of value of their outcomes and variability.

The decision tree, matrix profitability and cumulative distribution function can be used in choosing between risky variants. Some farmers take into account just expected yields, some of them the variability of the outcome and some only look at results of negative outcomes.

Risk on agricultural holdings can be reduced or controlled by multiple techniques. The farmers decrease the extent of possible outcomes, guarantee minimum results in exchange for fixed expanse, and provide greater flexibility in making decisions. There are those who take greater risk, which can provide high level of profit in favourable situations, but it implies ability and experience.

References

1. Aditto, S., Gan, C., Nartea, G.V., *Sources of risk and risk management strategies: the case of smallholder farmers in a developing economy*, INTECH Open Access Publisher, 2012.
2. Antón, J., Kimura, S., Lankoski, J., Cattaneo, A., *A Comparative Study of Risk Management in Agriculture under Climate Change*, OECD Food, Agriculture and Fisheries Working Papers, no. 58, OECD Publishing, 2012 (http://dx.doi.org/10.1787/5k94d6fx5bd8-en).
3. Backus, G.B.C., Eidman, V.R., Dijkhuizen, A.A., *Farm decision making under risk and uncertainty. Netherlands Journal of Agricultural Science*, no. 45 (2), 1997, pp. 307-328.
4. Bauer, L., Bushe, D., *Designing Risk Management Strategies,* Faculty of Extension, University of Alberta, 2003.
5. Boškovic, J., Prodanovic, R., *The methodology of risk assessment and cumulative impacts of genetically modified plants on the environment*, VI International Congress "Medicine and Geosciences – the impact of the environment on human health", AGES – Association geophysicists and ecologists Serbia, Editors: Sneyana Komatina, Nenad Bojat, Proc. 9-19, Belgrade, Serbia, 18-19 April 2016.
6. Broll, U., Welzel, P., Wong, K.P., *Price risk and risk management in agriculture*, Contemporary Economics, no. 7 (2), 2013, pp. 17-20.
7. Chavas, J.P., Shi, G., *An economic analysis of risk, management, and agricultural technology*, Journal of Agricultural and Resource Economics, no. 40 (1), 2015, pp. 63-79.
8. Diaz-Caneja, M.B., Conte, C.G., Pinilla, F.G., Stroblmair, J., Catenaro, R., Dittmann, C., *Risk management and agricultural insurance schemes in Europe*, EUR-OP, 2009.
9. Ferris, J.N., *Forecasting World Crop Yields as Probability Distributions*, Department of Agricultural Economics, Michigan State University, 2006.
10. Hanson, J., Dismukes, R., Chambers, W., Greene, C., Kremen, A., *Risk and risk management in organic agriculture: Views of organic farmers*, Renewable agriculture and food systems, no. 19 (04), 2004, pp. 218-227.
11. Huirne, R., Meuwissen, M., Van Asseldonk, M., *Importance of whole-farm risk management in agriculture*, [in:] *Handbook of operations research in natural resources*, Springer US, 2007, pp. 3-15.
12. Kahan, D., *Managing risk in farming*, FAO, 2013.
13. Kay, R., Edwards, W., Duffy, P., *Farm management,* Seventh Edition, McGraw Hill, New York, 2012.

14. Kimura, S., Antón, J., LeThi, C., *Farm Level Analysis of Risk and Risk Management Strategies and Policies: Cross Country Analysis,* OECD Food, Agriculture and Fisheries Papers, no. 26, OECD Publishing, Paris 2010.
15. Kuzman, B., Subic, J., Cvijanovic, D., *Analysis of the profitability of the new plant production of pasta and risk management*, Economics, no. 53 (3-4), 2007, pp. 44-57.
16. Lu, J., Liu, Y., Li, X., *The decision tree application in agricultural development*, [in:] International Conference on Artificial Intelligence and Computational Intelligence, Springer Berlin Heidelberg, 2011, pp. 372-379.
17. Nguyen, N.C., Wegener, M., Russell, I., Cameron, D., Coventry, D., Cooper, I., *Risk management strategies by Australian farmers: two case studies*, Australian Farm Business Management Journal, no. 4 (1/2), 2007, pp. 23.
18. Piggott, N.E., Marra, M.C., Goodwin, B.K., Fackler, P.L., Denaux, D., *Comprehensive Risk Management Strategies: Putting it All Together*, 2006.
19. Piggott, N.E., Marra, M.C., Goodwin, B.K., Fackler, P.L., Denaux, D., *Comprehensive Risk Management Strategies: Putting it All Together*, posted 7/2006.
20. Tangermann, S., *Risk management in agriculture and the future of the EU's Common Agricultural Policy*, International Centre for Trade and Sustainable Development, no. 34, 2011.
21. U.S. Department of Agriculture, *Risk in Agriculture. Risk Management Agency*, 2008.

12 Agricultural production risks and their solutions in Slovakia

Zuzana Chrastinová[1], Ivan Masár[1], Tesfu Weldesenbet[2]
[1] National Agricultural and Food Centre – Research Institute of Agricultural and Food Economics;
[2] Ministry of Agriculture and Rural Development of the Slovak Republic
zuzana.chrastinova@vuepp.sk, ivan.masar@vuepp.sk, weldesenbet.tesfu@vuepp.sk

Abstract

The article describes how agricultural production risks are currently handled through private insurance companies, self-insurance at the farm level and *ad hoc* payments from public budget and it analyses the performance of crops, livestock and property insurance in Slovakia, using the yearly data from 2000 to 2015. Maps of insurance loss ratios by region are supplemented. This article also provides an overview of the type of risk management tools implemented by the EU Member States in the period between 2014 and 2020. The main risk management tool that partially mitigated agricultural production risks in Slovakia is insurance provided by private companies. Descriptive statistics methods (mean, standard deviation, coefficient of variation) are used to describe the data.

Keywords: agricultural insurance, risk, agricultural production, disasters, animal diseases, loss ratio

JEL Classification: Q1, Q140, Q540, D810, G220

12.1. Introduction

Agriculture is exposed to several risks, such as production or yield risk, price or market risk, institutional risk, human or personal risk, asset risk and financial risk [Hardaker et al., 1997]. Production / yield risk is the major risk that farmers face. Production risks are often related to weather (excessive / insufficient rainfall, hail, extreme temperatures), but also include risks like plant and animal diseases. Yield risk is smaller in the livestock sector, as weather has a smaller influence thereon. The risks mainly caused by disease, mechanical failure in confinement operation and variability in weight gain. The economic situation of agricultural enterprises is highly affected by all these risks, and production risks might increasingly be influenced by rising quality requirements, the growing movement of animals and plants as well as climate change [EC, 2001].

There is no one common definition of risk in the literature. Agricultural risk has started to be examined since 1933 and several authors have discussed agricultural risk in their works, defined it and sought sources of its origin. [Har-

wood et al., 1999] define agricultural risk as important uncertainty that could likely cause money loss, possible health harm, unfavourable consequences for sources used in production and other types of events that influence prosperity of legal entities. Several authors have analysed agricultural production risks in Slovakia. Generally speaking, they perceive risk as unpredictable changes of key agricultural production factors that cause variability of production and economic indicators in agricultural enterprises. For example, factors causing uncertainty in the agriculture sector involve biological character of agricultural production, seasonality, animal and plant health, price volatility, legislative changes and range of other factors. Agriculture depends on natural conditions and it works with live material. There are risks that farmers have in common with other branches of national economy. However, some risks are unique to agriculture [Chrastinová, 2002; Koščo, 2005; Tóth et al., 2007; Piterková, 2016]. In the long-term, the most important risks in agriculture are considered to be weather and natural disasters, animal infections and epidemics, volatility of production prices, and sale issues [Palinkas et al., 2008].

The most important step in risk management is risk identification and classification of agricultural enterprises activities according to vulnerability to external and internal environment [Špička, 2006].

The amount of insurance premiums paid by agricultural enterprises is higher than the indemnities they received from insurance companies in Slovakia, which is considered as a shift of resources out of agriculture (Green Report). However, when we compare crop and livestock insurance performance with other non-life insurance in Slovakia, there is no big difference. For instance, in 2003, the total amount of premiums in non-life insurance in Slovakia was SKK 24,844 billion and the amount of indemnities paid out was SKK 9.93 billion. The loss ratio was 39.9%, which was identical with crop and livestock ratio. Therefore it is possible to state that agricultural insurance does not defy somehow out of average and such identical sense lack of damage compensations in terms of paid insurance premiums could have had any person who has insured vehicle, flat, house or liability insurance [Tóth, 2007].

12.2. Methodology

Agricultural production risks analysis is based on data obtained from the Ministry of Agriculture and Rural Development of the Slovak Republic. The Ministry's database contains data on around 2300 agricultural enterprises – legal entities and natural persons. Data have been also collected from various other sources: Agricultural Paying Agency, Statistical Office of the Slovak Republic and Eurostat. Special emphasis has been put on analysing production efficiency,

economic condition in agriculture, and on the annual loss ratios calculation of the insurance companies. The loss ratio is calculated by indemnities per year divided by insurance premiums paid per year. Loss ratios are computed for crop, livestock and asset by regions.

12.3. Results

The agricultural production process is closely associated with nature and directly depends on climatic conditions not in the control of farmers. Risk in agriculture is very high compare to other sectors of the economy because farmers face unpredictable biological and climatic factors during the whole year. Unlike other sectors of the economy, agricultural producers cannot forecast with certainty the amount of their agriculture output due to factors not in the control of farmers, such as weather, diseases, and pests. The other important sources of agricultural risk are price risk (input and output price volatility), financial risk (e.g. cash flows problem, the high cost of borrowing) and institutional risk (e.g. change in regulations), etc. Most common approaches to agricultural risk in Slovakia:

- A crop, livestock and asset insurance is provided by private insurance companies (systematic approach).
- *Ad hoc* payments for losses caused by catastrophes, calamities and natural disasters according to government's regulation. The source of *ad hoc* payments is the national budget.

Individually, on enterprise level, enterprise management diversifies the impact of risks through optimization of production structure and vertical integration, holding sufficient financial reserves in the good years and through hedging in the futures market.

There are more risk reducing tools in agriculture, but it is important to adopt a systemic approach, i.e. to solve risk not only individually at sector level and individual subjects, but also centrally at state level possibly multinational integration aggregates. In this regard it is crucial for the insurance to cover creation and distribution of reserves to damage compensations that arise from unpredictable events. Reserves are created from paid insurance premiums of agricultural enterprises and they are managed by private insurance companies.

Insurance of agricultural risks in Slovakia is provided by 3 commercial insurance companies: Allianz – Slovenská Poisťovňa, a. s. (approximately 60% market share), Generali Slovensko Poisťovňa, a. s. (around 18%), UNIQA Poisťovňa, a.s. (12%) and one Austrian insurance branch (AGRA poisťovňa – Die Österreichische Hagelversicherung VVaG). The three insurance companies specialize in contractual voluntary insurance and provide three types of insurance: crop insurance, livestock insurance and property insurance.

The supply of insurance products is limited because private insurance companies do not insure all risks. Uninsurable risks cause extensive damages on agricultural production. Plant production depends on soil and climatic conditions and is exposed to various risks (e.g. weather). On the other hand, weather has a smaller influence on animal production, but is highly affected by diseases and focal infections. At present, we do not have an exact figure of insurance penetration, i.e. insured crop area as a percent of total crop area; we estimate it at roughly 50-60%.

Descriptive statistics of insurance premiums and indemnities for crop, livestock and asset in Slovakia are shown in Table 1. The average premium for livestock was more volatile (coefficient of variation 46.3%) than the average premium for asset, and the average premium for crop was more volatile than the average premium for asset. In contrast, the average indemnity for livestock was more volatile (coefficient of variation 118.3%) than the average indemnity for crop and the average indemnity for crop (47.8%) was more volatile than the average indemnity for asset (23.2%).

Table 1. Descriptive statistics of insurance premiums and indemnities of crop, livestock and asset in Slovakia in the period between 2000 and 2015

Type of insurance		Mean	Min.	Max.	Std. dev.	CV (%)*
Crop	Premium	5.85	3.72	8.63	1.39	23.7
	Indemnity	3.43	1.53	5.80	1.64	47.8
Livestock	Premium	3.23	1.71	5.74	1.49	46.3
	Indemnity	1.26	0.15	5.78	1.49	118.3
Asset	Premium	11.78	7.70	13.64	1.71	14.6
	Indemnity	4.29	2.72	5.98	0.99	23.2

*Coefficient of variation (CV) = (standard deviation/mean) × 100.

Source: own calculations based on premiums and indemnities data shown in Figures 7, 8 and 9.

Implementation of risk management tools under the 1st and the 2nd pillar (2014-2020) and State aid (2014)

Agricultural production risks in the EU Member States can be financed under the Common Agricultural Policy (CAP) and State aid. The CAP offers the possibility to support risk management tools under the 1st pillar (direct payment) and the 2nd pillar (Rural Development). State aid is provided by national government to support farmers in case of risk. The 2013 CAP reform has transferred the two risk management tools from the 1st pillar[1] (insurance premiums and mutual funds, Article 68 of the Regulation (EC) No. 73/2009) to the 2nd pillar[2] and intro-

[1] Article 68 of the Regulation (EC) No. 73/2009.

[2] Regulation (EU) No. 1305/2013.

duced a new risk management tool – Income stabilization tool. The three main risk management instruments under the 2nd pillar: (1) Crop, animal and plant premiums; (2) Mutual funds; and (3) Income stabilization tool (IST). These tools are available to Member States to address both production and income risks.

1st pillar: Common market organization (Regulation (EU) No. 1308/2013), F&V and wine sectors

Risk management tools implemented by the EU Member States during the period between 2014 and 2020 are shown in Table 1. The uptake by the EU MSs of risk management tools (insurance harvest and Mutual Funds) under the 1st pillar is very low (6 MSs out of the 28 EU MSs). The use of mutual funds is null. The reasons behind this are the small size of many producer organizations (POs), the limited amount of financial resources and red tape.

2nd pillar: Rural development (2014-2020)

The current rural development policy provides the following three risk management tools:

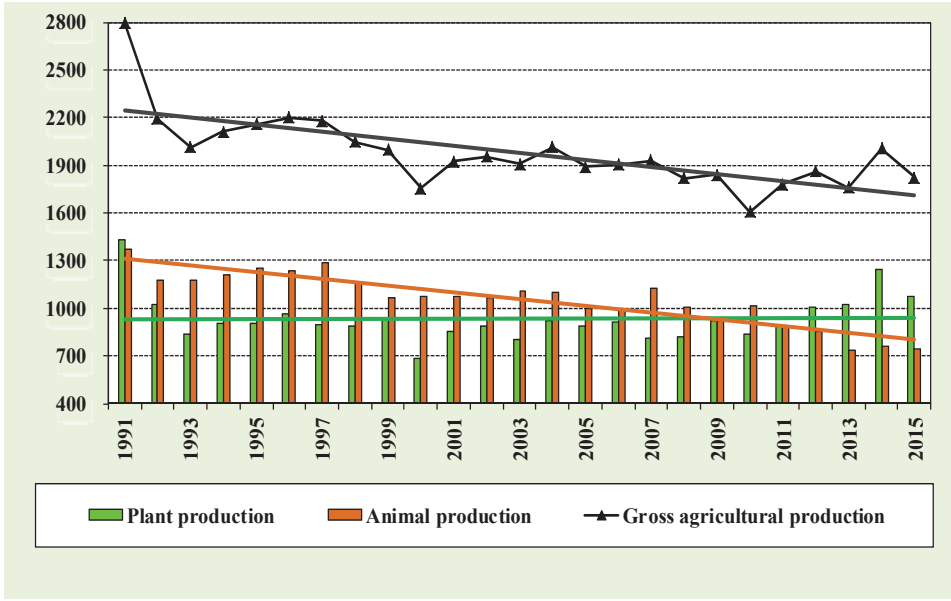
- Financial contributions to premiums for crop, animal and plant insurance against economic losses to farmers caused by adverse climatic events, animal or plant diseases, pest infestation, or an environmental incident;
- Financial contributions to mutual funds to pay financial compensations to farmers, for economic losses caused by adverse climatic events or by the outbreak of an animal or plant disease or pest infestation or an environmental incident;
- An income stabilisation tool, in the form of financial contributions to mutual funds, providing compensation to farmers for a severe drop in their income.

A recent study [Bardají and Garrido, 2016] found out that crop, animal and plant insurance is fairly the most extended measure in the EU MSs, the implementation of mutual funds and IST are very low. Ten out of the EU28 MSs are implementing insurance under own Rural Development Programme. The mutual funds tool is implemented by three EU MSs (Romania, Italy and France). In Romania, mutual funds focus on losses caused by common adverse climate events, which are not covered by insurance companies (drought, winter frost and floods). Another three EU MSs (Italy, Hungary and Spain) are applying the income stabilization fund.

State aid (2014)

Many MSs based their public aid exclusively on State aid (*ex-post* measures devoted to crisis management), which reveal a clear underuse of *ex-ante* (risk) management measures.

Figure 1. Development in gross agricultural production in Slovakia (EUR million, constant prices in 2000)



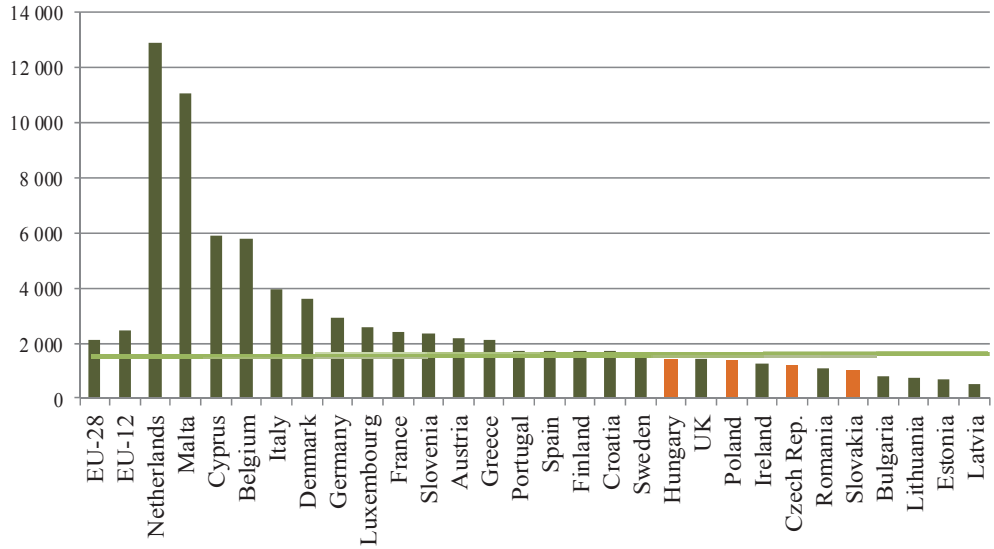
Source: Statistical Office of the Slovak Republic.

There is a significant difference in agricultural production efficiency among EU Member States (Figure 2). The average value of agricultural production per hectare of utilised agricultural area in Slovakia was lower than the EU 28 average. This result is valid for all Visegrad countries (V4).

Agricultural products price volatility becomes the EU markets feature due to several factors, such as climate change, speculation in the markets, changes in demand and expectations of further development. Risks significantly influence farmers' income and ability to stay farming. Agricultural income variability in time is characteristic for both Slovakia and other EU MSs. After significant income losses in 2009 and 2010, it partially stabilized. Almost 70 % of agricultural enterprises made profit. However, the level of profit in Slovakia as well as in other V4 countries, calculated per hectare of utilised agricultural area, was lower than in the "old" EU-15 countries (Figure 3).

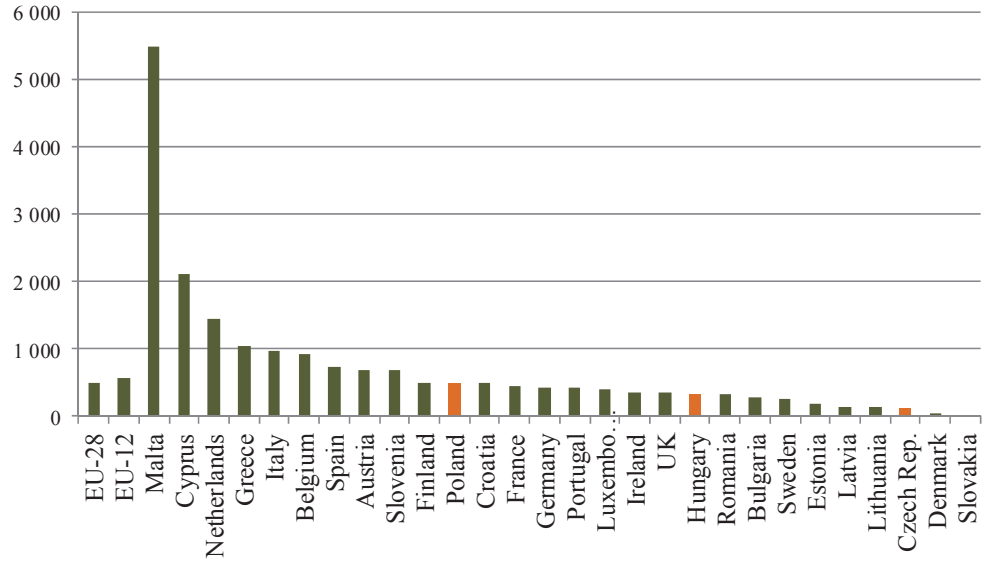
Direct payments are granted to farmers in order to support their incomes, direct payments and rural development payments have accounted for 44% and 43% of total support in 2015, respectively. State aid has been provided to subsidized insurance premiums in Slovakia; nowadays such measure is not available. The level of agriculture subsidy in Slovakia does achieve that of the old EU Member States, which influences Slovakia's agricultural competitiveness.

Figure 2. Development in agricultural production, per hectare of utilised agricultural area in the EU Member States, 2004-2014 (in €)



Source: Eurostat.

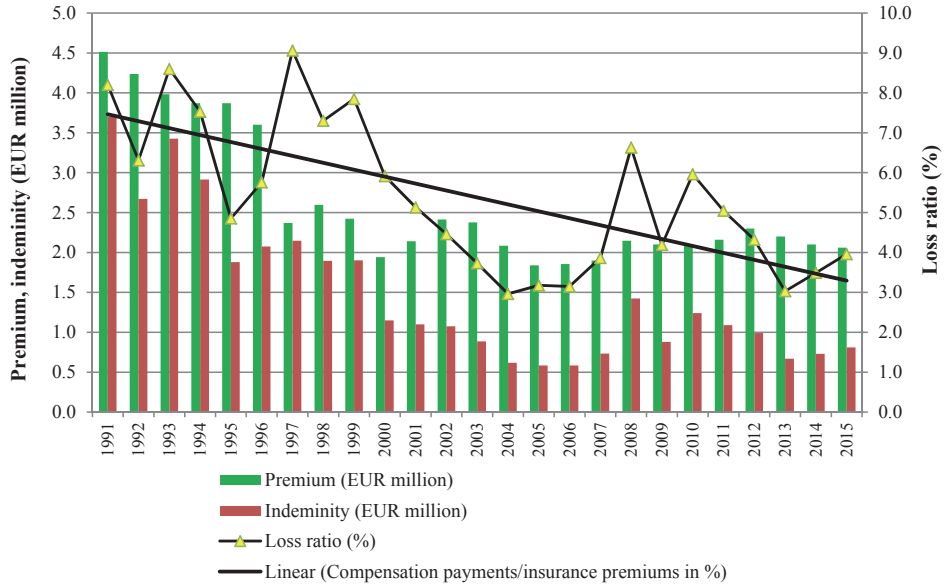
Figure 3. Development in profit / loss per hectare of utilised agricultural area (in €)



Source: Eurostat.

Agricultural production risks are handled by various risk management tools, the main risk management tool in Slovakia is insurance provided by private insurance companies. The other types of risk management tools are *ad hoc* payments in case of catastrophic events for which there are no insurance at all. Insurance is a voluntary agreement between private insurance companies and agricultural enterprises. Figure 4 shows the development in the total amount of premiums and indemnities in agricultural insurance in Slovakia. Figure 4 indicates that the total amount of premiums in agriculture has a declining trend since 1991. The main reasons are the diminishing of agriculture production and a very low demand of agricultural enterprises for insurance.

Figure 4. Development in total agricultural insurance premiums and indemnities in Slovakia, 1991-2015



Source: database of the Ministry of Agriculture and Rural Development of the Slovak Republic and Research Institute of Agricultural and Food Economics, since 2014 National Agricultural and Food Centre – Research Institute of Agricultural and Food Economics.

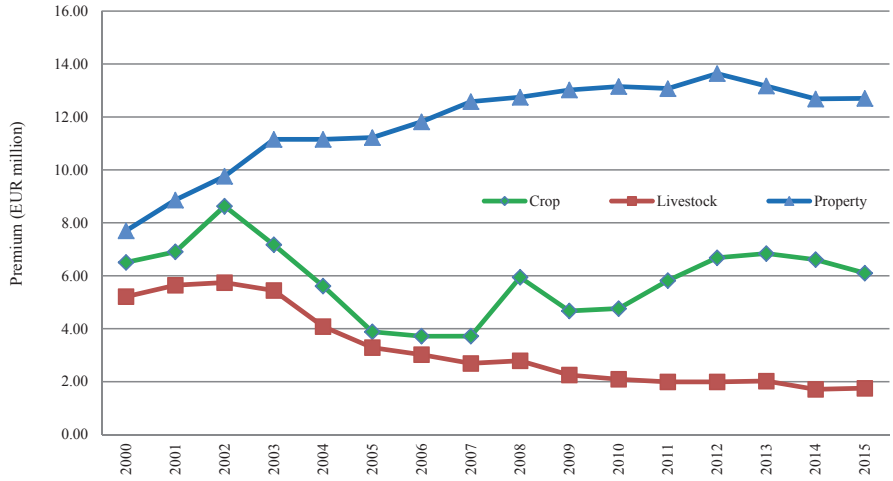
Since 2000 the situation in commercial insurance has moderately stabilised with some minor changes. However, there is still a significant difference between insurance premiums paid and indemnity. The average loss ratio (insurance indemnity divided by premium) has indicated a declining trend. In 2000, the average loss ratio was almost 60%, nowadays it is just 40%.

That means that for every euro paid as insurance premium, the farmer gets back 40 eurocents as indemnity. The difference introduces overheads, cost for reserves creation, costs of reinsurance and profit. Similar result was found for the

Czech Republic [Kořínková and Seifertová, 2016] where the average loss ratio in agricultural insurance (crop and livestock) was 36%. It means that collected insurance payments were higher than indemnities paid.

Figures 5, 6 and 7 indicate the development in crop, livestock and asset insurance premiums and indemnities in Slovakia. The Figures indicate that agricultural entrepreneurs mainly insure assets, insurance purchase for crops and livestock is low. From charts it is evident that agricultural enterprises mostly insured property, less crops and animals. The highest indemnity was paid to assets followed by crops and livestock. It could be deduced that agricultural enterprises approach differentially towards insurance and they decide what to insure and what not to insure. The level of farmers' participation in the agricultural insurance market has impact on insurance premium; the lower participation in insurance is linked to higher premium and vice versa. A higher insurance premium leads to lower interest in insurance thus higher risk for enterprises and in case of damage the negative impact on economics of enterprises.

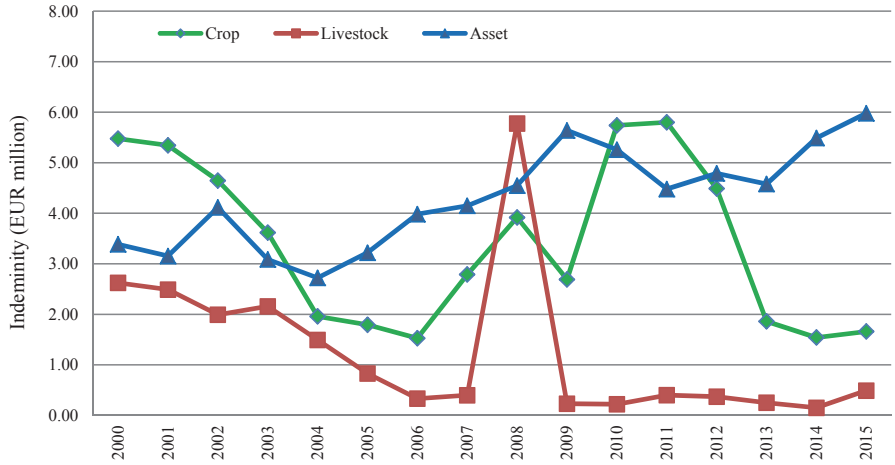
Figure 5. Development in crop, livestock and asset insurance premiums in Slovak agriculture (EUR million)



Source: own elaboration.

The next Figures (Fig. 7 to 9) illustrate the development in crop, livestock and asset insurance premiums and indemnities. As illustrated on the Figures, loss ratios were below 100%, which means that indemnities were less than premiums (except for crop loss ratio in 2010 and livestock loss ratio in 2008). The insurance policies contain some deductible amounts. Crop and livestock loss ratios have a declining trend. But then, loss ratios for asset indicate an upward trend.

Figure 6. Development in crop, livestock and asset indemnities paid in Slovak agriculture (EUR million)

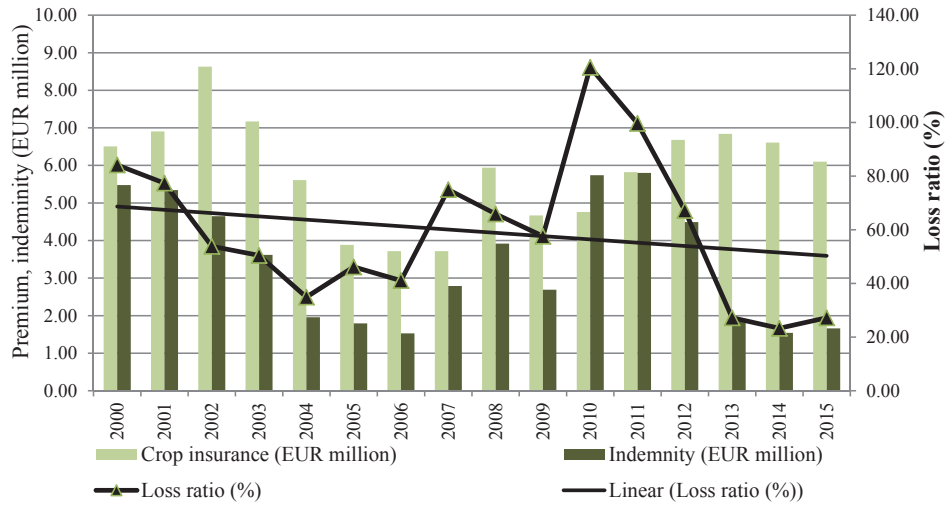


Source: database of the Ministry of Agriculture and Rural Development of the Slovak Republic and Research Institute of Agricultural and Food Economics, since 2014 National Agricultural and Food Centre – Research Institute of Agricultural and Food Economics.

Crop insurance penetration in Slovakia is insufficient [Tothová, 2015]. The total area on which insured crops are cultivated is very low, around 30% from total arable land. Farmers should reassess their conservative approach towards agricultural insurance. Major risks that cause damages to plant production are hail, floods, windstorm, spring frost, fire.

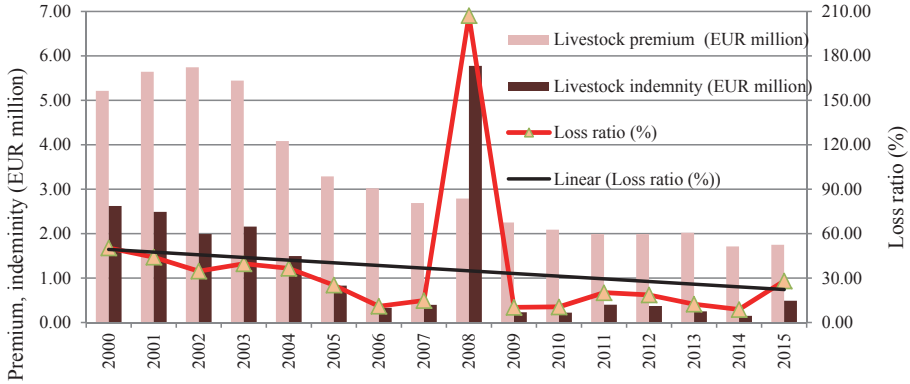
Animal production is exposed to different risks. Private insurance companies provide insurance policy for cattle, pigs, sheep, goats, horses and poultry (hens, turkeys, ducks and geese). Livestock insurance covers against loss (death or killing on official order because of: infection of livestock and poultry, natural disasters, individual damages on breed and reproductive animals, loss, injury, theft and loss of animals during transport, insurance of horses, option to widen infection coverage on mass infectious diseases, poisonings, costs of disinfestations, disinfection and deratization). In addition, according to farmers' demand private insurance companies provide special negotiations, predominantly insurance for eggs destruction in electric incubators and loss of one-day poultry, farm breeding insurance of fallow deer, mouflon, deer, pheasants, etc.

Figure 7. Development in crop insurance premiums and indemnities in Slovak agriculture, 2000-2015



Source: database of the Ministry of Agriculture and Rural Development of the Slovak Republic and Research Institute of Agricultural and Food Economics, since 2014 National Agricultural and Food Centre – Research Institute of Agricultural and Food Economics.

Figure 8. Development in livestock insurance premiums and indemnities in Slovak agriculture, 2000-2015

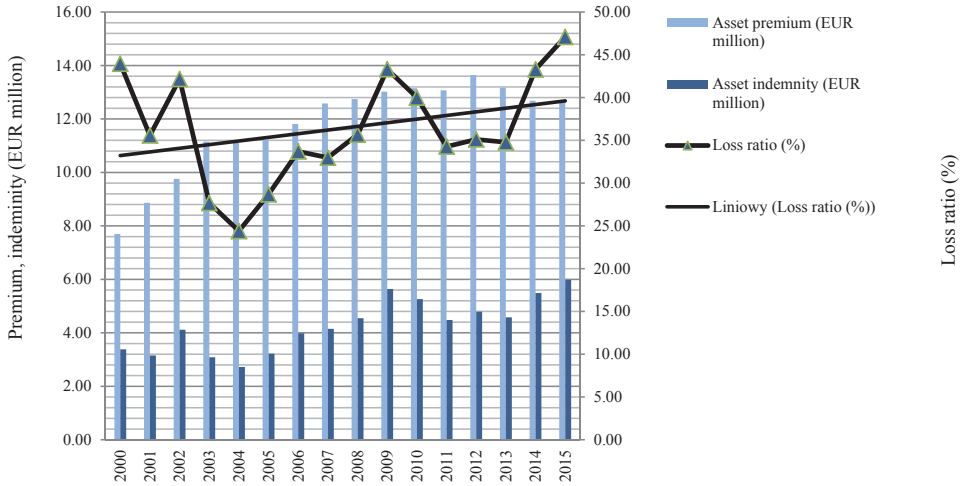


Source: database of the Ministry of Agriculture and Rural Development of the Slovak Republic and Research Institute of Agricultural and Food Economics, since 2014 National Agricultural and Food Centre – Research Institute of Agricultural and Food Economics.

Asset insurance includes buildings, halls and constructions including all building components. Tangible assets insurance relates to all production and operation facilities, material and product stocks and employees' stuff that are located in

operation unit including leased objects and objects for leasing. Asset insurance covers the following basic risks: fire, explosion, thunderbolt, aircraft crash, damages caused by water from water devices, theft through burglary, robbery, vandalism through burglary, windstorm and hailstorm, floods, earthquake, volcanic eruption, earth slide, avalanche and snow pressure, vehicle crash, smoke, shock wave, tree fall and pylon, glass breakage.

Figure 9. Development in asset insurance premiums and indemnities in Slovak agriculture, 2000-2015

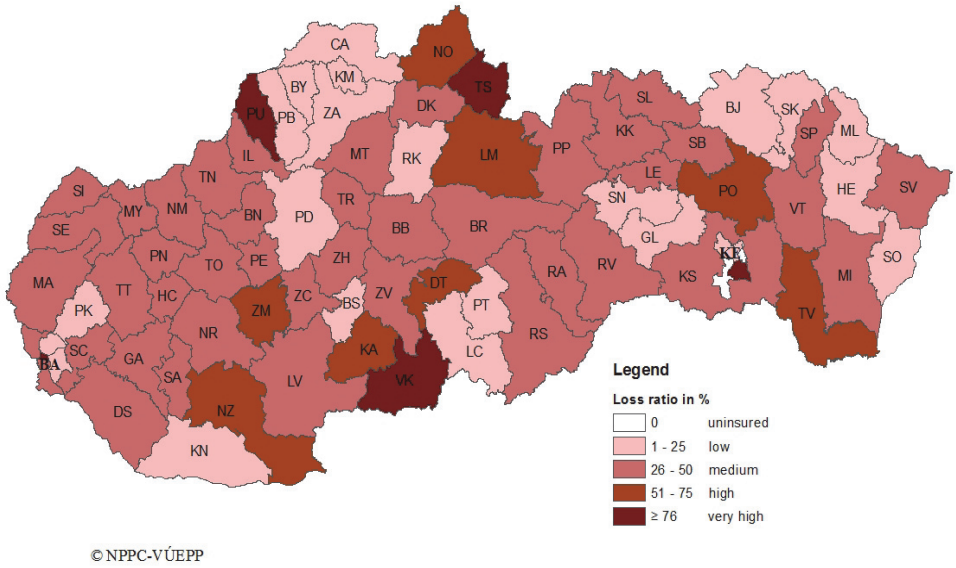


Source: as above for Figure 8.

Maps of loss ratios by region are presented below. The first map shows the average loss ratio in agriculture (crop, livestock and asset) by region. Maps 2, 3 and 4 demonstrate the average asset, crop and livestock loss ratios by region, respectively. The white spaces on the maps indicate that agricultural entrepreneurs do not insure any of their crops, livestock and asset. Bad financial situation of farmers and high costs of insurance are mentioned as two main reasons for that.

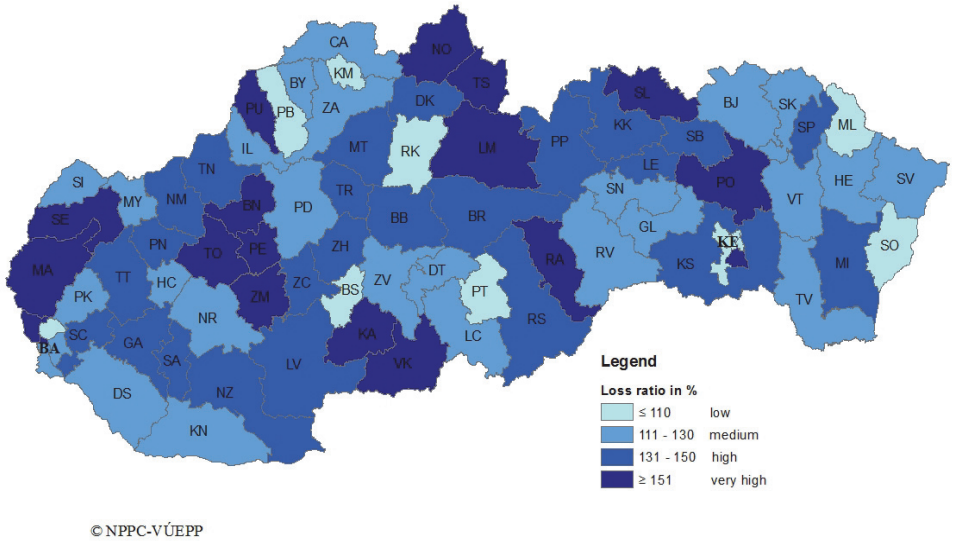
It is evident from aggregate data concerning agriculture but mainly according to enterprises that the insurance is seen not from global but especially from individual or local point of view, i.e. specific enterprises. It also confirmed reality of repeating climate changes during recent years that cause damages on property or to production of many agricultural enterprises on given areas while property or production of some enterprises remained unharmed.

Map 1. Average total loss ratios in Slovak agriculture, 2011-2015



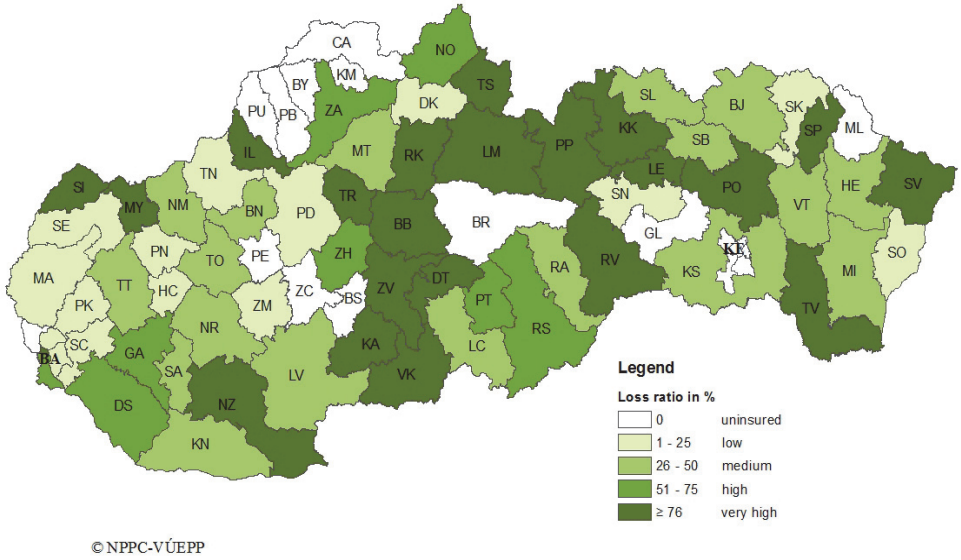
Source: own elaboration.

Map 2. Average asset loss ratios by region in Slovak agriculture, 2011-2015



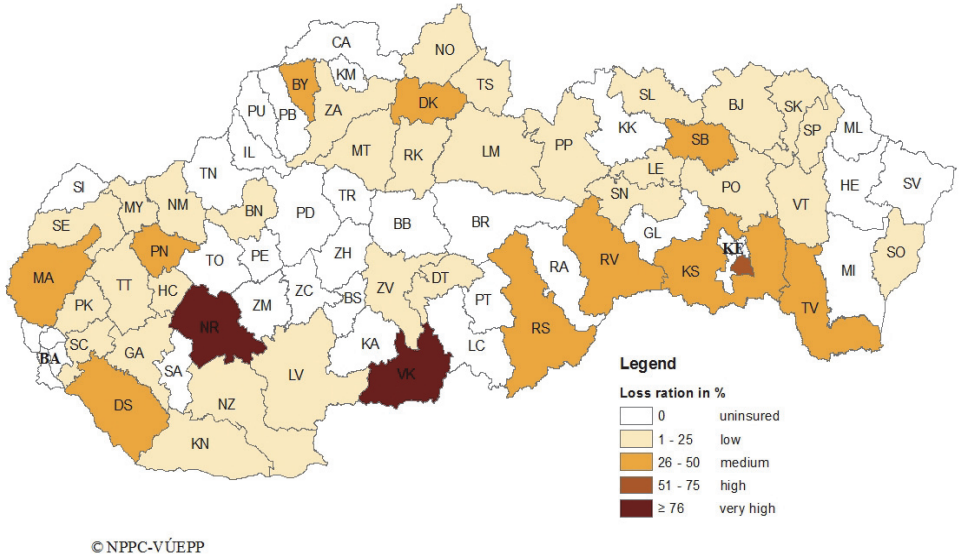
Source: own elaboration.

Map 3. Average crop loss ratios by region in Slovak agriculture, 2011-2015



Source: own elaboration.

Map 4. Average livestock loss ratios by region in Slovak agriculture, 2011-2015



Source: own elaboration.

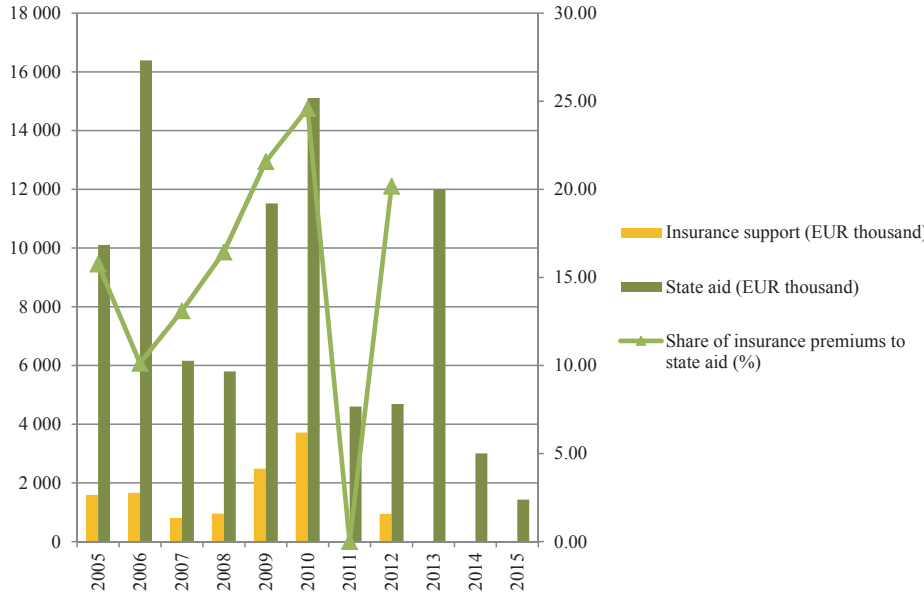
Incidence of large scale losses questions their compensation. In such cases it is necessary to introduce reinsurance of insurance companies and partially cover the losses of agricultural enterprises by the state. The insurance company

is constrained to create high reserves for excessive damages reimbursement that require higher insurance costs related to risk character. Farmers take reserved stand towards such insurance.

During previous years insurance support from state aid sources was provided (to a small extent) to partial insurance costs payment, i.e. partial payment of insurance premium what is also showed in Figure 10. Issue of support provision to insurance premium payments in agriculture was handled in a document called *"State support scheme to insurance premium payments in agriculture"*.

It is seen from insurance development in 1996-2015 (database data of Ministry of Agriculture and Rural Development of the Slovak Republic) that while up to 2010 the most risky were crops from level of damage progress point of view, the situation is changing and the most risky is property which enterprises insure in crucial rate. Even though compensation payments for crops or animals exceeded insurance premiums the compensation payments including property insurance on aggregate were not higher in any specific year and they fluctuated at 40-50% level.

Figure 10. Development in insurance subsidies through State aid



Source: Ministry of Agriculture and Rural Development of the Slovak Republic.

12.4. Conclusions

Agricultural business is influenced by specific risks that are often out of control of the farmers. Vegetable as well as animal production and whole tangible property are exposed to risk influence that consequently reflects to economic

risk of revenues in case of damages. Agricultural enterprises most often undergo consequences of following risk factors: weather and natural disasters, animals and plants diseases, price volatility of production, sale problems, input price changes, technologies, etc.). Weather, animal diseases and market impacts are permanently changing elements of land husbandry.

Risk management is turbulent process that is inevitable from agricultural enterprise management point of view. Therefore, risk reduction would mainly consist in identification of potential risk factors, development of management strategy for extraordinary situations that lead to loss minimization, preparation and implementation of measures to rectify in case of possible extraordinary events territorial as well as local aspects and reserves creation for extraordinary situations during significant economic years.

Farmers face various sources of risk. The current risk management tool in Slovakia (private insurance system) is not sufficient to reduce, mitigate and cope with uninsured risks. Therefore, the combination of private insurance with other risk management instruments (Mutual Fund, Solidarity Fund, State aid) is crucial. Many EU Member States implement various risk management tools.

Based on previous facts we can deduce that risk solution within agriculture in Slovakia is implemented mainly by means of commercial insurance. Commercial insurance does not sufficiently solve agricultural production risk because it does not cover all risks notably the risks that cause damages of whole area character. Among climatic risks it is especially drought. These risks, mainly drought, flooding, pests infestation have caused significant damages in the past years. *Ad hoc* supports in case of catastrophic damages are unsystematic and financially demanding.

Insurance claims are low and through insurance premium payments the agricultural enterprises significantly share in centralized insurance reserves creation of private insurance companies. It means that insurance companies collect more insurance premiums than they reimburse for damages. Risks in agriculture influence managerial decisions as substantial part of agricultural enterprises take aversion to risk and prefer to accept lower revenues than high insurance costs and also rely on state subsidies. This reflects in over insurance, i.e. insured crops area towards total cultivated crops area.

Discussed but still an open issue during last period is risk solution by means of risk fund, but its creation remains uncertain. Until now, the support to risk fund creation, which will cover uninsured risk damages and eliminate *ad hoc* payments from state budget in case of catastrophic damages, was insufficient. Implementation of risk management tools remains a voluntary decision of individual enterprises.

References

1. Bardají, I., Garrido, A., *State of play of risk management tools implemented by Member States during the period 2014-2020: National and European frameworks,* 2016 (ISBN 978-92-823-8632-3).
2. Chrastinová, Z., *Rizikovosť poľnohospodárskej výroby a jej riešenie na Slovensku a vo vybraných štátoch*, Štúdia, Výskumný ústav ekonomiky poľnohospodárstva a potravinárstva, Bratislava, 2002 (ISBN 80-8058-258-0).
3. Chrastinová, Z., *Systém kompenzácie strát v poľnohospodárstve vyplývajúcich z rizika prírodných katastrof*, [in:] *Ekonomika poľnohospodárstva*, č. 4, 2007 (ISSN 1335-6186).
4. European Commission, *Risk management tools for EU agriculture with a special focus on insurance*, Working document, Agriculture Directorate General, Directorate A. Economic analyses, forward studies, evaluation, 2001.
5. Hardaker, J.B., Huirne, R.B.M., Anderson, J.R., *Coping with Risk in agriculture,* CAB International, Wallingford, 1997.
6. Harwood, J.R., Heifner, K., Coble, J., Perry, J., Sommwaru, A., *Managing Risk in Farming: Concepts Research and Analysis,* Economic Research Service, 1999, pp. 130.
7. Kořínková-Seifertová, E., *Výmera poistených plodín klesla*, Zemědělec, no. 45, 2016.
8. Koščo, T., *Riziko a poisťovníctvo*, SPU Nitra, 2005 (ISBN 80-8069-539-3).
9. Palinkas, P., Székely, C., *Farmers Perteptions on Risk management practices in international comparison*, [in:] Bulletin of the Szent Istvan Univesity. Godolo, Maďarsko, 2007.
10. Piterková, A., *Vývoj podnikateľského rizika v slovenskom poľnohospodárstve a faktory určujúce úroveň rizikovosti poľnohospodárskych podnikov*, SPU, Nitra, 2016.
11. Špička, J., *Řizení podnikateľských rizík v poľnohospodárstve,* Praha: Výzkumný ústav zemědělské ekonomiky, 2006 (ISBN 80-86671-36-4).
12. *Správa o poľnohospodárstve a potravinárstve v Slovenskej republike za rok 2015*, Bratislava, MPRV SR, 2016.
13. Tóth, M., Koščo, T., Szovics, P., *Poistenie*, 1. vyd. SPU, Nitra, 2007 (ISBN 978-80-8069-853-9).
14. Tóth, M., *Súčasnosť a perspektíva poľnohospodárskeho poistenia na Slovensku,* [in:] *Mladá veda 2004: Medzinárodná vedecká konferencia mladých vedeckých pracovníkov a doktorandov: "Spoločne v Európe, spoločne pre Európu"*, Nitra, Slovenská poľnohospodárska univerzita, 2004 (ISBN 80-8069-456-7).
15. Tóthová, V., *Eliminácia rizík poistením*, Agroprogres, konferencia agromanažérov, Nitra, 2015.

13 Mitigating financial risk through agile balancing between market orientation and total quality management factors: evidence from B&H beverages industry[1]

Mirza Uzunović[1], Aleksandra Nikolić[1], Alen Mujčinović[2]*
[1] *University of Sarajevo, Institute of Agricultural and Food Industry Economics, Bosnia and Herzegovina,* [2] *University of Sarajevo, Bosnia and Herzegovina*
*m.uzunovic@ppf.unsa.ba (*corresponding author), mujcinovicalen@hotmail.com*

Abstract

For thriving in a continuously changing business environment, companies are embracing modern business practices to improve business performances and mitigate financial and other risks. Market orientation and total quality management are todays' two most used business concepts, presented through strategic orientation of the company – towards quality of products and processes or towards quality and agility of response to market demands. Paper presents integrated model of these two philosophies on sustaining adequate business performances, mitigating financial risks and delivering superior values for customers. To test the presented model, financial data, measure of market orientation (MKTOR) and measure of orientation to quality of products (TQMCSF) were collected through a survey of 46 BH companies [May 2016]. Structural Equation Modelling (SEM), along with descriptive statistics, were used to test the model. Model shows that mitigating financial risk is possible through specific combination of market orientation and total quality management factors.

Keywords: market orientation, TQM, risk mitigation, B&H beverages industry

JEL classification: L15, L25

13.1. Introduction

In todays' continuously and fast-changing market, companies are facing problems with global competition for limited resources and more important with changes in consumer's requirements. These conditions put pressure on companies to be more effective and efficient. In order to fulfil the above-mentioned conditions, companies have to continuously improve their organization, strengthen specific skills and gain recognition in the market, all with the aim of satisfying the demand of the market / customers [Aghaei et al., 2013; Chin et al.,

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

2013]. Organizational improvement of companies can be achieved by applying different management and business practices, such as building organizational culture, strategic management, quality management, etc. With significant increase in customers' requirements for quality and dynamic market conditions, it is no surprise that many companies opt for quality management as a strategic direction of their company [Aghaei et al. 2013; Idris-Ashari, Zairi 2004]. On the other hand, many companies are increasingly interested in business practice called "market orientation". With adoption of such a business practice, companies are trying to adapt to market needs, build competitive advantage and ensure profits.

Quality orientation and market orientation are two most used strategic initiatives applied by companies that are associated with improvement of business performances [Aghaei et al., 2013; Chin et al., 2013; Idris-Ashari and Zairi, 2004; Wang et al., 2012]. In most of the cases, these two business philosophies are analysed separately while this paper tries to integrate both practices into the conceptual model. Their possible combination, a comprehensive model should highlight all its key components in terms of maintaining and achieving adequate business performance, mitigating financial risks and adding a superior value for customers. This empirical research aims to determine ratio of unique elements of quality orientation and market orientation to mitigate financial risks.

In order to achieve this, we set the following objectives: (i) to explain theoretical approaches of quality and market orientation and build a conceptual model of agile balancing between these two strategies in order to achieve Enterprise Risk Management elements; (ii) to test the theoretical model in B&H beverages industry companies, and (iii) to determine financial risk mitigating ratios between quality and market orientation of the companies.

The paper is structured in accordance with the above-mentioned objectives. The first part consists of theoretical explanations of these two strategic initiatives and its impacts on financial risks; the second part explains the method which is used to measure the effect of these strategic orientations on the performance and risk indicators of companies; the third section provides the results of empirical research, and the last section presents the conclusions and recommendations.

13.2. Developing a conceptual model

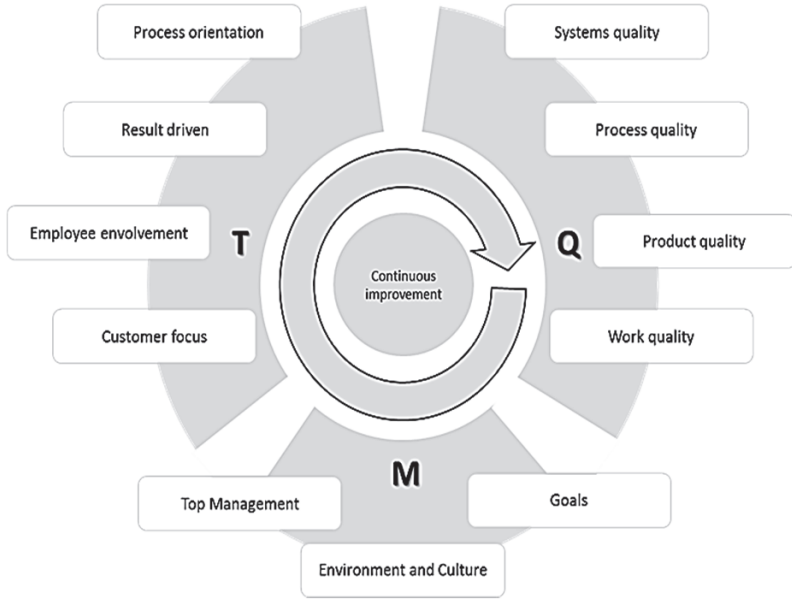
Under pressure of ever demanding market, companies have to find ways to operate more efficiently, and adequately meet the needs of customers, companies, employees, capital owners, but also the society as whole [Potocki, Brocato 1995]. In other words, companies have to be prepared for prompt and adequate response to the changing environment. In order to make more effective business and to agilely respond to market changes, companies often choose stra-

tegical orientation towards quality management or market orientation [Aghaei et al., 2013; Agus and Abdullah, 2000] or in quest to become more agile and lean, organizations are becoming more dependent on outside support [Faisal et al., 2006]. In every one out of these three cases, companies are facing certain risk and vulnerability. This conceptual model is trying to find a way to balance the quality and market orientation within the companies to mitigate financial risks. To develop such a model, the concept of total quality management and market orientation and its belonging factors are briefly explained and afterwards the conceptual model is presented.

Total Quality Management

Available literature provides numerous definitions of total quality management [Gharakhani et al., 2013; Martínez-Lorente, Martínez-Costa, 2004]. The summarized concept of total quality management presents a philosophy of broad spectre of systematic approaches to quality management; *apropos* total quality management is a description of a culture, attitudes and the ways of organizing company that tends to satisfy customer needs.

Figure 1. Concept of total quality management and critical success factors of TQM



Source: adapted from Saraph et al. [1989].

Saraph et al. [1989] define eight TQM Critical Success Factors: management leadership, resource management, measurement and feedback, continuous improvement, supplier quality management, system and processes, education and training, environment and work culture. Effective implementation of a total

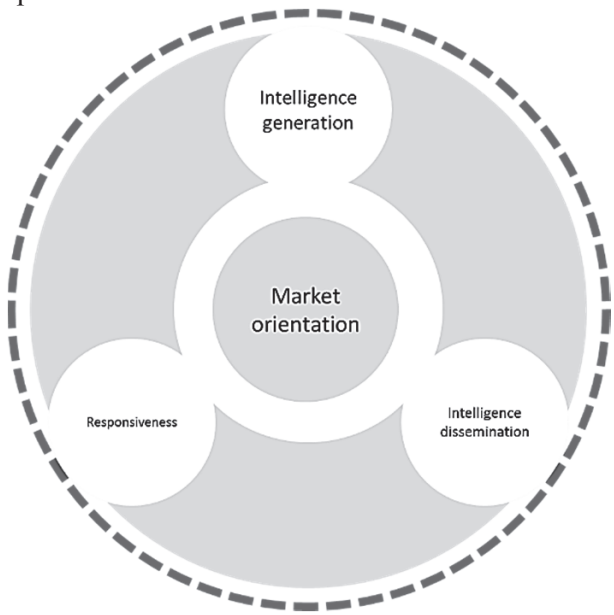
quality system should result in improvement of company business performances, both financial and non-financial performances [Agus and Abdullah, 2000; Esfahan and Naeini, 2013; Lai, 2003; Psomas and Jaca, 2016].

On the contrary, establishment of total quality management system can result in negative influence on business performance, mostly to the increase of direct and indirect costs. These costs are related to the education, training, certification process, prevention and control – quality assurance costs [Aghaei et al., 2013; Esfahan and Naeini, 2013; Lai, 2003].

Market orientation

Market orientation is a business concept with special focus on market needs, needs of consumers and other stakeholders. It represents a set of actions, collecting, processing and disseminating of information that should result in comparative advantage and better business performances. There are numerous definitions of a concept of market orientation [Deshpandé et al., 1993; Hunt and Morgan, 1995; Pelham and Wilson, 1999; Siguaw et al., 1998; Slater and Narver, 1992].

Figure 2. Concept of market orientation and market orientation factors



Source: adapted from Theuvsen and Peupert [2010] and Mujčinović [2013].

Like the concept of TQM, concept of market orientation is used for building competitive advantage of companies [Narver and Slater, 1993]. Therefore, numerous of empirical studies investigate positive relations between market orientation and business performances. Most of them are related to the return on investment,

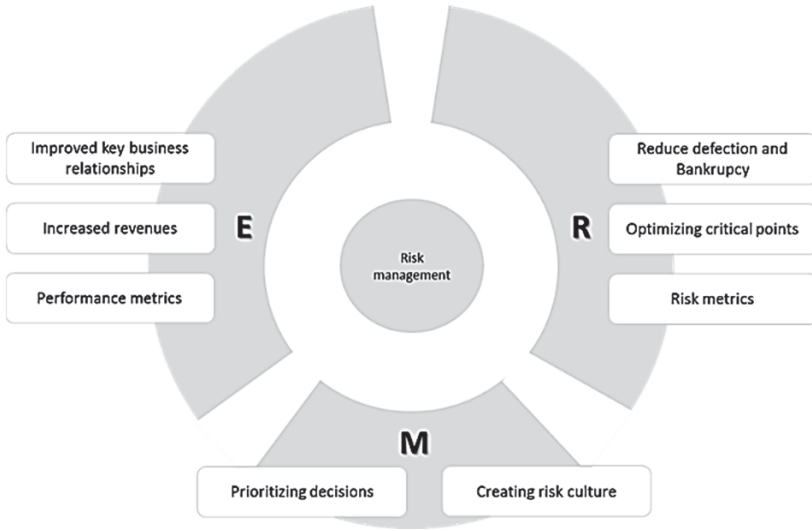
profit, market size and share, sale growth, liquidity, business position, overall performances, data processing, etc. [Atuahene-Gima, 1996; Deshpandé et al., 1993; Gatignon and Xuereb, 1997; Jaworski and Kohli, 1993].

Negative effects of implementation of a concept of market orientation exist but number of positive effects significantly exceeds negative. Some of them are long-term process, sometimes with radical changes, time and money consuming, negative influence on business performance, sale of new products, etc. [Bennett and Cooper, 1979; Christensen and Bower, 1996; Diamantopoulos and Hart, 1993; Gabrijan and Snoj, 1998; Gebhardt et al., 2006; Narver and Slater, 1993].

Conceptual model

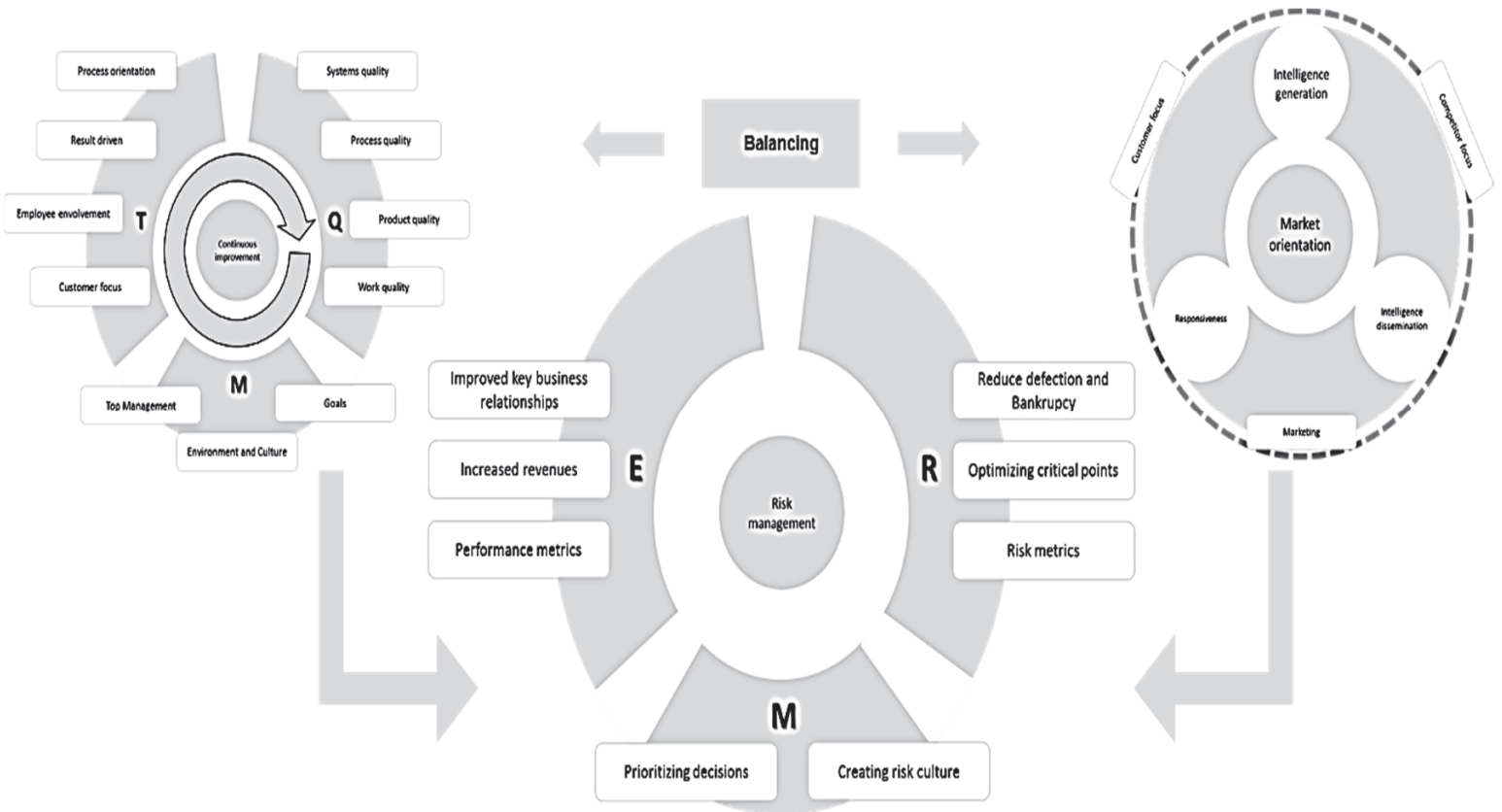
Combining these two specific concepts, TQM and market orientation and their specific constructs help us to develop research model, which is presented by, figure 4. To complete the conceptual model, it was necessary to involve enterprise risk management (Figure 3) in order to determine balancing ratios for quality and market orientation.

Figure 3. Concept of Enterprise Risk Management



Source: adapted from Theuvsen and Peupert [2010] and Mujčinović [2013].

Figure 4. Conceptual model of financial risk mitigation by balancing between TQMCSFs and MO factors



Source: adapted from Theuvsen and Peupert [2010], Scarlat [2012], Mujčinović [2013].

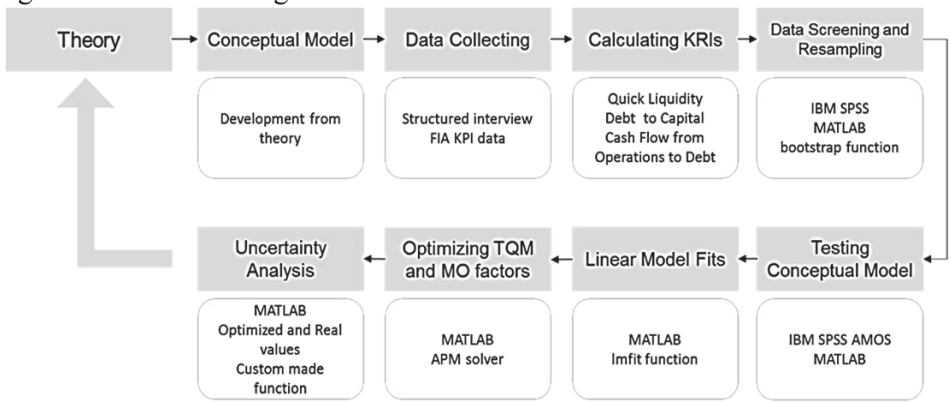
Enterprise Risk Management is a process, effected by an entity's board of directors, management, and other staff, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within the risk appetite, to provide reasonable assurance regarding achievement of entities aims [Scarlat et al., 2011]. In other words, to do this organization-wide activity of risk management, it is required to have risk indicators.

To complete the conceptual model for mitigating financial risk by balancing between TQMCSFs and MO factors, Enterprise Risk Management, represented through some of Key Risk Indicators (KRI), was used to test the ratio between these two orientations, in order to mitigate financial risk in companies. The conceptual model was tested as shown in the next chapter.

13.3. Research method

After developing a conceptual model, empirical research to test the developed model needed three sets of data: (i) data on implemented critical success factors of total quality management (TQMCSF); (ii) data on market orientation factors (MO); and (iii) financial statements of B&H beverages companies for KRIs calculation. Data on TQMCSFs and MO factors were collected through structured interview using scales developed by Saraph et al. [1989] and Kohli et al. [1993], respectively. Interview was conducted in May 2016 in 46 B&H companies, interviewing top-management personnel. Financial statements were procured through among Financial-Informatics Agency of Bosnia and Herzegovina. The research design is shown on the following Figure.

Figure 5. Research design



Source: own compilation.

Three KRIs were calculated for the companies: (i) quick liquidity as (cash and claims) to current liabilities ratio; debt to capital as total debt to total capital ratio; and cash flow from operations to total debt ratio. Previous KRIs were se-

lected on the basis that these KRIs (often used as Key Performance Indicators) are mostly calculated among companies and they represent the first warning sign in determining financial risks in companies. Three datasets were bootstrapped (to 1000 cases) using MATLAB 2015a bootstrap function and the model shown in Figure 6 was tested using SPSS v21 AMOS (Structural Equation Modeling).

Exploratory Factor Analysis was conducted, and it extracted three factors, later used as latent variables: (i) market orientation factors (consisting of intelligence generation, intelligence dissemination and responsiveness); (ii) total quality management critical success factors (consisting of management leadership, resource management, measurement and feedback, continuous improvement, supplier quality management, systems and processes, education and training, and environment and work culture); and (iii) key risk indicators (consisted of quick liquidity, debt to capital and cash flow from operations to debt ratios). After Confirmatory Factor Analysis, model was tested and goodness of fit indices were in adequate range (GFI = 0.962).

Figure 6. SEM model

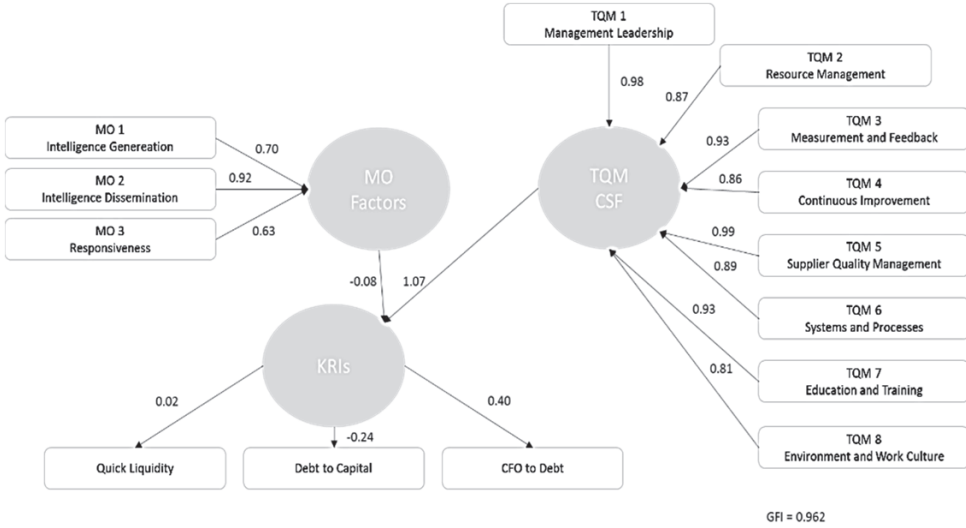
Source: own compilation.

Using a previous model, MATLAB function limit was used to determine regression weights between market orientation and quality orientation factors with calculated KRIs. The same regression weights were used to determine optimal values of factors in order to achieve better KRIs, by using MATLAB APM solver. Optimized values (from APM solver) and real values (measured by the interview) are converged to an uncertainty analysis (using Monte Carlo algorithm on 100,000 cases). The results of research are presented in the following chapter.

13.4. Results and discussion

Total quality management factors have positive effects on calculated key risk indicators, in accordance to the findings of Agus and Abdullah [2000], Esfahan and Naeini [2013] and many other authors, since calculated KRIs are basically key performance indicators (Figure 7).

Figure 7. Structural Equation Model of proposed conceptual model



Source: own compilation.

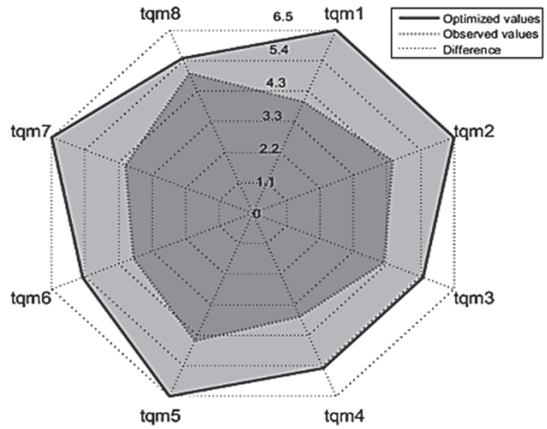
Market orientation factors have slight negative effect on calculated KRIs, since these factors present "openness" of the company to the market demands and uncertainty reduction. The following results are in line with Bennett and Cooper [1979] and Narver and Slater [1993], and they are consistent with the fact that companies in Bosnia and Herzegovina are small-sized and oriented on self-improvement through quality initiatives and adoption of quality systems.

Optimization of total quality management factors to quick liquidity show the highest values for management leadership, resource and supplier management, and education and training (Figure 8). Improving these factors should mitigate risk, since all three factors are dealing with decisions on resources (financial resources).

Optimization of total quality management factors to debt to capital shows highest values in measurement and feedback, continuous improvement and suppliers quality management (Figure 9), while optimization of total quality management factors to cash flow from operations to debt, shows debt to capital shows the highest values in measurement and feedback and supplier quality management (Figure 10). For all three KRI ratios, supplier management is

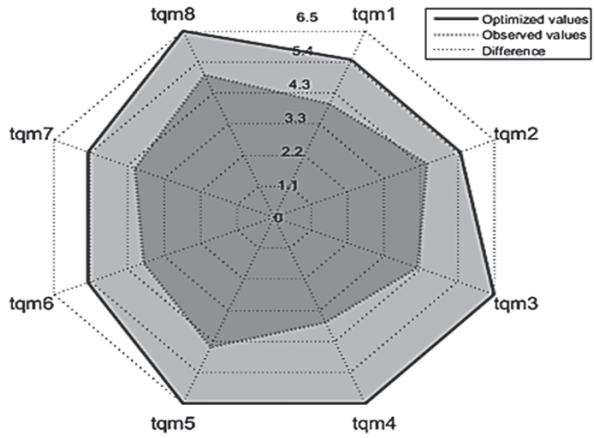
a TQM factor that needs to be improved to mitigate financial risk in B&H beverages companies. Monte Carlo simulation shows improved probabilities of each calculated KRI with the optimized values (Table 1).

Figure 8. TQM factors optimization for quick liquidity



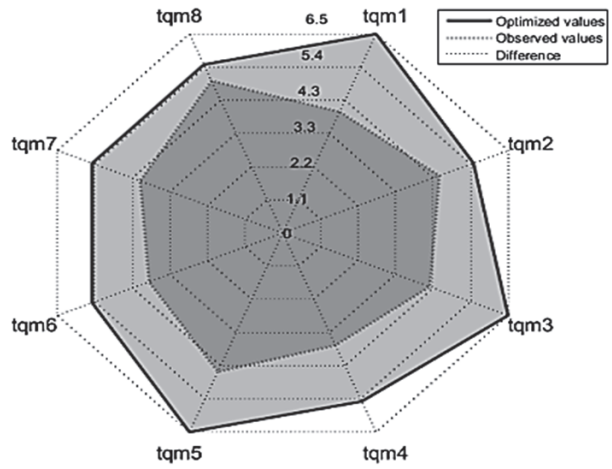
Source: own calculations.

Figure 9. TQM factors optimization for debt to capital



Source: own calculations.

Figure 10. TQM factors optimization for cash flow from operations to debt



Source: own calculations.

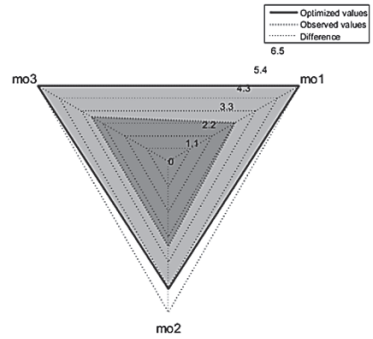
Table 1. Monte Carlo simulation of TQM factors

TQM				
mc	TQM	QL	DtC	CFO
	rp	0.031	0.000	0.044
	op	0.216	0.006	0.190

Key:
tqm1 – Management leadership; tqm2 – Resource management
tqm3 – Measurement and feedback; tqm4 – Continuous improvement;
tqm5 – Supplier quality management
tqm6 – Systems and processes; tqm7 – Education and training
tqm8 – Environment and work culture; QL – Quick liquidity
DtC – Debt to Capital; CFO – Cash Flow from Operations to Debt
rp – Probability for models with real values;
op – Probability for models with optimized values.
Source: own calculations.

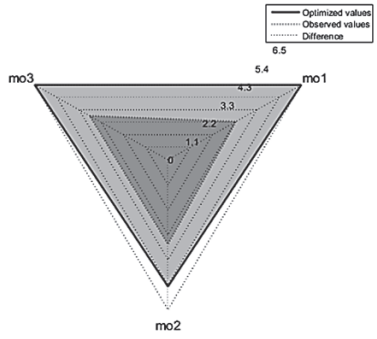
Optimized values for market orientation (Figures 11, 12 and 13) show that each factor (intelligence generation, intelligence dissemination and responsiveness) should be improved in order to improve each of the calculated KRIs. Monte Carlo simulation (Table 2) is following this result, except in case of debt to capital ratio, where optimized probabilities show slightly smaller probability with optimized values.

Figure 11. MO factors optimization for quick liquidity



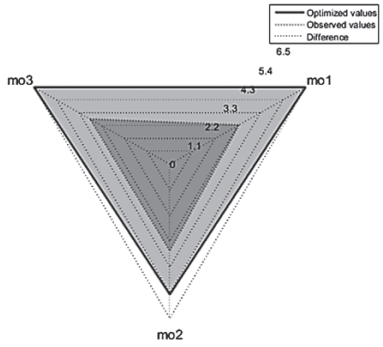
Source: own calculations.

Figure 12. MO factors optimization for debt to capital



Source: own calculations.

Figure 13. TQM factors optimization for cash flow from operations to debt



Source: own calculations.

Table 2. Monte Carlo simulation of MO factors

MO				
mc	MO	QL	CtD	CFO
	rp	0.115	0.317	0.820
	op	0.323	0.315	0.821

Legend:
mo1 – Intelligence generation; mo2 – Intelligence dissemination;
mo3 – Responsiveness; QL – Quick liquidity;
DtC – Debt to Capital; CFO – Cash Flow from Operations to Debt;
rp – Probability for models with real values;
op – Probability for models with optimized values.
Source: authors calculations.

By optimizing and simulating market orientation it is shown that B&H companies are lacking market orientation factors more than total quality management factors. Previous results are used to draw following conclusions.

13.5. Conclusions

By optimizing and simulating market orientation and total quality management factors and in order to show their ratio, its impact on risk mitigation in B&H beverages industry, one can say that B&H companies are more quality oriented and they lack the skills and knowledge to effectively use market information in order to mitigate financial risks.

Structural Equation Modeling shows that small-sized companies in small-sized economy, such as B&H, should mitigate their financial risks by better decision making processes (management leadership as a TQM factor) and changing internal culture and structure, as well as improving efficiency and effectiveness of the processes (continuous improvement as TQM factor) and supplier relations.

Of course, by improving efficiency and effectiveness of internal factors (total quality management factors) culture and environment should be more adequate for improvement of the market orientation factors. Thereby, improvement of the total quality management factors should create conditions for better market information usage and responsiveness of the companies in order to mitigate financial risks, as well as to provide more "tailored" products and satisfaction to their customers.

References

1. Aghaei, M., Asadollahi, A., Reza Dehgan Nejad, M., Amani Pour, M., Fekri-Debanlo, R., *Market Orientation's Impact on Customer Consent due to Total Quality Management Attitude,* Journal of Basic and Applied Sciences, no. 3(7), 2013, pp. 980-986.

2. Agus, A., Abdullah, M., *Total quality management practices in manufacturing companies in Malaysia: An exploratory analysis*, Total Quality Management, no. 11(8), 2000, pp. 1041-1051 (DOI: 10.1080/095441200440313).
3. Atuahene-Gima, K., *Market orientation and innovation*, Journal of business research, no. 35(2), 1996, pp. 93-103.
4. Bennett, R.C., Cooper, R.G., *Beyond the marketing concept*, Business Horizons, no. 22(3), 1979, pp. 76-83.
5. Chin, C.H., Lo, M.C., Ramayah, T., *Market Orientation and Organizational Performance*, SAGE Open, no. 3(4), 2013 (DOI: 10.1177/2158244013512664).
6. Christensen, C.M., Bower, J.L., *Customer power, strategic investment, and the failure of leading firms*. Strategic Management Journal, 1996, pp. 197-218.
7. Deshpandé, R., Farley, J.U., Webster Jr., F.E., *Corporate culture, customer orientation, and innovativeness in Japanese firms: a quadrad analysis,* The journal of Marketing, 1993, pp. 23-37.
8. Diamantopoulos, A., Hart, S., *Linking market orientation and company performance: preliminary evidence on Kohli and Jaworski's framework*. *Journal of strategic marketing,* no. 1(2), 1993, pp. 93-121.
9. Esfahan, M.R.D., Naeini, R.S., *Evaluation of the Relationship between Total Quality Management (TQM), Market Orientation and Services Quality in the Insurance Industry (Case Study: Isfahan Private Insurance Centers)*, Journal of Basic and Applied Sciences, no. 3(8), 2013, pp. 334-342.
10. Faisal, M.N., Shankar, R., Bauwet, D.K., *Supply chain risk mitigation: Modeling the enablers*, Business Process management Journal*,* no. 12(4), 2006, pp. 535-552.
11. Gabrijan, V., Snoj, B., *Tržna naravnanost podjetij v Sloveniji-realnost ali fikcija? Akademija MM,* no. 2(let 2), 1998, pp. 9-14.
12. Gatignon, H., Xuereb, J.M., Strategic orientation of the firm and new product performance. *Journal of Marketing Research*, 1997, pp. 77-90.
13. Gebhardt, G.F., Carpenter, G.S., Sherry Jr, J.F., *Creating a market orientation: A longitudinal, multifirm, grounded analysis of cultural transformation*, Journal of marketing*,* no. 70(4), 2006, pp. 37-55.
14. Gharakhani, D., Rahmati, H., Farrokhi, M.R., Farahmandian, A., *Total Quality Management and Organizational Performance*, American Journal of Industrial Engineering*,* no. 1(3), 2013, pp. 46-50 (DOI: 10.12691/ajie-1-3-2).
15. Hunt, S.D., Morgan, R.M., *The comparative advantage theory of competition*, The Journal of Marketing, 1995, pp. 1-15.
16. Idris-Ashari, M., Zairi, M., *Achieving Sustainable Performance Through TQM and Market Orientation: A Proposed Framework for Empirical Investigations,* International Journal of Applied Strategic Management, no. 2(2), 2004.
17. Jaworski, B.J., Kohli, A.K., *Market orientation: antecedents and consequences*, The Journal of Marketing, 1993, pp. 53-70.

18. Kohli, A., Jaworski, B., Kumar, A., *MARKOR: a measure of market orientation,* Journal of Marketing Research*,* no. 30, 1993, pp. 67-77.
19. Lai, K.H., *Market orientation in quality-oriented organizations and its impact on their performance*, International Journal of Production Economics, no. 84(1), 2003, pp. 17-34 (DOI: http://dx.doi.org/10.1016/S0925-5273(02)00382-1).
20. Martínez-Lorente, A.R., Martínez-Costa, M, *ISO 9000 and TQM: substitutes or complementaries?: An empirical study in industrial companies,* International Journal of Quality & Reliability Management, no. 21(3), 2004, pp. 260-276, (DOI: 10.1108/02656710410522711).
21. Narver, J.C., Slater, S.F., *Market orientation and customer service: The implications for business performance*, E-European Advances in Consumer Research vol. 1, 1993.
22. Pelham, A.M., Wilson, D.T., *Does market orientation matter for small firms*, Developing a market orientation, 1999, pp. 167-194.
23. Potocki, K., Brocato, R., *A System of Management for Organizational Improvement,* Johns Hopkins Apl Technical Digest, no. 16(4), 1995.
24. Psomas, E.L., Jaca, C., *The impact of total quality management on service company performance: evidence from Spain*, International Journal of Quality & Reliability Management, no. 33(3), 2016, pp. 380-398 (DOI: 10.1108/IJQRM-07-2014-0090).
25. Saraph, J.V., Benson, P.G., Schroeder, R.G., *An Instrument for Measuring the Critical Factors of Quality Management*, Decision Sciences, no. 20(4), 1989, pp. 810-829 (DOI: 10.1111/j.1540-5915.1989.tb01421.x).
26. Scarlat, E., Charita, N., Bradea, I.A., *Indicators and metrics used in the enterprise risk management (ERM),* Economic computation and economic cybernetics studies and research / Academy of Economic Studies, no. 46(4), 2011.
27. Siguaw, J.A., Simpson, P.M., Baker, T.L., *Effects of supplier market orientation on distributor market orientation and the channel relationship: the distributor perspective*, The Journal of Marketing, 1998, pp. 99-111.
28. Slater, S.F., Narver, J.C., *Superior customer value and business performance: the strong evidence for a market-driven culture: commentary*, Marketing Science Institute, 1992.
29. Wang, C.H., Chen, K.Y., Chen, S.C., *Total quality management, market orientation and hotel performance: The moderating effects of external environmental factors*, International Journal of Hospitality Management, no. 31(1), 2012, pp. 119-129 (DOI: http://dx.doi.org/10.1016/j.ijhm.2011.03.013).

14 Methodology for integral estimation of Ukrainian agriculture efficiency[1]

Vasyl D. Zalizko
Institute of Agrarian Economy,
National Academy of Agrarian Sciences of Ukraine, Kyiv
zwd@ukr.net

Abstract

The article presents the author's system analysis of the methodology problems hindering efficiency of Ukrainian agriculture. On the basis of this analysis methodological preconditions for further integral estimation of the related prospects, risks and challenges are formed. The author's example demonstrates the application of the integral estimation algorithm for the efficiency dynamics of Ukrainian agrarian enterprises under the risks and challenges related to the Eurointegration.

Keywords: index method, integral estimation methodology, efficiency dynamics, challenges, risks

JEL Classification: D24, Q12

14.1. Introduction

Nowadays, Euroaspirations of Ukraine are of no doubt. In 1998 the presidential decree "On the approval of Strategy of Ukraine integration into the European Union" was approved. This document is in full legal compliance with the Constitution of Ukraine which provides a stable environment for peaceful and mutually beneficial cooperation with all members of the international community. Besides that, in 2005 one more official strategic goal was announced – the memberships in NATO and in the EU. However, unlike Poland, which got full EU membership several years after the same formal announcement by the government, Ukraine is still on its way to the inclusion.

One of the key risks which are hindering the Eurointegration processes in Ukraine, is the inconsistency of public authorities actions (especially noteworthy in this context is the notorious summit in Vilnius, which eventually lead back in 2013 to the so-called "Revolution of Dignity"), and also, in relation to such in-

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

consistency also noteworthy is the absence of a comprehensive scientific approach to estimation of the efficiency dynamics of Ukrainian agrarian enterprises.

Analysis of key research publications proves that in scientific literature, problems related to the estimation of Ukrainian agriculture efficiency has been studied by quite many Ukrainian and foreign authors. In particular, we need to mention here the works by such authors as R. Baldwin *et al.* [1997], P. Gaidutskyi, Y. Lupenko, N. Mekheda and A. Marenych [2013], M. Maliszewska [2004], V. Mokryak et al. [2011], etc. These and some other authors have been considering various aspects of Ukrainian economy's compliance with European standards in order to outline the necessary directions for systemic changes.

However, many issues related to the formation of a methodology for integral estimation of prospects and challenges related to complex estimation of efficiency agriculture remain to be very much topical and understudied.

The article's objective is to formulate the methodological preconditions for integral estimation of efficiency agriculture of Ukraine, and also to demonstrate the example of efficiency rate dynamics for agricultural enterprises on the basis of integral subindex constructed specifically for such purposes, taking into account the key risks.

14.2. Key materials presentation

Rephrasing the famous management principle "If you can't measure it – you can't manage it", we can state that managerial science and research always starts with estimation, or assessment. And one of the most precise ways of estimation is integral one, since it allows radically minimize the level of subjectivity by means of the optimal set of indicators. Economic literature describes dozens of ways to solve this problem, but one of the most efficient ones is the synthesis of the classical theory of evaluation, macroforecasting, index method and multifactor analysis (noteworthy, many of these ideas date back to the famous works of M. Kondratieff and L. Kantorovych) [Kuzyk, 2011].

In today's conditions, when research is going more and more global in its cooperation and science is being integrated into production, there is a necessity to change the traditional ways of economic estimation of political processes' consequences. This can be of special interest for all sorts of regional integration (including the EU enlargement processes) and also for the post-socialistic countries which still experience the influence of Soviet legacy. This can be partially explained by the fact that traditional economic indicators of GNP, GDP, public debt rate, inflation etc. do not really predetermine the consequences of Ukraine's Eurointergration because as in the case of most post-soviet states which all have shifted from centralized administrative style of management to market economy,

there is a range of risks related to setting new connections between the key financial and economic mechanism of national economies' functioning and harmonization of social, research and environmental institutions' performance.

Considering the specifics of this particular research, it is worth differentiating the methodological approaches to estimation of Eurointegration risks on the micro- and macrolevels. And this would further shape the general methodology for prospects and challenges estimation in the context of Ukraine's integration into the EU on the basis of determining the dynamics of enterprises' development by branches as well as assessing the level of social and environmental development of local territories.

Thus, on its microlevel proposed here methodology includes the construction of three integral subindices which would later help estimating the Eurointegration consequences for national enterprises of the agrarian and industrial sectors as well as for those working in the social sector. Mentioned here indices would be calculated on the basis of the Kharazishvili-Zalizko algorithm (more – in the author's previous work on this algorithm [Zalizko and Martynenkov, 2016]. This algorithm includes the following steps:

- **1**. To form an open dynamic system of indicators which, for the convenience can be written down by means of the matrix method, for example:

$$\Psi_k = \begin{pmatrix} \varphi_{11} & \varphi_{12} & \dots & \varphi_{1j} \\ \varphi_{21} & \varphi_{21} & \dots & \varphi_{2j} \\ \dots & \dots & \dots & \dots \\ \varphi_{k1} & \varphi_{k2} & \dots & \varphi_{kj} \end{pmatrix}, \quad k, j \in N. \tag{1}$$

Quantity of elements in such a system can be different and depends on the availability of statistics data and specifics of each stage in evaluation.

- **2.** Using the method of comparison with the reference value, all statistical values are normalized in order to be further used in the dynamic series of integral indices, applying formula (2).

$$z_i = \begin{cases} \dfrac{x_i}{x_{i,\max}}, & \text{if } x_i \text{is the stimulator}, i \in N, x_{i,\max} \neq 0; \\ \dfrac{x_{i,\min}}{x_i}, & \text{if } x_i \text{ is the destimulat or}, i \in N, x_i \neq 0; \end{cases} \tag{2}$$

where:

z_i – the normalized statistical values of the indicators x_i;

$x_{i,\min}$ and $x_{i,\max}$ – the smallest and the biggest values, accordingly.

In the case, when some of the indicators in the dynamic statistical series are equal to zero or are negative, we suggest shifting the statistical axis by several scale units, so that the inequality $x_i > 0$ is satisfied. As a result of normalizing we get the values within the interval (0; 1) keeping the accuracy of estimations.

- **3.** Then we can find the vector of dispersions D_i and the matrices of the absolute values of the factor load A_i, using the axis rotation and quartimax normalization, so as to set simple correlations between the related variables and factors, separately for each group of indicators (depending on the level of a particular research).

This matrices A_i and D_i are to be determined by means of the following formulae:

$$A_i = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1j} \\ a_{21} & a_{21} & \dots & a_{2j} \\ \dots & \dots & \dots & \dots \\ a_{j1} & a_{j2} & \dots & a_{jj} \end{pmatrix}, \tag{3}$$

$$D_i = \begin{pmatrix} d_1 \\ d_2 \\ \dots \\ d_j \end{pmatrix} \; i, \; j \in N, \tag{4}$$

where:

a_{jj} – the absolute values of elements in the matrix after the axis rotation and quartimax normalization;

d_j – the values of dispersion (i, j – quantity of groups and indicators, respectively).

- **4.** Then we find the weight of influence for each factor for further estimation of prospects and risks related to the Eurointegration. For this, we form the following matrix Ω_i :

$$\Omega_i = A_i \times D_i = \begin{pmatrix} d_1 a_{11} + d_2 a_{12} + \dots + d_j a_{1j} \\ d_1 a_{21} + d_2 a_{22} + \dots + d_j a_{2j} \\ \dots \dots \dots \dots \dots \\ d_1 a_{j1} + d_2 a_{j2} + \dots + d_j a_{jj} \end{pmatrix}. \tag{5}$$

Then we can form the matrix of weights for each of the factors:

$$\mathrm{Y}_i^{(1)} := k\mathrm{Y}_i, \; k = \left(\sum_j \alpha_j \right)^{-1}. \tag{6}$$

This enables the final estimation of scalar values of the estimated integral index and the related subindices in the multiplicative form (7) which fully describes socioeconomic and administrative processes:

$$I = \prod_{j=1}^{n} z_j^{\alpha_j}, \quad \sum_j \alpha_j = 1, \quad \alpha_j > 0, \quad n \in N. \tag{7}$$

- **5.** After that we carry out the integral convolution in two stages: first – for separate groups of indicators, second – on the level of integral indices of groups. This process involves using the principal components method for determining the weight coefficients, and also T criterion – for grounding the margin values and some other features as well as the multiplicative form of the integral index and its key components which enables presentation of the final values in the dynamic series as tables (it is recommended to use Statistica 10 and Microsoft Excel 2010 for all calculations).

Let us demonstrate further steps of the mentioned algorithm developed for estimation of the Eurointegration risks for Ukrainian agricultural sector.

The first step in the algorithm is to be performed taking into consideration the significant limitation of the statistical data and basing on the methodology of Structured Analysis and Design Technique (SADT), according to which we set the matrix Ψ_1 the elements of which are the indicators of Ukrainian agroenterprises' dynamic development (by default, all studied indicators are to be obtained from trustworthy sources to be further compared in the same monitoring periods on the basis of normalization).

Following the methodology developed in [Zalizko, 2014] for determining the efficiency of production resources in Ukraine's agriculture we form the matrix structure of Ψ_1:

$$\Psi_1 = \begin{pmatrix} \varphi_{11} & \varphi_{12} & \cdots & \varphi_{1j} \\ \varphi_{21} & \varphi_{21} & \cdots & \varphi_{2j} \\ \varphi_{31} & \varphi_{31} & \cdots & \varphi_{31} \\ \varphi_{41} & \varphi_{42} & \cdots & \varphi_{4j} \end{pmatrix}, \tag{8}$$

where:

φ_{1n} is the index of agricultural production volumes, to 1990 in %;

φ_{2n} is labour productivity at agrarian enterprises calculated per working person, in constant prices for the year 2010, UAH;

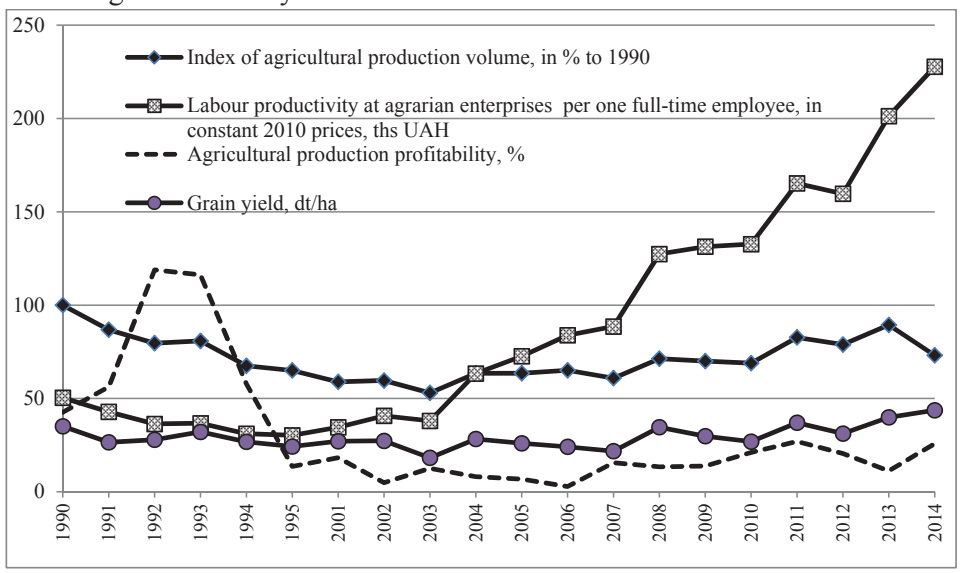
φ_{3n} is agricultural production profitability, in %;

φ_{3n} is the grain yield, dt/ha; n=1, 2, …, j;

j stands for the quantity of years under study (here the time period is 1990-2014).

Thus, using the official statistics concerning the key indicators of Ukrainian agrarian producers' performance (see Figure 1), which well describe the efficiency of resource use, we get the matrix Ψ_1 .

Figure 1. Dynamics of key indicators of agricultural production in Ukraine describing the efficiency of the resources used



Source: constructed by the author on the basis of (ukrstat.gov.ua).

Methodology for determining the key indicators of agricultural production which describe the efficiency of resource use the following notations:

$$I = \frac{I_{prodvol}}{I_{prodprice}} \cdot 100\,\%, \quad P = \frac{D_{sales}}{I_{prodprice} \cdot N},$$

$$R = \frac{VP}{C_{sales}} \cdot 100\,\%, \quad U = \frac{V_{prodvol}}{S_{land}} \cdot 100\,\%,$$

where:

I – the index of production volume (in % to the base year);

P is labour productivity per one employed (in prices of the constant year);

R – profitability of the sold product;

U – yield,

$I_{prodvol}$ – the index of production volume,

$I_{prodprice}$ – the index of product prices,

D_{sales} – income from the product sold,

N – employees' quantity,

VP – gross profit,

C_{sales} – prime cost of the product sold,

$V_{prodvol}$ – volume of the product grown,

S_{land} – productive lands area.

Now, at the second step let us normalize all needed statistical indicators used in dynamic series (Figure 1) using formula (1). Since all these indicators are of stimulating characters, we get the following Table of normalized values.

Table 1. Normalized values of key indicators describing the efficiency of agricultural production in Ukraine

Years	Index of agricultural production volume	Labour productivity at agricultural enterprises per one employee, in constant prices of 2010 [thou. UAH]	Agricultural production profitability [%]	Grains yield [dt/ha]
1990	1.000	0.221241	0.358284	0.803204
1991	0.868	0.188039	0.472666	0.606407
1992	0.796	0.159689	1.000000	0.638444
1993	0.808	0.161172	0.977292	0.734554
1994	0.675	0.136628	0.486123	0.613272
1995	0.650	0.132840	0.114382	0.556064
2001	0.589	0.151819	0.153911	0.620137
2002	0.596	0.178829	0.041211	0.624714
2003	0.530	0.166878	0.105971	0.416476
2004	0.635	0.278270	0.068124	0.647597
2005	0.635	0.318862	0.057191	0.594966
2006	0.651	0.368182	0.023549	0.551487
2007	0.609	0.388891	0.131203	0.498856
2008	0.713	0.559256	0.112700	0.791762
2009	0.700	0.576641	0.116064	0.681922
2010	0.689	0.582562	0.177460	0.615561
2011	0.827	0.725473	0.227082	0.846682
2012	0.789	0.701105	0.172414	0.713959
2013	0.894	0.883486	0.094197	0.913043
2014	0.731	1.000000	0.216989	1.000000

Source: summarized by the author on the basis of (ukrstat.gov.ua).

Now let us present the vector of absolute values of factor loadings A_1 and the dispersions matrix D_1, using the axis rotation and quartimax normalization:

$$A_i = \begin{pmatrix} 0{,}346558 & 0{,}293199 & 0{,}891028 & 0{,}001276 \\ 0{,}942827 & 0{,}232654 & 0{,}021779 & 0{,}237647 \\ 0{,}115615 & 0{,}968601 & 0{,}220054 & 0{,}004733 \\ 0{,}865485 & 0{,}119634 & 0{,}347403 & 0{,}340491 \end{pmatrix},$$

$$D_1 = \begin{pmatrix} 53{,}08551 \\ 35{,}38610 \\ 7{,}64901 \\ 3{,}87938 \end{pmatrix}.$$

According to our fourth step in the suggested algorithm we find the weight matrix Ω_1, which describes the influence of each factor of the related integral subindex

$$\Omega_1 = \begin{pmatrix} 35{,}5928056\ 1 \\ 59{,}3716538\ 7 \\ 42{,}1140372\ 4 \\ 54{,}1563011\ 3 \end{pmatrix}$$

This enables determining the values of weights coefficients α_j:

$$\alpha_1 = 0{,}186121; \quad \alpha_2 = 0{,}310465; \quad \alpha_3 = 0{,}220222; \quad \alpha_4 = 0{,}283193.$$

This over, with high probability, describes the level of each factor influence on the general level of agricultural production efficiency (Table 1).

Using formula (2) we can visualize the dynamic series for the integral subindex in question (Figure 2).

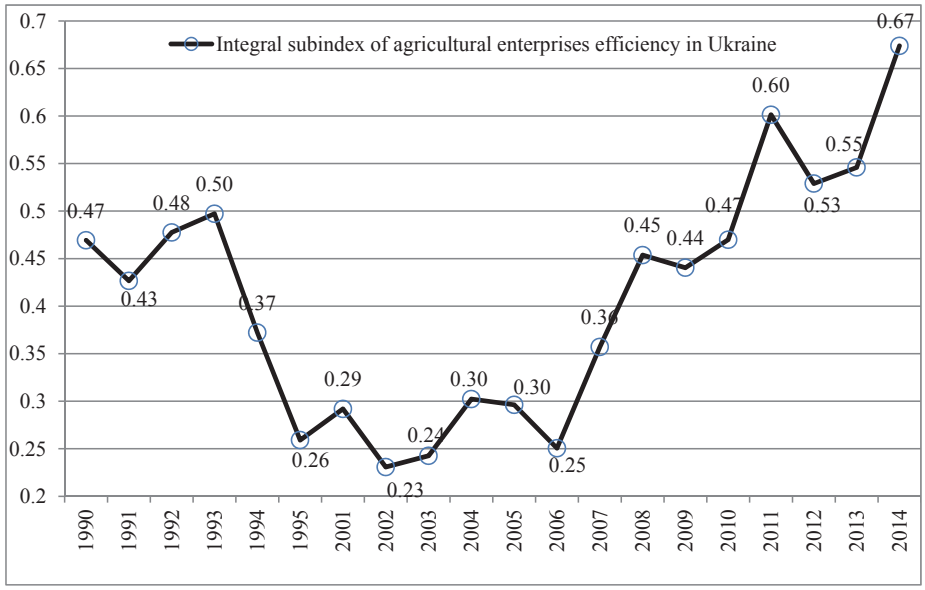
As shown in Figure 2, the constructed dynamic series of integral subindex values has several bend points of local extremum, in particular, the least efficient enterprises' activity was in 2002, while the most efficient was in 2014.

Despite the fact that since 2006 we observe systemic growth in efficiency at agricultural enterprises, there is still a range of challenges which may hinder further development of Ukrainian agriculture (the strategic sector for our country).

First of all, we need to mention here the necessity for modernization of state regulation mechanisms concerning both production and further distribution of crop farming products. This concerns better access to products markets both in Ukraine and abroad for small producers.

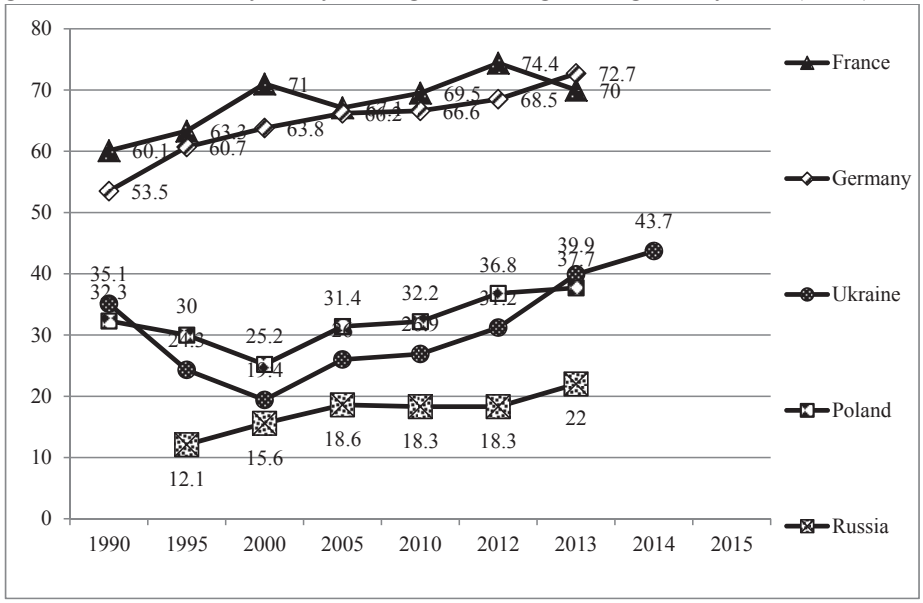
Secondly, comparing the indicators of yield and gross harvest of grains in Ukraine and in selected countries (we have chosen the countries in which climatic, natural and land conditions are comparable to Ukraine, see Figure 3) we can note that applying innovative agritechnologies (used for example, in France, Germany or Switzerland) Ukraine would be able to get at least twice better results, both in terms of yield and harvest.

Figure 2. The dynamics of integral subindex of agricultural enterprises efficiency in Ukraine



Source: calculated by the author using formula (2).

Figure 3. Cross-country analysis of grains and grain legumes yields (dt/ha)



Source: constructed using the data from (ukrstat.gov.ua).

The above statements prove that Eurointegration of Ukraine is the only realistic way of solving the current social, economic and environmental problems. The methodology of integral estimation in this context is one of the efficient and universal instruments for monitoring of changes and further building of economic mathematical models for forecasting further development of national economy.

Besides that, we need to mention here the unbalanced and irregular nature of agricultural enterprises development which may further threaten the economic security of rural territories in Ukraine. Systematization of the related threats is presented further in Table 2.

Table 2. Systematization of threats to economic security of agricultural enterprises and rural territories in Ukraine

Subsectors	Components	1990/1991	2013/2014	Risks
Crop farming	Sugarbeet production	44.0 mln t	5.6 mln t	Loss of food independence
	Vegetables production	4.2 mln t	0.8 mln t	
	Production of flax, tobacco and hop	125.7 ths t	1.7 ths t	
Husbandry	Cows	8.4 mln heads	2.5 mln heads	Significant decrease in the quantity of heads for all types of livestock
	Sheep and goats	8.4 ml heads	1.7 mln heads	
	Pigs	19.4 mln heads	7.9 mln heads	
	Meat production	44 mln t	24 mln t	Significant decrease in production of strategically important food products
	Dairy production	24.5 mln t	11.5 mln t	
Economic indicators and welfare	The index of gross agricultural product	1.00	0.89	Regress in agricultural sector
	Average income from agricultural production calculated per village council	3.4 mln USD	1.4 mln USD	Decreasing GDP of the country
	Employment in agriculture, forestry and fishery	5 mln employed	3,5 mln employed	Lower employment level and less vacancies for rural population
	The share of rural households' money income as compared to the same share of urban households	90%	80%	Disbalance and inequality in money incomes of rural and urban population

Source: constructed by the author using the data from (ukrstat.gov.ua).

We fully share the opinion expressed by the Ambassador of Germany in Ukraine Christof Weil concerning the top-5 priority vector for further development of the country: "climate/energy sector, healthcare/nutrition, mobility, securi-

ty and communications" [http://www.kiew.diplo.de, 2016]. It is also worth noting here that these directions have to be supported through academic and research mobility and global cooperation in academic field for further construction of the integral estimation system of compliance between Eurointegration changes implemented on our side and external and internal economic interests of the state on the other. This concerns not only Ukraine, but all parties involved, current EU member states and other potential candidates for inclusion. It is also important to create preconditions for stimulation of innovation and investment activity of enterprises which further would eventually lead to better banking, budget, financial, food and overall economic security of Ukraine and Europe as a whole.

14.3. Conclusions and propositions

Thus, the suggested methodological grounds, necessary for integral estimation of risks, challenges and prospects, related to the Eurointegration of Ukraine, enable further, more global research, aimed at finding new sources and ways of the EU development stimulation, in particular, by means of joint research and technological potentials of agriculture.

The system analysis of the key indicators of Ukrainian agriculture in dynamics demonstrates the efficiency level of resource, use in today's agriculture of Ukraine and also proves that there will be a range of positive consequences for Ukraine from the EU membership, especially in the context of global food security.

The proposed algorithm of integral estimation also enables determining the threshold and alarming values of the integral indicators, presents risks in their multiplicative forms on the basis of the principal components methods, t-criterion and other econometric tools excluding though the traditional expert assessment (which often has high level of subjectivity). This definitely increases the stringency of the obtained results. First of all, it concerns the economic mathematical models for forecasting risks of the financial and socioeconomic development of local territories under Eurointegration conditions on the basis of spline approximation theory.

References

1. Baldwin, R., Francois, J.F., Portes, R., *The Cost and Benefits of Eastern Enlargement: The Impact on the EU and Central Europe*, Economic Policy, April, 1997, pp. 127-170.
2. Gaidutsky, P., *Ukraina: problema integratsii (Ukraine: the problem of integration),* Natsionalna bezpeka i oborona [http://www.razum-kov.org.ua/ukr/files/ category_journal/NSD_141-142_ukr.pdf].
3. Gaidutskyi, P., *Ukraina – ES: problem integratsii (Ukraine – EU: the problems of integration)*, 2013 [http://agroconf.org/content/gayduckiyukraina-es-pro-blemy-integracii].

4. Zalizko, V.D., *Shlyakhy pidvyshchennya efektyvnosti vyrobnychykh resursiv silskogo gospodarstva Ukrainy u konteksti zmitsnennya ekonomichnoi bezpeky (The ways of increasing the efficiency of production resources in the agriculture of Ukraine in the contexts of strengthening its economic security*), Ekonomika APK, no.10 (240), 2014, pp.19-26.
5. Zalizko, V.D., Martynenkov, V.I., *Metodyka otsinyuvannya ekonomichnoi bezpeky silskikh terytorij (Methodology for economic security estimation for rural territories),* Ekonomika Ukrainy, no. 1 (650), 2016, pp. 19-34.
6. *Ekspres-vypusky Derzhavnoi sluzhby statystyky Ukrainy (Express issues of the State Statistics Service of Ukraine),* http://www.ukrstat.gov.ua.
7. *Evropeiska integratsiya Ukrainy: gromadska dumka (European integration of Ukraine: public opinion)*, Natsionalna bezpeka ta oborona, no. 5, 2007, pp. 51-68.
8. Kuzyk, B.N., Kushlyn, Y.V., Yakovets, Y.V., *Prognozirovanie, strategi-cheskoe planirovanie I natsionalnoe programmirovanie (Forecasting, strategic planning and national programming*), Moscow: Ekonomika, 2011, pp. 604.
9. Lupenko, Y. *Agrarnyi sector zberigae svoyu investystiynu pryvablyvist (Agricultural sector still has its investment attractiveness*), 2015 [http://www.iae.kiev.ua/presscentre/presrelease/714--2015-950-.html].
10. Mekheda, N., Marenych, A., *Naslidki evrointegratsii: sotsialnyi aspect (Consequences of Eurointegration: the social aspect*), Finansovyi prostir, no. 4(12), 2013, pp. 209-214.
11. Maliszewska, M., *EU Enlargement: Benefits of the Single Market Expansion for Current and New Member States,* Studies & Analyses, Warsaw: Center for Social and Economic Research CASE, no. 273, 2004, pp. 43.
12. Mokryak, V.L., Lobanova, A.S., Mokryak, E.V., Slavina, O.S., *Svit I Ukraina: dynamika osnovnykh pokaznykiv sotsialno-ekonomichnoi statystyky: navchalno-metodychnyi posibnyk (The world and Ukraine: the dynamics of key indicators in social and economic statistics: study guide*), A.S. Lobanova (ed.), 2nd ed. Kryvyi Rih: Vydavnychyi dim, 2011, pp. 548.
13. *Otsinka naslidkiv ugody pro vilnu torgivlyu mizh Ukrainoyu ta ES (Estimation of consequences of the free trade agreement between Ukraine and the EU*), 2007, http://wto.in.ua/files/ content/articles/ fta_eu_impact.pdf.
14. *Posolstvo Federatyvnoi Respubliki Nimechc*hyna, The Embassy of the Federal Republic of Germany, Kyiv, 2016 [http://www.kiew.diplo.de].
15. *Rekomendatsii uchasnykiv Drugogo zasidannya Robochoi grupy: Ukraine – ES na shlyakhu do rozshyrenoi zony vilnoi torgivli na temu: Potentsial Zony vilnoi torgivile mizh ES ta Ukrainoyu dlya rozvytku agrarnogo sektoru ekonomiky (Recommendations of the participants of the Second sittings of the Working Group "Ukraine – EU on the way to expanded zone for free trade" on the topic: Potential of the free trade zone between the EU and Ukraine for the development of agricultural sector),* [http://www.niss.gov.ua/public/File/2011_table/0609_re-kom.pdf].
16. *Komitet z pytan evropeiskoi integratsii Verkhovnoi Rady Ukrainy (Committee on European integration of the Verkhovna Rada of Ukraine*), [http://comeuroint.rada.gov.ua/komevroint/control/uk/publish/article?art_id=56220&cat _id=45826].

15 Entrepreneurial process and risks in small and medium-sized organic agricultural holdings in Serbia[1, 2]

Drago V. Cvijanovic[1], Vesna Kocic Vugdelija[2], Željko M. Vojinović[3], Otilija Sedlak[4]
[1] University of Kragujevac, Vrnjacka Banja, Serbia,
[2] Business School of Novi Sad,[3, 4] University in Novi Sad, Subotica, Serbia
drago.cvijanovic@kg.ac.rs, vesna.kocic-vugdelija@teachers.org,
zeljko.vojinovic@ef.uns.ac.rs, otilijas@inbajmok.com

Abstract

Agriculture production has become a strategic factor for development and economic integration of Serbia into the European Union. In the last few years organic production has been popularized as from the farmers so as from the state of Serbia and particular attention is given to this section. In this area, as in other parts of Serbian economy, entrepreneurship gets more and more important role because entrepreneurial process can be useful in developing and improving small and medium agricultural holdings in way of production, productivity and efficiency and risk management. This paper has presented main parts of entrepreneurial process on small and medium agricultural holdings in Serbia, including possible investment calculation in organic production with highlighting risks and risk perception, so as the stimulus that have been brought by the government. All three parts of the paper present unique entrepreneurial process created for enhancing market possibilities of organic producers.

Keywords: organic agricultural production, entrepreneurial process, efficiency, risk

JEL Classification: D24, Q10

15.1. Introduction

Contrary to a widespread opinion that the theory of management is adapted only to large companies, the need for continuous planning and management in small and medium enterprises, because of the above facts, is even more important. In this paper, emphasis is placed on the organization of small and medium-sized farms that are starting organic vegetable production in green-

[1] Paper is a part of research within the project no. 46006 III "*Sustainable agriculture and rural development in the function of accomplishing strategic objectives of the Republic of Serbia in the Danube region"*, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.
[2] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

houses. In this type of production, especially in the first few years, the range of possibilities is wide, and every decision entails long-term consequences.

The specificity of the production in greenhouses is reflected in the fact that, unlike the crop production (which occurs in natural climatic conditions) this production takes place indoors, all year round. Of great importance is that through the production, market is supplied with specific products during the autumn-winter, i.e. time when natural and climatic conditions do not allow the production in the open. Constructed area under greenhouses in Serbia cannot meet market needs for products in the off-season such as tomato, peppers, cucumbers, etc. and consumers are directed to the imported vegetables.

Serbia has extremely high potential for organic production. The development of organic agriculture could affect the quality of life in local communities and the state as a whole. Long-term organic farming would help in reducing the gap between rich and poor regions and achieving stability in production. Also, through education and informing of producers and consumers it can be built awareness of the need of consuming organic food in function of health improvement. The necessity of this research appeared because of the lack of information in management of small and medium households, which make the largest number of agricultural organizations in Serbia.

Because of that, and many other facts such as economic result (profitability), social responsibility and environmental preservation, number of organic producers is increasing each year. This can be confirmed by Table 1 which shows number of organic producers in region of Balkan and East Europe in the last four years.

Table 1. The organic producers in the region from 2011 until 2014

Year	2011	2012	2013	2014	Increase from 2011 to 2014
Country	**Producers**	**Producers**	**Producers**	**Producers**	**%**
Albania	146	39	39	39	-73
Bosnia and Herzegovina	25	25	24	24	-4
Bulgaria	1,562	2,754	3,854	3,893	149
Croatia	890	1,528	1,608	2,194	147
Hungary	1,433	1,560	1,673	1,672	17
Macedonia FYR	419	554	382	382	-9
Romania	9,471	15,315	14,901	14,159	49
Serbia	312	1,073	1,281	1,281	311
Slovenia	2,363	2,682	3,049	3,293	39

Source: http://www.organicdatanetwork.net/odn-statistics/odn-statistics-data (access 30/09/2016).

According to Table 1 in almost every country in the region Balkan and near Serbia (except Albania, Bosnia and Herzegovina and FYR Macedonia) number of organic producers increased significantly in the last four years. Main increase in 2009 was in Serbia, from 312 to 1,281 producers, Bulgaria from 1,562 to 3,893 and Croatia from 890 to 2,194. A positive trend of growth in number of producers had Bulgaria, Croatia, Hungary, Romania, Serbia and Slovenia. In those countries number of organic producers was increasing almost each year taken into analysis.

The aim of this research is synthesizing all aspects of management, risks and investment opportunities to make appropriate entrepreneurial approach to holdings engaged in organic production of different types of vegetables. Besides that, it is also considered a legal framework for organic production in Serbia, possibilities and restrictions that are brought by the state.

15.2. Methodology

For research, it has been used methodology of analysis of literature and statistical data in the field of management, agribusiness and organic production, which was completed by a series of interviews with the producers. It has been interviewed six farmers involved in organic production in the Republic of Serbia.

In order to gather the necessary information, we used the technique of direct interviews. In this type of testing, the instrument is prepared as a list of research problems and questions tailored specifically to an individual. Questions are asked in a particular order, and the interview is not a rigid plan, but it serves as a reminder of topics that must be processed. The advantage of the partially structured interview is that it allows the possibility of checking some information with others from the same source and makes their comparison [Novicki, 2004].

15.3. Results

Management capabilities in organic production today are as important as technical capacity. This production requires even additional management skills if we have in mind the complexity of the type of production [Vegetable Gazette, num. 14]. Besides the above, managers in Serbia do not have enough business experience in market conditions, and they need help in the knowledge, skills and standards of organic production. One form of assistance is the dissemination of managerial knowledge through consulting [Mihailović, 2007].

Management of production

Management of the production process is essential for rational logistic action and economic efficiency of reproduction cycle. In agriculture, this segment refers to the planning of work, labour, sowing, harvesting, etc. The following plans are the most important for decision makers in small households:

- Plan of the required amounts of vegetables for each period,
- Planting plans with precisely specified dates for each type,
- Plan of the area that is required for normal growth of vegetables,
- Plan of rotation crops,
- Plan of planting crops according to the seedbeds.

Finances management

Financial management includes planning of investment and current spending, bill paying, book keeping, paying employees, payment of taxes, etc. What is missing in Serbia is, eventually, free training in the field of book keeping for owners of small and medium-sized households, especially because of the complexity of the fiscal system in this field. However, interviewed producers of organic vegetables pointed out the site of Agricultural extension services of Serbia [Agriculture Extended Service of Serbia, 2016], where are found a lot of literature on this subject, and the list of advisors by specialty and regions.

For small and medium producers of organic products, the most important is to seamlessly do book keeping that the inspectors require, such as:

- Plan of property,
- Extract from the register of holdings,
- Bills of purchase of seeds and other products, etc.

Decision makers on households need to learn basic book keeping, to synchronously keep accounts, and to use Excel program (or other, similar program for calculating and recording).

Human resources management

Possibilities for human resource management in agriculture are numerous. The method of management depends on the owner's management skills. Important is the fact that the wage workers usually use only the kinetic energy and not a creative one, which is used for finding better solutions and practices in business [Leković, 1998]. Therefore, in addition to hiring seasonal workers, there is a need to take into account the human capital that will sustain the entrepreneurial spirit of household (Table 2).

Table 2. Human resources in agricultural production divided into the categories

Family members	The benefits of working with family members are knowledge of the workers who usually work without formal charges and who are dedicated workers
Local labour force	The population in rural areas is in most cases the main source of seasonal labour. The benefits of employing them are the proximity and the possibility of finding "trusted" people. The disadvantages are the motivation, education, and their unwillingness to work intensively
Foreign labour force	In Serbia mostly come from Romania and Bulgaria. The advantage of opting for this work force is an extremely efficient and willing to work more hours, and the disadvantages are the necessity of providing shelter, food and language barriers
Interns and students	All agricultural educational institution (whether school or university) has in its program a mandatory practice. The advantage of the decision for this work force is in low cost (sometimes even unpaid work). The disadvantages are reflected in the fact that this category of labour generally is available only for part of the season, and at least in August and September, when there is the most intensive work
Woofers **[World Wide Opportunities on Organic Farms, 2016**]	Mainly young people, who travel around the world and work on farms of countries that are members of the organization WWOOF (World Wide Opportunities on Organic Farms or Willing Workers on Organic Farms), or which are not members, but have "hosts" who care about their stay at a particular farm. Despite their popularity, in Serbia there is only one household which is registered as the host for woofers. The advantages of hiring woofers are free labour force in exchange for food and accommodation. They are motivated professionals who have rich experience, so thanks to the most professional of them business can be even improved. The disadvantage is the uncertainty. When they arrive, the moment of departure is unknown. Their working hours are usually shorter than the traditional seasonal work, and there are language barriers.

Source: Leković [1998], World Wide Opportunities on Organic Farms [2016].

Management of the process of organic certification

One of the important factors in organic production is the work on the certification process. Final consequence is that without this certificate the price of products will never be justified in the eyes of consumers. This process is a logical sequence of events resulting from a production plan, management of the household and financial resources. The manufacturer shall maintain records on the use of plots of land intended for organic farming in the prescribed form. These records contain information on the order of applied operations, fertilizer, processing, protection, and irrigation, and all other operations applied before and after harvesting.

All depends on which regulations producers are applying. For example, if an organic product was directed to the Swiss market, then it should be applied to Bio Suisse standard [Bio Suisse, 2016], which is very rigorous. In this case, there should be no conventional nursery on the estate, i.e. it must all be organic. Then, at harvest it must be used gloves that do not contain latex, and they are supplied exclusively in Switzerland. Also, 7% of the area should remain undeveloped (as an ecological zone). Inspection by the EU standards is much simpler, but the ma-

jor predispositions are good management skills. Average cost of inspection for certification per hectare is about 300 Euros, and that depends on the inspection agency. It is necessary to bear in mind that the yield in the first year of the certification process does not mark as organic. The so-called conversion takes 3 years.

To established organic production in Serbia, it is necessary to provide spatial isolation of parcels and farms of the possible sources of pollution and prescribe the quality of irrigation water and air. Engaging plot of land in organic agriculture can start immediately if the land has not been used in the last two or three years (for perennial plants) or processed without the use of synthetic – chemical means for fertilization [The Ministry of Agriculture, Forestry and Water Management of Serbia, 2016]. If the plot was used with the funds of synthetic chemical origin, it can be switched to organic agriculture at the end of the transitional period (conversion) – two or three years for growing crops without using synthetic chemical means. All authority over the certification of organic production has the Ministry of Agriculture, Forestry and Water Management of Republic of Serbia and in 2015 mandate to carry out certification of organic production received 12 certification organizations. Based on the report of authorized certification organization, Ministry of Agriculture since 2008 has been making the unique records of organic producers (certified and those during the conversion).

Risk management

Agricultural production is subject to many uncertainties. First, the negative consequences of large-scale, industrialized conventional agriculture undermine the earth's capacity to continue producing food [Anton, 2010]. In deciding the future trajectory of agriculture, it is important to balance the known harm caused by our current, high-input agriculture system with the potential costs and benefits associated with a transition to alternatives. Yield is only one factor within a set of complex socio-economic forces that determine what management practices growers adopt, how much land is dedicated to agricultural production, and how much food is available and accessible for the hungry [Ponisio and Kremen, 2016].

Any farm production decision plan is typically associated with multiple potential outcomes with different probabilities. Weather, market developments and other events cannot be controlled by the farmer but have a direct incidence on the returns from farming. The risks that threaten agriculture are divided into basic and additional. Hail, fire and lightning represent basic risks, storms, spring frost, autumn frost and flood fall in additional risks. Under the influence of climate changes, one insurance company as an additional risk recently introduced drought [Birovljev et al., 2015]. In this context, the farmer has to manage risk in

farming as part of the general management of the farming business. Hazards and unforeseen events occur in all economic and business activities and are not specific to agriculture.

We will show how options influence decisions and reduce eventual risks that farmers could face on the market. To illustrate, we will say that on October 1, 2014, Serbian organic wheat farmers could have sold their 2015 crop for 320€/t by selling a July 2015 futures contract on the Procurement agency in Serbia.

If wheat price at harvest in July is 300€/t, farmer buys a futures contract for 300€/t for a net gain of 20€/t on the futures market, and then sells wheat for 300€/t in the cash market. His net position is 300€ + 20€ = 320€/t. If wheat price at harvest is 340€/t, farmer buys a futures contract at 340€/t for a net loss of 40€/t on the futures market, and then sells wheat for 340€/t in the cash market. His net position is now 340€ - 20€ = 320€/t. Furthermore, on October 1, 2009, Serbian organic wheat farmers could have bought an option that gave them the right to sell a July futures contract for 320€/t. If wheat price at harvest is 300€/t, they will exercise the option. More precisely, they will sell a futures at 320€/t, buy one at 300€/t, for a gain of 20€/t. On the other hand, if wheat price at harvest is 340€/t, they do not have to exercise this option.

Even if farmers do not want to trade with futures or with a government, they have some other possibilities to succeed. To moderate some risks, they can do a diversification of the production, or they could make forward contracts with processors. To conclude, there are a lot of options that can reduce the downside risk without giving up the upside potential [O'Shaughnessy, 2005].

The start-up of entrepreneurial process

Management development in SMEs, unlike large companies, has its specificities. In the first phase of work and business of small companies attention is mostly focused on the product and its placement [Mitrović, 2009]. This is precisely the period in which the most important are knowledge and skills of producer, because he is the holder of managerial functions.

Reorientation on the organic type of production requires new investments in machinery and means of production. In the growth phase, there is a limitation of the resources, and the question of fixed assets is very significant in developing new ways of doing business. This paper analyses a household that for the first time is performing the process of organic production.

Investment calculation for organic production in the greenhouse

With proper organization and management of the estate, by hands it can be produced up to 3,000 vegetable seedlings[3]. Each part of plan, from labour to yield, must be ensured so that the production process will be effective. Producers, who have been interviewed for this article, and who do not use or use poor machinery, said that, if hand work is intense[4], it can also generate a higher yield per hectare than the mechanized work. However, they stressed that in this case it is necessary to keep the farm level in small businesses and to provide additional resources during the winter.

Organic farming is a production method that requires a big commitment, and thus performance. As the managerial capacity is developing through experience, in the initial phase of low mechanized organic farming, it should not be produced more than 2,000 seedlings. Table 3 presents an overview of the necessary investment for organic production of around 2,000 vegetable seedlings[5].

Table 3. Material and investment for starting phase of production of 2,000 vegetable seedlings

Infrastructure	**Costs €**
Greenhouse of 0.3ha	2,000 (average cost)
System for heating greenhouse	1,000
Refrigerator	2,000
Extension for the preparation of seedlings	depends on the existing infrastructure
The main irrigation system	500
Tools and equipment	
Cultivator	2,000
Knapsack sprayers	50
Rakes, shovels, spades and wheelbarrows	70
Black foil	100
Crates, weighing	100
Trailer	200
Total costs	**8,020**

Note: Costs are approximate for 2011 and they are variable in case of different suppliers.
Source: own calculation.

As the certification of organic production takes about 3 years, a medium--term planning is minimal challenge for decision makers. Table 4 presents the medium-term plan of investment on holdings in order to increase production at 15,000 plants.

Such investment plan must be accompanied by an adequate investment program i.e. business plan which is serving as a proof that investments are carefully planned and have operational and financial sense.

[3] Interviewed producers gave an example of tomato production.
[4] From April to August even 50 hours a week.
[5] The estate and field were not calculated.

Table 4. Medium-term plan for production of 15,000 plants

Infrastructure	Costs in €					
	2011	2012	2012	2013	2014	2015
Land	Bought in 2010					
Facilities	Bought in 2010					
Barn (76x22)	Bought in 2010					
Storage			1,000			
Refrigerator				2,000		
Greenhouse		2,000				
Certification			300	300	300	300
Workshop						3,000
Mechanization						
Tractor (30ks)		12,000				
Cultivator		2,000				
Equipment						
Tool for gardening		70		50		
Main system for irrigation		500				
System "drop by drop"			700			500
Other equipment			300			
Van for delivery			3,500		5,000	
Investments per year		**16,570**	**5,800**	**2,350**	**5,300**	**3,800**
Trend in investments (year per year) %		**-**	**- 65**	**- 59**	**44**	**- 72**

Source: own calculation.

The role of the State in entrepreneurial process

Serbia has enacted a new Law on Organic Production (in May 2010), trying to follow the changes that have occurred in the legislation of the European Union [Official Gazette of Republic of Serbia, No. 30/10]. It is applicable from 1 January 2011. Article 4 of the Act speaks about promoting of development and promotion of organic production resources which will be provided from the budget of the Republic of Serbia, grants and other sources. Ministry of Agriculture, Forestry and Water Management, as a ministry of the Republic of Serbia for these questions has provided terms and manners of distribution and the use of these incentive funds in 2015 by the Decree on the use of incentive funds to support the development of organic production for 2015 [Gazette of Republic of Serbia, No. 43/15].

In Serbia's budget for 2015 it was envisaged to subsidize agriculture with nearly EUR 4.5 million. The support through subsidies was provided by the same regulation and for organic livestock production. The right to use subsidies had individuals as holders of domestic commercial farms, then enterprises and cooperatives if they meet the requirements prescribed by regulation. Exercising the rights to subsidies was not only for the owners of land that is used for organic production, but also the tenants of the land, engaged in organic production. Namely, it was subsi-

dized hectare area in which has been performed the organic production. For crop production per hectare the state approved EUR 243, for vegetable production EUR 340 per hectare and for fruit and wine production EUR 437 per hectare. The right for encouragement from the Republic of Serbia had producers of organic products that have entered into agreements with certifying organizations authorized by Ministry of Agriculture.

So far the part of the budget for financing organic production was low, and the aid was allocated only in the form of direct assistance. There are proposals to provide indirect assistance to organic producers, for example to reduce the rate of VAT in turnover of organic products, but such measures are still only an option. Financial support for organic production has started for the first time in 2005/2006. The volume of subsidies for organic production was EUR 19,000. In addition to this sum the Ministry of Agriculture, Forestry and Water Management together with the Ministry of Economy and Regional Development also subsidizes approximately 50% of the certification costs of organic production.

15.4. Conclusions

Development of organic agricultural production implies many efforts that come from areas of finances, human resources, risk management, law, etc. In this area, as in other parts of Serbian economy, entrepreneurship gets more and more important role because entrepreneurial process can be useful in developing and improving small and medium agricultural holdings in way of production, productivity and efficiency. This paper has presented main parts of entrepreneurial process on small and medium agricultural holdings in Serbia, including possible investment calculation in organic production with risk perception, so as the stimulus that have been brought by the state. All three parts of the paper present unique entrepreneurial process created for enhancing market possibilities of organic producers.

Using methodology of literature analysis and interviews authors were enabled to analyse main parts of entrepreneurial process in organic agricultural production in greenhouses. This process included the analysis of:

- Production management in organic agriculture, with elements of planning,
- Financial management – the accounting and book keeping, with possible investment calculation for new greenhouse,
- Human resource management, where authors made an analysis for possible and needed working force on households,
- Certification management as an important and unavoidable step in organic production,
- Risk management where authors gave optional decisions for possible reduce of eventual risks that farmers could face on the market,

- Involvement of the state in promoting the organic agriculture, where it can be seen a regulatory framework and budget for development of this type of production. The state is trying to stimulate farmers to re-orient on the organic production method, but in the opinion of the surveyed farmers incentives that the state pays are not enough.

At the end of the analysis, authors made a conclusion that organic production in Serbia is still a risky and costly investment. There are many interested producers and enough natural resources for this kind of production, but for entrepreneurial process it is important to include and manage all the elements presented in the paper.

References

1. Agriculture Extended Service of Serbia, http:// www.psss.rs (September 2016).
2. Anton, J, *Risk management in agriculture: a holistic approach*, OECD Publications, 2000.
3. Bio Suisse, a private-sector organization, is the federation of Swiss organic farmers, http://www.bio-suisse.ch (October 2016).
4. Birovljev, J., Vojinovic, Z., Balaban, M., *Potential of agricultural production and its impact on insurance premiums,* Economics of Agriculture, no. 3, 2015, pp. 705-723 (UDC: 631.1:368.171).
5. *Investment Program for Vegetable Production in Greenhouses*, Vegetable Gazette, num. 14, pp. 146, www.poljoberza.net/PG14_2.aspx (September 2016).
6. Leković, B., *Management:* Philosophy and Technology, Želnid, Belgrade, 1998, pp.161.
7. Mihailović, B., Savić, M., Katić, B., *Konsalting, održivi razvoj i organska proizvodnja: perspektiva Srbije*, Industrija, Economics Institute, Belgrade, vol. 35, Iss. 4, 2007, pp. 81-94.
8. Mitrović, M., *Modern Management*, Interview – Magazine "Profit", February 2009.
9. Novicki, M., Human Rights Monitoring: Monitoring of the observance of human rights, Civic Initiatives, association of citizens for democracy and civic education, Belgrade, 2004, pp.83.
10. O'Shaughnessy, J.P., *What works on Wall Street: a guide to the best-performing investment strategies of all time*, McGraw-Hill Professional, 2005, pp. 357.
11. Official Gazette of Republic of Serbia, no. 30/10.
12. Official Gazette of Republic of Serbia, no. 43/15.
13. *Organic producers in Europe 2011-2014*, http://www.organicdatanetwork.net (September 2016).
14. Ponisio, L., Kremen, C., *System-level approach needed to evaluate the transition to more sustainable agriculture*, Royal Society Publishing, 2016.
15. The Ministry of Agriculture, Forestry and Water Management of Serbia, http://www.minpolj.gov.rs (July 2016).
16. World Wide Opportunities on Organic Farms, http://www.woof.org (September 2016).

16 Critical factors for risk reduction in the Serbian agri-food sector[1]

Branko Mihailović, Predrag Vuković
the Institute of Agricultural Economics, Belgrade, Serbia
brankomih@neobee.net, predrag_v@iep.bg.ac.rs

Abstract

Climate change and uncertainties related to energy sector in terms of the high degree of globalization of markets can in a relatively short period of time cause a significant change in demand, scope and structure of agricultural production, causing both price volatility and threaten food security. The lack of predictability in the business of agri-food sector is conditioned by the lack of long-term contractual relationship between the food industry and manufacturers of raw materials, as well as lack of market integration, primary agricultural production and industry that the benefits for their input just agricultural products. Accordingly, the article analyses the key risks to which the group is exposed to the agri-food sector in Serbia. It is primarily about: institutional, financial, market, technical and operational risk. In article is shown the risk matrix in which are listed the specific risk events and their potential effects, the probability of the event, as well as the proposal of some of the key measures to overcome them.

Keywords: risks, competition, critical factors, the agri-food sector

JEL Classification: D81, Q12, Q14

16.1. Introduction

To organize business environment for agricultural producers, companies, associations and other interested parties, in fact means, way to organize individual institutions, their relationships on market principles, and all these relations regulate in a consistent system. The condition for this is to organize and functions of the state on a modern way, in terms of stimulating, development-oriented factors of the economy.

It should be noted that the macroeconomic environment is so organized that works in harmonious interaction of individuals and institutions. In this context should function individuals with new rights and obligations, with the new own im-

[1] The paper is a part of the research at the project 46006 "*Sustainable agriculture and rural development in terms of the Republic of Serbia strategic goals realization within the Danube Region"*, financing by the Ministry of Education, Science and Technological Development of the Republic of Serbia in the period of 2011-2016.

age. The same applies for all institutions, which along with the new rules must have individuals and groups with clearly defined roles.

Serbia has great potential in the agricultural sector, which is not fully utilized [Simonović et al., 2012]. With adequate strategic planning and risk reduction, agriculture can make a major contribution to the economic development of the country. This is because of its connections with and influence on other sectors, which is extremely important for the development of Serbia, due to the fact that it employs, directly or indirectly, a large number of people involved in significant work in foreign trade, ensure food security for citizens, contributes to rural development and ecological balance.

Realization of agricultural competitiveness requires from macroeconomic management to change the basic elements of agricultural development strategies, primarily in the direction of creating a sustainable agricultural system, which leads to the growth of knowledge and innovation, as well as in the direction of market development and agricultural chain products. Namely, agricultural production in Serbia insufficiently fulfils the requirements of the market in terms of quality, price, range, delivery of products and organic production standards. Low capacity utilization and the inability to product placement are result of the business philosophy, which is the production of an end in itself, where the ecological aspect of production was relegated to the background. This attitude towards the economy led to higher inventories, which were further maximizing already high production costs [Mihailović, 2007].

At the same time, the necessary business decisions were not made on time; technology, labour and production discipline were not at a satisfactory level. The condition for achieving sustainable development is the introduction of automation, flexible manufacturing system, achieving high-quality products, revitalization funds for the work, which should contribute to reducing the risks in agri-food sector in Serbia.

16.2. Factors having positive and negative impact on the flow of agricultural development in Serbia

Agriculture is one of the pillars of economic development of the Republic of Serbia, and its importance to the national economy, in addition to economic has also and social and environmental component. The main characteristic of changes in the agrarian structure of Serbia during the transition is that they take place between the conversion of state / public property into private (investors bought large estates with infrastructure, equipment and facilities), while the turnover of land between private owners was not significant (private property was not subject to major transactions involving large, external capital accumulated outside agriculture).

At this point we will give an overview of the basic parameters that have decisive influence or which in the future could affect the flows (both positive and negative) of agricultural development in the Republic of Serbia. The following lists represent the most important factors of positive impact on flows of agricultural development:

1. *Favourable natural resources (location, soil).* The Republic of Serbia has favourable natural conditions for the development of a variety of agricultural production, because it is located in the most suitable area of north latitude. Along with climate, soil is the most important natural condition for the development and arrangement of agriculture. According to the Statistical Office of Serbia agricultural land makes 65.6% of the territory of Serbia [Republic Statistical Office, 2013]. The Republic of Serbia possesses 5,346,597 ha of land (agricultural, forest, other land), or 3,437,423 ha of utilized agricultural land (0.48 ha utilized agricultural land per capita) [Republic Statistical Office, 2012]. Even 73% of utilized agricultural land makes arable land and gardens (more precisely 2,513,154 hectares).
2. The Republic of Serbia possesses sufficient quantities of water to meet their needs, but only if it is used on rational way and protected against possible accidental or deliberate pollution. Significant wealth represents mineral and thermal mineral water, whose variety of physical and chemical characteristics put in order of the places with the richest areas in the European continent. From all available water less than 8% originated from national territory, while the remaining 92% of the transit of water. In such conditions cooperation with countries in the Danube basin receives great importance, as well as developing regional cooperation in the field of management of water resources [Mihailović et al., 2014b].
3. Numerous free trade agreements (especially the CEFTA agreement, preferential exports to the EU market, free trade agreement with the Russian Federation, the General System of Preferences with the United States), the Republic of Serbia has created favourable conditions for foreign trade in goods in the field of agri-food sector. These agreements provide a chance to domestic producers and exporters to the market several times larger than the domestic, overcome the problem of small markets and to increase capacity utilization, with the exercise price competitiveness and increase product quality.
4. Certain number of companies is located at the top of the technical equipment and has highly educated personnel, while other companies are lagging behind the modern technological and marketing requirements. Since the beginning of privatization process, most of investment are recognized in the oil industry, beer, milk, confectionery products and in industrial water treatment, on

the other hand less investment and less technological equipment are recognized in the industry for the processing of sugar, meat, fruits and vegetables.

Factors of negative impact on the flow of agricultural development:

1. As a result of the uncontrolled use of chemicals most of the arable soil is acidic and in Vojvodina is salted. Consequently, there exist need for implementation of agrotechnical measures in order to improve soil structure – calcification, greater use of organic fertilizers etc.
2. Water regime, although it is favourable but is not sufficiently utilized. River flows are little use for irrigation. Irrigated areas on farms of agricultural holdings (family farms, legal entities and entrepreneurs) covered 99,773 ha, which represent 2.9% of using agricultural plots [Agriculture Census, 2012]. Consequently, agricultural production depends on rainfall, which are, depending on atmospheric processes and relief characteristics – unevenly distributed in time and space.
3. The ownership structure of agricultural land makes small and fragmented agricultural holding (used agricultural land per farm amounts to 5.44 ha) [Agriculture Census, 2012].
4. There is a relatively low capacity utilization of the food industry.
5. The basic limiting factors for greater and more effective involvement of the food industry in the international market are the following: insufficient range of food products in relation to the offer in the developed world; fluctuations in market quality products, either due to lack of standards, either because of non-compliance and poor control of applicable standards; lack of long-term and solid contractual relations or proprietary connection between the food industry and primary agricultural production;
6. Trade liberalization and the reduction of tariff protection (in the framework of the WTO and the Stabilization and Association Agreement);
7. Low competitiveness and innovation of agricultural producers in Serbia. It is necessary to involve small-scale producers in modern market chain, because they are not sufficiently competitive, traded in the informal channels, and their cost of implementation of the standard is high.
8. Areas of primary agriculture and food industry for greater investment are not attractive. Reasons are: institutions are not still developed; institution of negative/non-stimulating business environment; high investment and political risk; high capital costs; the presence of a large number of cost; and many other factors.
9. Changes in customers' behaviour, in their demand or habits and cause changes in the functioning of market chains. It is expected that when the ongoing global crisis these changes are even more pronounced [USAID, 2009].

16.3. Institutional risks in the agri-food sector in Serbia

There are different perceptions of risk. Primarily, it should be known the main factor of risk insurance, something without insurance could not exist. The risk could be defined as the threat of occurrence of economic or social damage events that include insurer obligation to pay damage or payment of the sum insured in accordance with the terms of insurance [Petrevska et al. 2010]. Table 1 shows the risk matrix in the agri-food sector in the Republic of Serbia. Below are analysed institutional risks that affect just the performance of the agri-food sector in Serbia.

1) Unpredictable agricultural policy. One of the main characteristics of agricultural policy in the past is its unpredictability. Inconsistency in the formulation and implementation of agricultural policy in the past has caused many consequences, such as: (1) reduction of investment and productivity in the agricultural sector; (2) non-market spillovers profit between economic actors in the supply chain; (3) the slow adjustment of food safety standards.

Measures to overcome the risks. In the coming period are evident need to adopt new laws and by-laws and regulations in the field of agriculture, the application of existing laws, as well as for the further development of an institutional framework, primarily through reform the Directorate for Commodity Reserves, through the establishment of appropriate laboratory and inspection organizations (in accordance with EU standards), through reforming the system of advising, supporting institutions, etc. Institutional support to the country (administrative simplification) is necessary and in the field to facilitate and expedite the construction of the necessary infrastructure for agriculture.

2) Insufficient use of the program to support rural development. The programs to support rural development can have significant effects if they are aimed to increase the competitiveness and innovation of agricultural production, increase employment in rural areas, improvement of the environment and quality of life in rural areas.

Measures to overcome the risks. Rural social capital and stimulation of the involvement of citizens in decision-making processes at the local level – must be encouraged more information and educating the rural population about their role and importance in the process of creating public-private partnerships, local action groups (LAG) and the like. Especially important is good cooperation of the population / stakeholders with local authorities on issues of rural development and agriculture, as well as with non-governmental sector in joint implementation of various activities. Integrative approaches to local development are very useful, especially in terms of building local capacity and help

government agencies and Ministry of Agriculture and Environmental Protection of the Republic of Serbia in the direction and control of state aid / support.

3) Insufficient development of institutional support and the legislative framework. Insufficient development of institutional support and the legislative framework is reflected in non-reformed Directorate for Commodity Reserves, Advisory services and water management organizations which still operate as state-owned enterprises. Actual situation is aggravated because it is not implemented the reform of scientific institutions supporting agriculture. On the other hand, chambers of commerce, cooperative unions and professional organizations, due to the reluctance to carry out internal reforms, still do not represent the holders of agricultural development. However, in this period was formed several major state institutions: the General Inspectorate for the Veterinary Administration; plant protection; water; forests; land; agricultural payments; established a Register of agricultural holdings.

Measures to overcome the risks. In order to approach extension service needs of agriculture it is necessary to decentralize and networking consulting work. Support for these process should be decentralization of the advisory bodies of individual ministries, which would create conditions for more adequate answers to the needs of individual farms and agricultural enterprises, and the possibility of a partnership approach to solving business problems. Also, in order to allocate resources efficiently, requires regional exchanges of consultants, including networking consulting work. Agricultural companies and manufacturers are insufficiently informed about the role and importance of counselling services and the education of people, in this sense, is not enough.

4) Undeveloped business infrastructure. Building integrated business infrastructure in order to stimulate investment activity, attracting foreign and domestic investment and increase employment.

Measures to overcome the risks. Industrial zones and parks are successful and efficient mechanisms for the promotion of industrial development. Projects balanced development of business infrastructure to consolidate resources in terms of business infrastructure so that they are balanced and do not compete with each other, but, rather, supplemented by offering facilities that are complementary with other industrial logistics centres.

Table 1. Risk matrix in the agri-food sector in Serbia

Institutional risks		
Risks	**Influence**	**Measures to overcome risks**
Unpredictable agricultural policy	− Impact assessment: average − Probability: medium	New laws and by-laws and regulations in the field of agriculture.
Insufficient utilization of support program for rural development	– Impact Assessment: High – Probability: Medium	Rural social capital and stimulating involvement of citizens in decision-making processes at the local level.
Insufficient development of institutional support and legislative framework	− Impact assessment: average − Probability: medium	In order to approach extension service to requirements of agriculture, it is necessary to decentralize and networking advisory work.
Undeveloped business infrastructure	− Impact assessment: average − Probability: medium	Industrial zones and parks are successful and efficient mechanisms for the promotion of industrial development.
Financial risks		
Risks	**Influence**	**Measures to overcome risks**
Rural poverty	– *Impact assessment: average* – *Probability: medium*	The active role of the state in terms of adoption and application of the law; direct financial support, advice and logistic role of the state.
Unfavourable long-term loans for the purchase of new agricultural machinery and equipment	– Impact Assessment: High – Probability: Medium	Collecting of documents of the applicant and its processing etc.
Unfavourable short-term loans for export financing	– Impact Assessment: High – Probability: Medium	Approval of loans for financing working capital for production and exports of goods and services of domestic origin.
Investment risk	– *Impact assessment: average* – *Probability: medium*	Reducing investment risk through diversification of funding sources.
The global financial crisis	– Impact Assessment: High – Probability: Medium	To encourage the development of new processing capacity according to available strategic raw materials and market requirements etc.
Market risks		
Risks	**Influence**	**Measures to overcome risks**
Insufficient quality of the labour force in the rural labour market	– *Impact assessment: average* – *Probability: medium*	Improving knowledge and skills of the population in rural areas.
Delayed restructuring of agricultural companies	– Impact assessment: average – The probability: high	Restructuring of agricultural enterprises must be made in the direction of the end of the process of ownership restructuring, and then the market etc.

Table 1 (cont.)

Low utilization of processing capacities	– *Impact assessment: average* – *Probability: medium*	Expanding the assortment of food products, standardize the quality of products and others.
Changes in customer requirements	– Impact Assessment: High – Probability: Medium	The development of the food industry that is focused on meeting the needs and desires of consumers, with an emphasis on innovation, quality and the like.
Lack of modern market chains	– Impact Assessment: High – Probability: Medium	It is necessary to involve small-scale producers in modern market chain, enhance competitiveness at the level of processing facilities.
Technical risks		
Risks	**Influence**	**Measures to overcome risks**
Technical and technological backwardness of agriculture	– Impact Assessment: High – Probability: Medium	Investments in the modernization of agriculture, which would contribute to its greater competitiveness on the world market.
Environmental pollution	– *Impact assessment: average* – *Probability: medium*	It is necessary to pass to the technology in agricultural production that are friendly to the environment etc.
Production risks		
Risks	**Influence**	**Measures to overcome risks**
Floods and droughts	– *Impact Assessment: High* – *Probability: High*	The introduction of irrigation systems and drainage systems.
Hail (storm) and frost	– *Impact Assessment: High* – *Probability: Medium*	Modernization of the anti-hail protection and development of varieties tolerant to adverse climatic conditions.
Pests in the form of plant and animal diseases	– *Impact assessment: average* – *Probability: medium*	The development of varieties tolerant to diseases and pests

Source: authors' estimate.

16.4. Financial risks

Most people are risk averse, which can be interpreted so that people do not like bad things, but they love the good things, and this is a behavior that is characterized by an aversion to uncertainty [Latham and White, 1994]. Unfortunately, financing of agricultural production in Serbia, as its yields and associated high financial risks.

1) Rural poverty. Serbian rural areas cover 85% of territory, with 55% of the population, and form 41% of the country's GDP [Bogdanov, 2007]. Poverty of rural areas is closely linked to great dependency rural economy from agriculture. From the point of poverty, especially the vulnerable categories of farms small and medium size (the farm holdings which have 5 ha), which deals only in

agriculture, but this category is the most numerous. These households are exposed to high income and market risk due to: the growing competition in the domestic and foreign markets; small taking a loan and investment; reduced job opportunities outside of agriculture; the devastation of the area and the lack of institutional support. Also, the socially vulnerable category includes elderly people and pensioners, women, youth, internally displaced persons.

Measures to overcome the risks. Although the association of farmers can reduce the high rural poverty, and improve the productivity and competitiveness of farmers, without the active role of the state in terms of adoption and application of the law (which regulate the field of primary agricultural production, trade, credit, financing, merger), and without direct financial support and advisory and logistical role of the state – It cannot be expected positive effects of the merger.

2) Adverse long-term loans for the purchase of new agricultural machinery and equipment. Creating conditions for easier access to credit lines to banks under more favourable conditions than the market, farmers who are holders of registered family farms acquired a new agricultural machinery and equipment.

Measures to overcome the risks. Informing potential beneficiaries through:

- Presentation for associations of agricultural producers;
- Delivery of promotional material of local economic development to local administrations;
- Promoting vacancy in professional journals;
- The collection of documents of the applicant and its processing.

3) The unfavourable short-term loans to finance exports. Ensuring financial assets to support the preparation and implementation of export programs, employment, increase exports, increase profitability, increase competitiveness.

Measures to overcome the risks. Approval of loans to finance working capital for production and exports of goods and services of domestic origin, with a repayment period of up to 180 days, and in accordance with the terms of the individual competition.

4) Investment risk. For example, investments in infrastructure and irrigation equipment are significant, in some cases, per unit of area is the very high, and it is necessary to orientate towards a market economy and competitiveness of agricultural production. For irrigation is necessary to choose the very income plant, which can pay off expensive irrigation practices. Drip irrigation system ("*drop by drop*") is only suitable for very intensive and income plant species, which cannot pay the high costs of construction, operation and maintenance of this system.

Measures to overcome the risks. Reducing investment risk can be achieved through diversification of funding sources. For example, the sources of funding for the construction of an integrated water supply system of Srem areas can be, among other things:[2]

- The assets obtained from the Development Fund of Abu Dhabi (the funds are intended for irrigation projects);
- Potential loan assets from the Kuwait Development Fund, the Development Fund Emirates, etc.;
- Donor/credit funds and funds of the European Union.

Loan funds of international financial institutions, such as: the World Bank, International Bank for Reconstruction and Development (IBRD), International Finance Corporation (IFC), European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD).

5) The global financial crisis. Lack of investment capital will cause adverse trends in the agricultural sector in Serbia, which is sublimated can be summarized as follows: reduced predictability of business due to the difficulty in maintaining macroeconomic stability; increasing the cost of capital; dinar depreciation increases the purchase price of the agricultural production inputs and deteriorating creditworthiness of farmers; reduced purchasing power of the population affected by the decline in demand; insufficient funds at EU and national level can lead to an increase in the tax burden, but also the abolition or reduction of agricultural subsidies.

Measures to overcome the risks. In such circumstances, increase the pressures of foreign producers to sell products on the Serbian market, while it is difficult placement of Serbian goods abroad, and this raises the issue of lack of competitiveness of Serbian agriculture. Accordingly, it is necessary to:

- improve the marketing activities for agricultural and food products in order to gain new markets or return to some of our traditional markets;
- support the development of brands in the food industry;
- encourage the development of new processing facilities available to strategic raw materials and market demands;
- encourage and support investments towards increasing the number of small and medium enterprises with a market propulsive export programs and production.

[2] Previous feasibility study of the general project of the regional water supply system Srem with previous feasibility study, Belgrade Banking Academy, to the Institute of Economic Sciences, Institute of Agricultural Economics, Konzit, Belgrade, 2014.

16.5. Market risks

In order to reduce risk and uncertainty in the agri-food sector in Serbia, it is necessary to have adequate information about the changes which happens in the environment, especially in the market. Market risk cannot be eliminated, but through market research it can be significantly realize reduced [Mihailović, 2007]. There are many agricultural companies in Serbia which are considered to have fully mastered the business and to know the market. However, a growing number of enterprises, agricultural producers and agricultural associations engaged consulting companies, marketing agencies, institutes and other independent advisors to solve business problems. The main market risks in the agri-food sector of Serbia are given below.

1) Insufficient quality of the labour force in the rural labour market. The quality of the workforce is one of the limiting factors of economic development in rural areas, because investors "bypass" the city that does not offer high-quality and skilled workforce. On the other hand, more educated populations are difficult to retain in rural areas with no attractive economic environment and jobs appropriate for their specific needs and preferences.

Measures to overcome the risks. Improving knowledge and skills of the population in rural areas (knowledge of economics, marketing, management, information technology and use of the Internet, etc.) is a very important factor, as for agricultural production and for diversification of activities in non-agricultural sectors.

2) Delayed restructuring agricultural enterprises. The complex business systems in Serbian agriculture provide greater production, the application of scientific solutions, and technical and technological inventions. These systems have a larger number of organizational units, which are characterized by a relatively large extent autonomous business decisions. In doing so, these systems are composed of a number of specific economic entities, companies that have special legal and economic status.

Measures to overcome the risks. Restructuring in our conditions, shall cover all areas of functioning of agricultural enterprises and the result is a delayed reaction and adaptation to changes. Restructuring of agricultural enterprises must be made in the direction of:

- completion process of the ownership restructuring and privatization of agricultural enterprises;
- market restructuring which represents a redefinition of the market in which the company performs with the aim to improve sales and business operations;
- organizational restructuring and changes in the organizational model and the concept of enterprise operation;

- business restructuring that should result in significant changes in the affairs of the agricultural company;
- financial restructuring that involves a change in the capital structure of the company, which is changing the relationship between ownership and debt.

3) Low utilization of processing capacities. There is a relatively low capacity utilization of the food industry (capacity utilization, which are designed for the market of the former Yugoslavia, ranges from 30% to 50%). The highest level of use there is at capacity for the production of mineral water, oil refineries, mills, capacity for fruit and vegetables, confectionery products, breweries, dairy and sugar refineries. The lowest level of use is the capacity for processing animal feed and slaughter houses, causing inefficiencies in operations and weak competitiveness of the sector.

Measures to overcome the risks. Factors for greater and more effective involvement of the food industry in the international market, thereby increasing capacity utilization, are the following: (a) expanding the assortment of food products in relation to the offer in the developed world (not wide enough range of existing products, a small number of the introduction of a completely new products or improving existing products and processes, is a small degree of added value products through increasing role of knowledge, innovation, etc.); (b) standardization of product quality; (c) entering into long-term and solid contractual relations or proprietary connection between the food industry and manufacturers of raw materials (primary agricultural production).

4) Changes in customer requirements. Changes in customer requirements, their demand or habits and cause changes in the functioning of market chains. It is expected that under the ongoing global crisis, these changes are even more pronounced. Due to decreased demand in some markets, manufacturers must adapt its production to new requirements, traders need to find new markets and adapt to the new conditions of sale with a delay in payment, or to find a new point of sale or new sources of funding. In such circumstances, the goal is to reach marketing strategy to capitalize on the benefits on the basis of scale, synergies and external flexibility [Kotler, 2003].

Measures to overcome the risks. In the following period emphasis must be placed on the development of the food industry that is focused on meeting the needs and desires of consumers, with an emphasis on innovation, quality, high level of food hygiene and food safety standards. Development policy of the food industry must follow global economic trends (such as the concentration capacity and capital, the introduction of highly sophisticated technology), and in this process the role of the state is important, both from the standpoint of security and protection of competition and control of abuse of monopoly position, and from

the aspect of fiscal and investment support, especially small and medium processing capacities in the rural areas of the country.

5) Lack of modern market chains. The modern market chains in Serbia are not still built in appropriate way. In the area of primary production, there is present a high level of competition, while at the processing level is present small competition as a result of an unattractive area for investment because of undeveloped institutions; failure to fulfil a EU export standards for a large group of products; as well as unfamiliarity of real competitiveness due to high tariff protection [Cvijanović et al., 2009].

Measures to overcome the risks. It is necessary to involve small-scale producers in modern market chain, because they are not sufficiently competitive, traded in the informal channels, and their cost of implementation of the standard is high. Also, it is necessary to improve competitiveness at the level of processing capacity, which would thus find new markets and increase consumption. Due to decreased demand in some markets, producers must adapt its production to new requirements, traders need to find new markets and adapt to the new conditions of sale with a delay in payment, or to find a new point of sale or new sources of funding.

16.6. Technical risks

On the basis of the surveyed 154 companies (small, medium and large enterprises) in the whole of Serbia, the data indicate that in the food industry, the average age of machinery and equipment is 27.17 years.[3] In central Serbia, the average age of machinery and equipment in the food industry is also about 27 years. It is clear that without modern machinery goods produced in Serbia cannot reach high quality standards and be competitive on foreign markets.[4]

1) Technical and technological backwardness of agriculture. Constant technical and technological improvement of agriculture often supports the need for labour in many segments of the national industry; the results of agricultural production can be significantly enlarged with relatively small amounts of additional capital invested; Given that requires a relatively small investment, agricultural development can represent significant savings of human capital.

Measures to overcome the risks. Having regard to the obsolescence of the equipment used and technology solutions, or lack of equipment in primary agriculture (here are understood and irrigation systems), there is a need for significant capital investments in the modernization of agriculture, which would contribute to its greater competitiveness on the world market (especially the EU

[3] The Union of Employers of Serbia, 2010, p. 4.
[4] The Union of Employers of Serbia, 2010, p. 5.

market). It should be noted that the introduction of modern technology and production solutions in agricultural practices requires usually large and financially strong (commercial) farms.

2) Environmental pollution. One of the conditions for the sustainable use of resources is the monitoring of the environment and this can be achieved through the establishment of appropriate inspection services whose professional staff will be able to perform quality control of land and water resources. Coordinated actions of all services that are related to agriculture, starting from the national to the local level, it is possible to reduce the level of pollution originating from agriculture. In this way the state of the environment would improve in areas that are involved in agriculture which would result in the production of healthier and safer food.

Measures to overcome the risks. In agricultural production it is necessary to transform on technology that are friendly to the environment. Also, through forming services for monitoring the condition of land and water resources gained to access to a quality of land / water. This service, in cooperation with other professional services on local or city level have a detailed insight into the quality of soil and water in the territory of their municipality and its order accordingly unable to plan all activities related to the further use of soil / water. Also, data service that could serve as a centre for informing the local population and all stakeholders on the environmental situation of the municipality in which they live.

16.7. Production risks

Agricultural production depends on biological processes affected by weather conditions, soil fertility, pests, diseases, etc. Consequently, in agricultural production in Serbia “uncertainty is the only certainty”. Production risk is significantly linked to agricultural production, in contrast to the production processes which are technologically determined and almost always create identical products. The entropy of the system in this production is the minimum and maximum predictability. In agricultural production is vice versa, because agriculture is under the influence of unfavourable factors that are very difficult to be controlled or avoided. It's about the bad weather, such as insufficient or too rich rainfall, hail (storm), cold, extreme low or high temperatures, pests in the form of plant and animal diseases, etc.

Measures to overcome the risk. The introduction systems for irrigation and drainage, modernization of anti-hail (storm) protection, the development of varieties plant tolerant to adverse climatic conditions, as well as the development of varieties plants tolerant to diseases and pests.

16.8. Networking scientific-research and consulting activities in the function of minimizing risk in agriculture

In economic theory, but in contemporary practice, it is well known: if the total capital, as production potential, conditionally divide to natural (Kp) and manmade – physical and intellectual (Kh); it is necessary that the total stock of capital (Kp + Kh) not decline during doglednog time [Milanović et al., 2008]. The obvious prerequisite for this is to ensure a certain degree of substitution between different forms of capital, i.e. inevitably reduce natural capital is replaced by increasing the available human, and primarily intellectual capital. It is, therefore, only achieved by increasing the application of already acquired and new knowledge and the best of modern manufacturing practices, i.e. the use of resources overall scientific and technical and cultural potential.

A substantial contribution to the major role in meeting this important conditions precisely belongs to science, art, or the appropriate network institute that would provide the necessary support to enterprises in the management of the transformation process. Over time, the institutes in Serbia have adjusted their activities and went to meet the needs of the economy.

According to some estimates, in the financing of research projects in Serbia the state accounts for 70% and the private sector with 30%; In developed countries the situation is inverse: the country accounts for 30% and the private sector with 70%. In such circumstances it is necessary to stimulate meaningful partnership between the public and private sectors, primarily in the form of: 1) intrasectoral mobility of researchers; 2) intersectoral mobility of researchers. Namely, in solving business problems interdisciplinary approach is necessary, as they often occur unstructured business problems for which they cannot apply simple solutions. Also, the results of empirical research show that it is necessary to do two things: a) decentralization of consulting work, and b) networking of research organizations.

Analysis of demand for consulting services in agro-complex indicates that the most engaging are private consulting organizations (70%), and scientific research organizations (20%) [Mihailović, 2011]. The most important criteria for the selection of consultants are business integrity and professional competence [Mihailović et al., 2014a]. The offer consultancy services of research organizations can be based on contingent approach, with maximum adaptation to market requirements. The selection of consulting services that would be the focus of business deals institutes in Serbia can be customized aspects of which are given below.

- The results of empirical research show that in the area of operational management in companies of agro-complex greatest demand in the area: production consulting, standardization of production and creation of business plans;

in the field of corporate strategy significantly the share of marketing research and strategic planning [Mihailović, 2011]. Accordingly, it could be enforced short-term adjustment of consulting business offers services with special attention would be given to consulting in the implementation of certain standards in production.

- Long term adjustment would be made in accordance with the experience of some countries that have had at the stage of EU accession and after accession phase. Past experience indicates that certain sectors are potential winners after joining the EU. Potential winners are: tourism, transport, construction, financial services and consulting services in the field of environmental protection. Traditional manufacturing industry is essential modernization and introduction to marketing logic. Consulting services connected with ecology and environment requirements are relatively new issue, but it is believed that in the future this segment of the market of consulting services will have a greater significance. In support of this conclusion is the fact that this sector is stronger in many countries that have joined the EU. What is certain is that these services are interdisciplinary.
- Development of consultancy services in the field of environmental protection is under the influence of Serbia's accession to the European Union. The EU market accounts for about 500 million customers. Accessing this market imposes harsher operating conditions that are reflected in tougher competition and a number of regulations in the field of environmental protection, protection of producers and consumers, etc., and it is inevitably to adapt to these trends.
- In line with this business environment, and bearing in mind the current business of institutes in Serbia, it would be useful to require specific organizational and personnel adjustment: eventually formation a sector of consulting; training of individual employees for the introduction of certain standards in production, in order to have certified researchers and consultants in this field; stimulating networking with other scientific research organizations and private consultancies.
- In the field of environmental management, there are at least three types of consulting projects that may be included in the job offer: (1) diagnosis of the environmental conditions, corporate social responsibility and sustainable development; (2) education and implementation of standards for organic production; (3) interrupting production and technology. The offer of consulting organization depends on the needs, i.e. market demand for consulting services. At the same time, the offer is conditional on human potential of consulting organizations. The most important are the experience and expertise

of consultants who make it possible to meet the demands of clients on the issue of environmental management.

- At the same time, it is important to emphasize the necessity of increasing specialization of consultants for specific areas. Specifically, in order to meet the standards of organic production, it is necessary that consultants have a new highly specialized knowledge. Ideal for consultants (the so-called CMC – "Subject Matter Specialist") involves knowledge of specific areas such as socio-economic consulting, environmental consulting, as well as the introduction of new regulations and standards in the EU. Consequently, the assumption of a successful consulting includes the continuing education consultants and exchange business experience and innovation through consulting associations.

16.9. Associating of farmers as a response to increased risks in the agri-food sector in Serbia

Associating or through modern terminology speaking networking, is being widely spread in the world trend. The aim of association is a synergy that contributes to the networked actors better use of individual performance in the market. Global business networking has become a contemporary strategic need, a new model of entrepreneurial behaviour and global megatrend, which is just based on the search key competence of the company and the efficiency of organizational and procedural networks, and consists in creating a flexible, synergistic and competitive organizational structure [Drasković, 2004].

The key objective of the network business connections consists in the realization of its useful economic and organizational effects (direct and indirect). It is in the literature explains over its fundamental principles of formation and functional specifics of existence, which is reflected in the dynamic tendency of organizational development, continuous expansion and development in order to achieve better positioning and greater success in the market.

Practice has shown that through networking organizational structure, business processes, scientific research and so on, comes to the key knowledge, skills and other benefits that are on the market valorised as competitive. Networked partners in business processes is increasingly common use their core competencies in order to faster, cheaper, more flexible, better quality and greater results, which creates a competitive advantage in the global marketplace. Accordingly, below are some models of networking contributing to the spread of innovation and risk reduction in the agri-food sector in Serbia.

The formation of cooperatives of agricultural producers in the principles of modern cooperatives, creates the necessary conditions to achieve satisfactory production and economic results. This concept can be applied to the formation

of an entire production chain, from primary production, through obtaining a number of semi-finished products, to the highest level of finalization. Cooperatives of agricultural producers, built on the principles of modern cooperatives, can be seen as a business system – company, with all of its business functions, which would be implemented through a service or employees of relevant specialists. Producers would enter subject of works, tools and their own labour; on the other hand cooperatives would provide all other services which are necessary for successful functioning of production: commercial – procurement of raw materials, product sales, marketing; financial – the provision of loans for fixed assets, the provision of loans for working capital; accounting – keeping accounting records for the farm; logistics – warehousing, transportation, distribution.

From the standpoint of available resources, organization, technology and management, it is assumed that the cooperative is much functional in relation to family farms. From the above mentioned reasons, observation of cooperatives of agricultural producers with this aspect would be significant, both in the theoretical and in practical terms for planning and organization in a variety of conditions making. For example, the organizational model of cooperatives of agricultural producers should be designed so that producers did not transport fruit to the buying centres, but it submitted them directly from the plot. This concept requires finding the optimal program transport fruit, with clearly defined levels, from a number of starting places to destination. The final destination may be controlled, some processing facilities or shopping centres. Number of starting places will depend on the number of fruit producers who are members of cooperatives, as well as the number and location of their plantations. By the optimal program of transport, which will enable the efficient transport and distribution of products, with the rational use of means of transport and the lowest transportation costs, could be reached by the methods of linear programming [Dimitrijević et al., 2006].

Clusters can be defined as a critical mass of companies and institutions in one place, an unusual competitive success in certain fields [Porter, 1998]. According to Porter, a strong competitive advantage in the global economy lie mainly in local things – knowledge, relationships, motivation – differences that competitors cannot easily copy, which can best be developed through clusters [Porter, 1998]. Cluster associating characterized by cooperation and connections (unification and complementarity) of members, their geographical or local limiting, active channels for business transactions and communications, creation of joint products and/or services or joint resolution of some need or objective.

The main factors in development of clusters should be companies which participate in them. Only through their active participation, the cluster will strengthen and develop. Educational institutions also play a role, and in some cas-

es have proven to be an important catalyst in the development of clusters. Colleges can have an educational role, but can also be the key factors in research and development and innovation in the single clusters. Also, part of the cluster represent organizations for provision of business services with expertise who can be responding for needs of clusters such as marketing, consulting, etc. organizations. All these bodies can contribute to the strengthening and development of a cluster can have a legitimate role in its development. Finally, local authorities, regional development agencies and other corporate bodies have a significant role in the promotion of cluster development through interventions, strategic guidance, grants, creation of favourable conditions for the development, organization of seminars in the regions, reducing the risk of entering the job or when taking loans, etc. In most cases, clustering along the line of "bottom-up" leads to the so-called quasi clusters, namely associations, which in the future have a perspective to become clusters. Worth highlighting the following "clusters", namely associations, formed at the initiative of members, not for obtaining state subsidies, but to companies within the cluster strengthen its position in the market [Mihailović et al., 2007]: Association of Fruitland, Cluster of farmers in Kraljevo, "Rakovica agriculture cluster", Begečka Vegetable Association.

Business incubators are instruments of local economic development to support the newly established small businesses in the early years of their growth and development when they are most vulnerable [Danilović Grković, 2005]. Namely, in the initial stage of the creation of new small businesses they minimize the ignorance and lack of experience in management, accounting, market knowledge and conducting business; these functions are integrated through a common hosting service and occasionally consultants provide such activities for all companies in the hall – incubator of new enterprises. According to the same source, the most important services they provide facilities for incubation include organized access to expertise, experiences, advisory services, advice and mentoring in key business networks and groups is also an important element of these capacities. Offer of physical premises and these services to entrepreneurs increases the likelihood of success of the company in relation to the company that operates independently: research at EU level shows that the mortality rate (in the first five years of operation) of companies that have their business started in the business incubator is less than 15%, unlike other companies, where it is known that the mortality rate as high as 50%. The incubator operates as a capacity in which companies enter and exit, or stay in the incubator companies is limited (usually 3 years).

Contracting community farmers – it usually combine several farmers (4-5), inside or outside the cooperatives to their farms to be able to rationally make use of agricultural machinery. However, in Serbia to this contractual community should

be much higher by the farmer, should go to the exploitation of more powerful tractors and corresponding machine, but in the present size of our family farms. In addition, when joining larger farms, can be used more powerful tractors within each individual farms, because the plots have sufficient size (5-10 ha). With that in mind, here should be to seek appropriate solutions through a special performance for land consolidation. In addition to the grouping of land ownership, land consolidation should be characterized by the same grouping of land utilization methods. Joining farmers to monitor association plots. By combining farmers makes it easier to perform tasks with the help of machines and reduce the costs of production, because the machines fully exploit the larger surface area of associated farmers.

Contracting Community of Fruit Growers, winegrowers and other users for the time being. These communities usually formed cooperative or producers outside the cooperative, which in certain favourable locations have their own plots, and are willing to switch to the advantages of large (plantation) production [Mirić, 1994]. Plant was erected on the land of farmers as a single territory, regardless of the limits of individual parcels of farmers, which may or may not be marked, to indicate ownership of individuals. All activities and in raising and later in the exploitation, which can run mechanized, are performed in the plantation regardless of the limits of individual parcels. All handicrafts conducted individual on his land, or even better in his or her lines, that are defined distribution in proportion to the entered land. In distribution of the resulting product jointly participate according to involved work. The transition to a modern organized production break free members of cooperatives of many heavy handicrafts, while the secured placement of raw materials. Also, materials other than the production can still participate in the processing. Manufacturing Cooperative achieved thanks to these communities best supply sufficient quantities of raw materials required quality, with appropriate time-sharing and low-cost procurement and transportation.

The contracting community of livestock breeders – farmers can come together to jointly produce milk. Herd is size that can provides efficient operations. Such contractual community milk producers have significant advantages over the tendency with us to form a mini-farm in terms of small family farms. Instead of 3 cow house for a dozen cows, it's cheaper to raise a barn with 28-30 cows. Also, instead of three rooms with devices for cooling milk, raises one with better mechanized devices. In our case, each producer must every day perform tasks in the barn, which deters many to devote to the job. Without stating the other rationality in cow houses with larger capacity, in which members of the business community contracting milk producers can easily understand the advantage of contracting communities. It is natural that the community can be educated herders and livestock production lines in others [Mirić, 1994].

Associating according to the model of machinery rings – machinery rings are a special form of organization of farmers in countries with developed agriculture (mainly in Western Europe and Japan). The basic idea is to use the most rational and most productive agricultural machine. Such an approach to the problem of soil cultivation led to the separation of farmers in two basic categories. Those who receive the service and those who provide these services. Such division came to the service providers who are highly specialized only for specific operations, so that the quality of services at the highest level. In addition, the maximum exploitation of mechanization, so the price of the services provided is lower. On the other hand recipients can devote to other problems in its agricultural production (inputs, product placement) and not be burdened with their "unused" equipment. Taking into account the fragmentation of holdings in Serbia, as well as the dispersion of the necessary equipment and machinery, creating mechanical earrings would be achieved more efficient production due to more rational use of existing resources, where to simultaneously fulfil the economies of scale. In such conditions, the cooperative should be in their future work primarily oriented to the work related to the cooperative members. It is necessary for their activities in the future based on respect for the cooperative principles. Also, unions must be organizational restructure, expand membership, to formalize relations between the relevant normative acts and ensure their consistent implementation.

It is necessary that cooperative associations and cooperative unions, trains for cooperative revision to know-how to successfully sanction of previous and protect future negative phenomena such as for example, that only employees could be member of cooperative and that they only have right to managing with cooperative association; that the sale of property of the cooperative; that no procedure of the law on cooperatives, etc. On that way co-operative association could become organization of employee in truth sense of the word.

16.10. Conclusions

Reducing risks in the agri-food sector in Serbia can be achieved through networking of economic actors and ensuring a stimulating business environment, primarily through measures of agricultural and macroeconomic policy. In fact, with appropriate policies, which can cause an increase in productivity, agriculture of Serbia can build competitiveness and make a significant contribution to the economic development of the country.

Although in the field of systemic reforms have been lot done in the future is a key role of the state in creating a favourable and stimulating macroeconomic and business environment, which is the only basis for stimulating agricultural

policy, aimed at restructuring, market development and increase investment in the agricultural sector of Serbia.

Regulated state, developed market, financial, institutional and infrastructural base, is clear legislation and their effective implementation – today are the first and main preconditions to economic entities to compete in the market. In order to achieve the competitiveness of agriculture macroeconomic management must change the basic elements of agricultural development strategies, primarily in the direction of creating a sustainable agricultural system, whose growth leads innovation and knowledge, as well as in the direction of market development and agricultural chain products.

References

1. Bogdanov, N., *Small rural households in Serbia and rural non-farm economy*, UNDP, Belgrade, 2007.
2. Cvijanović, D., Mihailović, B., Simonović, Z., *The role and importance of marketing in the development of the agricultural sector of Serbia*, Monograph, Institute of Agricultural Economics, Belgrade, 2009.
3. Danilović Grković, G., Kovacević, B., Sedmak, A., Nedeljković, M., *The establishment of a business incubators of technical faculties in Belgrade*, XIII Telecommunications forum TELFOR 2005, Belgrade, Sava Center, 22.-24.11.2005.
4. Dimitrijević, B., Ceranić, S., Rajić, Z., Djurić, D., *The organizational model of association of fruit producers*, Economics of Agriculture, Special Issue (13-67), Belgrade, 2006, pp. 487-493.
5. Drasković, V., *Global business connections as a megatrend and new management strategies*, Economics of entrepreneurship, no. 2, 2004, pp. 126-129.
6. Drašković, M., *Process of clasterization as component of global competition*, Montenegrin Journal of Economics, no. 4, 2006, pp 165-173.
7. International Labour Organization (the Office for Central and Eastern Europe), *Consolidation of the legal and institutional basis for social dialogue in the Western Balkans and Moldova*, December 2010.
8. Kotler, P., *How to create, manage and dominate the market*, Adižes, Novi Sad, 2003.
9. Latham, G.P., White, G., *The Futility of Utility Analysis,* Personnel Psychology, no. 47, 1994, pp. 31-46.
10. Mihailović, B., Birmančević, B., Obradović, M., *The selection factors of consultants in Serbian agro-sector*, Economics of Agriculture, Year 61, no. 1 (1-268), 2014a, pp. 149-162.
11. Mihailović, B., Cvijanović, D., Milojević, I., Filipović, M., *The role of irrigation in development of agriculture in Srem District*, Economics of Agriculture, vol. LXI, no. 4 (829-1088), 2014b, pp. 989-1004.

12. Mihailović, B., *Development of consultancy services in Serbia and their impact on the performance of companies in agrocomplex*, Monograph, Institute of Agricultural Economics in Belgrade, 2011.
13. Mihailović, B., Paraušić, V., Simonović, Z., *Analysis of factors affecting the business environment in Serbia in the final stage of economic transition*, Monograph, Institute of Agricultural Economics, Belgrade, 2007.
14. Mihailović, B., *The role of consulting in process of restructuring companies in transition*, Monograph, Institute of Agricultural Economics, Belgrade, 2007, pp. 94.
15. Milanović, M., Stevanović, S., Đorović, M., *Development advantages and elements of the Belgrade agrarian-rural multifunctionality*, International Scientific Meeting: *Multifunctional Agriculture and Rural Development III – rural development and (un)limited resources*, Faculty of Agriculture in Zemun – Belgrade, Book 2, 4-5th December 2008, pp. 83-89.
16. Mirić, S., *Cooperative-production association of farmers – Anniversary of 100 years of agricultural cooperatives of Serbia*, Cooperative Union of Serbia, Belgrade, 1994.
17. Petrevska, M., Tuscany, B., Milos, D., *Ensuring crop production*, Belgrade, Beoknjiga, 2010.
18. Porter, M., *Clusters and the New Economics of Competition*, Harvard Business Review, November-December, 1998.
19. Republic Statistical Office (Republic of Serbia) *Agriculture Census 2012*, Book 1, 2012.
20. Republic Statistical Office, *Municipalities and regions in the Republic of Serbia 2012*, Statistical Office, Belgrade, Serbia, 2013.
21. Simonović, Z., Jelocnik, M., Vasić, Z., *Economic Position of Serbian Agriculture in the Period Transition*, Economics of Agriculture, no. 3, 2012, pp. 535-544.
22. USAID, *The impact of the global economic crisis on Serbian agriculture*, April-May 2009.

17 Structural changes and agri-environmental assessment of agriculture in Bulgaria[1]

Julia Doitchinova, Hristina Harizanova, Zornitsa Stoyanova
University of National and World Economy, Sofia, Bulgaria
juliadoj@abv.bg, h.harizanova@gmail.com, zori_stojanowa@yahoo.de

Abstract

The main aim of the paper is to analyse the effects of structural changes in the agri-environmental assessment of the Bulgarian agriculture. Authors propose recommendations and possibilities to reduce the adverse effects of the activity of farms. Evaluations show that the environment influences directly on the activity of grain producers. They consider that the problems with soil, loss of nutrients in the humus layer, deposition of deleterious substances into water will degrade the quality and quantity of their production. The implementation of restrictions as 5% environmental tax per tons of fuel, between 1 and 5% environmental tax on the use of pesticides and between 1% and 5% of the profit to be invested for research and development would have a strong negative impact on agricultural holdings in economical aspect and highly positive impact on environment. Implementation of integrated production, whose main element is integrated pest management. Use of biofuels that emit lower quantity of emissions and renewal of machinery will impact positively on air protection. In this regard, the state support is indispensable in the form of subsidies and credits for the purchase of new equipment and modernization of farms.

Keywords: structural changes, agri-environment state, Bulgarian agriculture

JEL Classification: Q10, Q15

17.1. Introduction

More than 25 years in Bulgarian agriculture is undergoing processes of continuous changes. They reflect into new structures (land, production and organizational) of the Bulgarian agriculture. These changes affect the quality parameters of the environment and the behaviour and decisions of farmers applied technologies for the cultivation of plants and animals.

Main aim of the paper is to analyse the effects of structural changes in the agri-environmental assessment of the Bulgarian agriculture. On this base are

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

proposed recommendations and possibilities to reduce the adverse effects of the activity of farms. The tasks are as follows:

- changes in production, land and organizational structures of the agriculture;
- agri-environmental assessment of the Bulgarian agriculture;
- evaluation of the possible farmers reaction to introduce environmentally friendly practices (analysis of results of empirical research);
- conclusions and recommendations for improving agri-environmental assessment.

Part of the research is to be traced out the changes in agriculture and farms during first programming period and how these changes reflect on the environment. By conducted survey are summarized possible reactions of farmers to introduce environmental friendly practices.

17.2. Literature review

Structural changes in agriculture and their impact on the efficiency and competitiveness of farms, farmers' incomes, rural development, the quality characteristics of the environment are the subject of research interest in recent decades. Some authors [Zimmermann and Heckelei, 2012] consider that agriculture is undergoing a progressive structural change with a decline in the number of farms. This farm structural change increases the productivity and efficiency of farming through the redistribution of land and labour and the realization of economies of scale. Mugera et al. [2011], Bojnec and Latruffe [2013] have examined the relationship between farm size, farm-level efficiency and productivity.

While the economic benefits from farm structural change are indisputable, there is still a strong attachment to a highly fragmented structure of family farms in the policy debate and it seems to be a little consensus about how much restructuring, rationalization and consequent decline in smaller farm employment is acceptable [Buckwell, 2015].

Balmann and Valentinov [2016] identify at least two major problems for the public debate on agricultural structural change. The first of them relates to the view „that farmers are often considered a disadvantaged group and that structural change affects particularly poor farmers negatively". A second type of issues on structural change are related to "criticisms about a tendency of moving away from peasant farming towards some kind of "factory farming". Boehlje [1999] coined the term "biological manufacturing". Agriculture is increasingly integrated into value chains in which key actors in the value chain like large retailers define how farmers have to produce. Both types of concerns are not new and often used as arguments in favour of political protection and regulation of the agricultural sector like in the EU Common Agricultural Policy (CAP).

The policy debate regarding farm size inequality is particularly intense in Eastern Europe, where financial investors have engaged in large-scale land deals, leading to concerns about further increases in land concentration with an associated detrimental impact on farming communities [Kay et al., 2015; Van der Ploeg et al., 2015].

Production structures engaged in agricultural activity and producing agricultural products are the result of a long evolutionary process, depending on the specific conditions existing in each country, it has different limits in time aspect [Boehlje, 1984].

17.3. Methodology

The territory of Bulgaria is divided into 28 districts and 264 municipalities divided into 6 regions. Among the main criteria for selecting the region to conduct research can state the following two types:

- Area where grain is the most widely practiced and occupies the largest share of the total UAA of the area.
- Area where grain is close to the national average.

The selection of the region is based on quota principle where is a sufficient information about major structural proportions in the gross up.

On the basis of statistical information for the area occupied by grain sector, the sample will be weighed according the area where is located the farm. On national average, grain production is around 50% of the total UAA. By these criteria, areas are divided into the following three groups:

- Grain sector with a share above the average for the country: North-west, North Central and North-East regions.
- Grain sector with a share about average – South-East region.
- Grain with a share below the national average: South Central and South-West region.

In the criteria for selection of area from the study are excluded South-West and South Central region, because their average cover is fewer than 50% of UAA with grain sector.

In each selected region, the main objective was to cover more than 5% of the areas by grain sector. The choice of areas is as follows:

- Northwest region: Tenant/land covered by Levski, Lovech, Montana and Pleven;
- North Central region: Tenant/land covered by V. Tarnovo and G. Oria-hovitsa;
- North-East region: Tenant/land covered by Dobrich, Tarhgovishte and Shumen;
- South-East region: Tenant/land covered by Karnobat, Nova Zagora, Sliven.

The study was organized by questionnaire with open and closed questions that supports interview with the owner / manager of the farm. The analysis is also based on expert opinion and branch organizations and state structures.

According to survey data is used for each question descriptive statistics which is the basis for an in-depth analysis for disclosure of the essential characteristics of farms in Bulgaria and their environment assessment. The date is distributed to a arithmetic average – this is the most commonly used average. It is a reflection of the whole complex of causes and conditions affecting a phenomenon. By arithmetical mean are summarized in a single number all observed values of the studied trait. Another method used for processing the data is factor analysis. A factor analysis is section of multivariate statistical analysis. It allows defining generalized criteria (factors), by several variables.

As well for the paper and conducting of agri-environmental assessment of the grain sector is based on qualitative indicators.

The research connected with environment assessment of grain sector is a part of a big survey which was conducted as a panel data in 2007 and 2015. The used data is from 2015, by specialized questionnaire dedicated to agri--environment assessment [Harizanova, 2015].

17.4. Structural changes of the Bulgarian agriculture

Within the first programming period of Bulgaria's membership in the EU, the economic importance of the agricultural sector in the Bulgarian economy has stabilized at 4.7-4.8%. The share of employees in total employment remained at 19%, 86.4% of the employed are self-employed.

Generally positive trend of growth of gross added value created in agriculture by 11%, while the value of production increased by 21% in 2014 compared to 2007. These results are mainly due to the serious increase of plant production (59%), reducing livestock (13%) and continuing the trend of reducing the proportion of livestock to 28.5% (Table 1).

In recent decades, plant is undergoing processes of limiting the number of crops. In 2015 – 77.9% of the arable land is dominantly cultivated by four crops. Many areas are transformed to monoculture agriculture.

The negative trend in the development of livestock is the tendency of reduction in the number of animals (Table 2).

The highest share of reduction is noted, during the research period, in number of goats (over 44%), pigs (over 30%), dairy cows (18%) and ewes (12%). Increase is observed only for the number of buffaloes (20%). Regardless of the increasing trend the average size of herds in all livestock, they are still significantly lower than in most of the EU countries [Hariznova, Metodieva and Metodiev, 2014]. The average herd size of dairy cows is 8.3 in ewes – 31 animals, in goats – 9.4, etc.

Table 1. Changes in sector agriculture (2014 compared to 2007)

Indicators	2007	2014	2014/2007
Share of GVA for sector "Agriculture, forestry and fishery" of the total GVA	4.7%	4.8%	2%
Employees in agriculture (thou.)	723.9	666.5	- 8%
Share of the employed in agriculture of the total employed	19,0%	19.0%	-
Share of the self-employed of the total employed in agriculture	89.8%	86.4%	- 3.4%
GVA for sector Agriculture, forestry and fishery (mln euro)	1443	1607	11%
Production from branch "Agriculture"(mln euro)	3315	4009	21%
Production from horticulture (mln euro)	1566	2485	59%
Production from livestock breeding (mln euro)	1246	1087	- 13%
Production of agricultural service (mln euro)	225	247	10%
Share of production from livestock breeding of the total agricultural production	41 %	28.5%	- 12.5%

Source: MAF 2007, 2014.

Table 2. Changes in the number of livestock

Years	Cattle	Dairy cows	Buffaloes	Pigs	Sheep/ewes	Goats
2007	602,056	335,886	8,968	888,609	1,526,392	495,484
2008	564,904	314,668	9,222	783,649	1,474,845	429,834
2009	539,555	296,757	8,311	729,798	1,400,252	360,822
2010	544,456	308,165	9,241	664,000	1,367,987	356,334
2011	557,641	306,843	9,887	608,266	1,454,617	341,362
2012	526,112	288,749	9,212	530,945	1,361,545	293,639
2013	575,584	307,097	9,964	586,418	1,369,578	289,308
2014	552,807	295,374	9,555	553,114	1,335,283	292,644
2015	550,201	276,160	10,843	600,068	1,331,894	276,919
2014/2007	-8.18	-12.06	6.55	-37.76	-12.52	-40.94
2015/2007	-8.61	-17.78	20.91	-32.47	-12.74	-44.11

Source: MAF 2007, 2014.

In Bulgaria, during the transition period is observed a decline in a total number of farms. This process continues after the country's accession to the European Union. Between 2007 and 2013 the numbers of farms declined with 48%. According to the data presented in Table 3 the reduction is mainly in landless farm groups and farms under 5 hectares of agricultural land. Liquidated farms are more than 230 000 farms (56% of the total), having land up to 2 hectares. The decline happened mainly because marginal reasons, and a lot of small scale and subsistence producers left the sector. Even the tendency there is still farms smaller than 10 hectares and they have share above 90% of total farm numbers.

In the holding over 5 ha is observed an increasing in the number, but most significant is the change in the group from 30 to 50 ha – 108.95%.

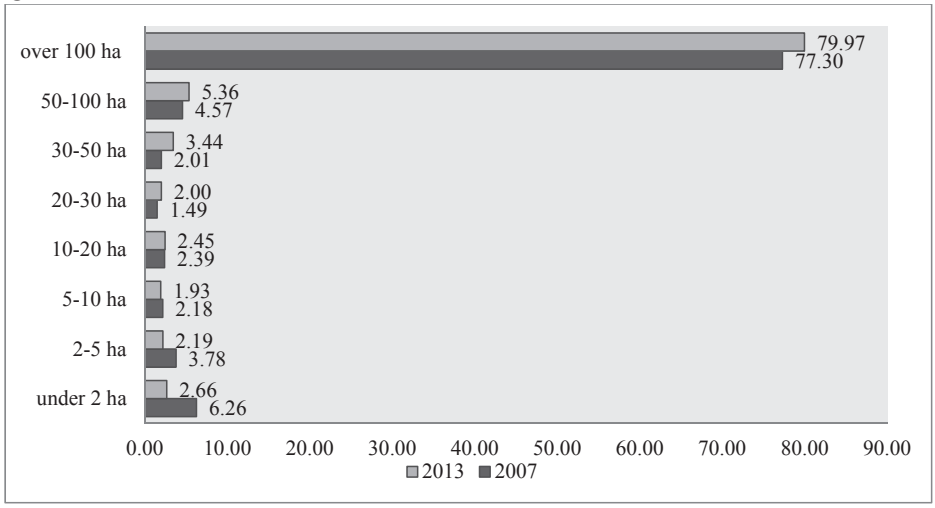
Table 3. Distribution of farms by used agricultural land

Agricultural area size classes	2007		2013		2013/2007
	Number of farms	Structure	Number of farms	Structure	Changes in the number
0 ha	11,212	2.27	9,549	3.76	-14.83
under 2 ha	417,385	84.64	183,643	72.26	-56.00
2-5 ha	39,244	7.96	27,808	10.94	-29.14
5-10 ha	10,061	2.04	10,881	4.28	8.15
10-20 ha	5,477	1.11	6,780	2.67	23.79
20-30 ha	1,936	0.39	3,211	1.26	65.86
30-50 ha	1,632	0.33	3,410	1.34	108.95
50-100 ha	1,968	0.40	2,959	1.16	50.36
over 100 ha	4,218	0.86	5,901	2.32	39.90
Total	493,133	100	254,142	100.00	-48.46

Source: MAF 2007, 2014.

Bulgarian agriculture is characterized by a dualistic structure of farms: on one hand small-scale (usually subsistence oriented) farms, and on the other large farms (agricultural enterprises). 80% of the used agricultural land is operated by 2.3 % of the farms (514 ha average farm size) and 87% of the farms cultivate 4.8% of the used agricultural land (Figure 1). The rented or used under rent agricultural land – in 2013 is around 83%.

Figure 1. Distribution share of farms and cultivated land 2007-2013



Source: MAF 2007, 2014 and own calculation.

According to Farm Accountancy Data Network occurred favourable changes in the productive and/ or economic results of the farms. Total production per hectare of crop and livestock unit increases respectively with 71.8% and 38.6%. The net added value per annual work unit increases with 85.3% (Table 4).

Table 4. Average economic indicators of agricultural holdings by years (2009-2012)

Indicators	Euro per hectare and AWU				%
	2009	2010	2011	2012	2012/2009
Total crops output/ ha	477.1	647.8	745.6	819.9	71.8
Total livestock output / LU	676.7	767.4	783.5	937.9	38.6
Net value added / AWU	4150.99	6255.53	6868.38	7691.95	85.30

Source: MAF, 2007, 2014.

17.5. Agri-environment state of agriculture

Agri-environment state of agriculture is of great importance to achieve sustainability in Bulgaria. At this stage the major weaknesses of the environmental perspective in the agricultural sector can be summarized as:

- Destruction and fragmentation of natural habitats;
- Change the way land use;
- Use of fertilizers and pesticides in agriculture;
- Intensive forestry logging, deforestation;
- Overexploitation of natural plant resources;
- Overgrazing or abandonment of pastures and meadows;
- Dissemination of invasive and introduced species;
- Reclamation, water use, adjusting the watercourses.

The air pollutants by share for 2014 are presented in Table 5. In Table 5 is visible that the agricultural activities are heaving the largest share of pollutions by ammonia and nitrous oxide. The dynamic between 2007 and 2014 are shown in Table 6.

During the studied years between 2007 and 2014 is observed a positive tendency of reducing the amount of realized in the atmosphere pollution in the air of agricultural activities.

The biggest reduction is observed by ammonia (-73% -2014/2007) and methane (53%). The other air pollutions are having mostly reduction line NMVOC (18%) and N_20 with 3%. NOx, CO and CO_2 during the observed period are increased average with 4%.

Table 5. Air pollutants by sectors in Bulgaria for 2014

Items	Fuel processes	Agriculture	Producing processes	Household combustion	Road transport	Other transport	Processing and storage of solid waste	Environment
Sulphur oxides (SOx)	75%	0%	22%	3%	0%	0%	0%	0%
Nitrogen oxides (NOx)	34%	3%	26%	3%	32%	2%	0%	0%
Non-methane volatile organic compounds (NMVOC)	0%	9%	6%	11%	5%	0%	0%	69%
Methane (CH_4)	0%	13%	64%	2%	0%	0%	20%	1%
Carbon monoxide (CO)	1%	1%	8%	60%	22%	0%	0%	8%
Carbon dioxide (CO_2)	63%	9%	8%	1%	16%	0%	0%	1%
Nitrous oxide (N2O)	18%	41%	0%	0%	1%	0%	0%	39%
Ammonia (NH3)	0%	87%	9%	0%	3%	0%	0%	0%

Source: NSI, 2016 and own calculation.

Table 6. Air pollutions of agricultural sector 2007-2014

Pollutants	2007	2012	2014
Sulphur oxides (SOx)	-	-	-
Nitrogen oxides (NOx)	3621	3538	3780
Non-methane volatile organic compounds (NMVOC)	28117	31039	23866
Methane (CH_4)	128969	89128	84166
Carbon monoxide (CO)	1883	1840	1966
Carbon dioxide (CO_2)	4344879	4246043	4535814
Nitrous oxide (N_2O)	15723	23765	15263
Ammonia (NH_3)	47967	34435	27792

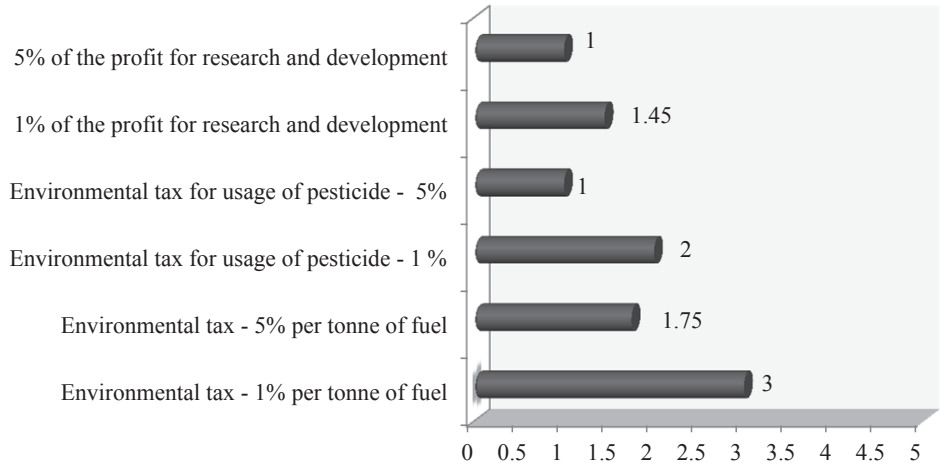
Source: NSI, 2016 and own calculation.

All of the negative impact of the agricultural sector over environment is as well common for the grain sector. The characteristic of a grain sector has of all negative traits (except overgrazing as this is a problem of Bulgarian livestock). Of great importance is to reveal the influence of the activity of grain and wheat farms on the elements of the environment and is there a mechanism to reduce the negative activity impact.

17.6. Evaluation of the possible farmer's reaction to introduce environmental friendly practices

Agri-environmental assessment of the grain sector has a special part of the article and it aims to enclose how grain sector could be changed to be more environmental friendly. As well are searched a relationship how the agricultural holdings would change their behaviour.

Figure 2. Assessment of impact of taxes implementation on the economic state of grain holdings



Key: 1 – negative impact; 5 – positive impact.
Source: own calculation.

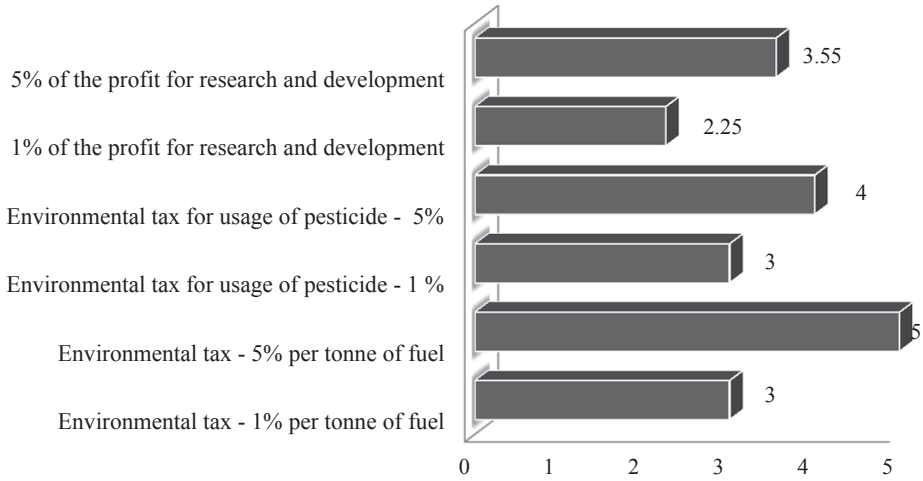
In order to examine the attitude of agricultural producer to move to more environmental friendly practice and techniques have been proposed some restrictions which respondents have to evaluate. The farmers had a large range of possible measurements between which they had to choose and evaluate the possible impact if they are implemented. Part of the questions was directed to influence the implementation of environmental taxes over the economic condition of the producers.

Data from the figure 2 shows that most negative impact over the grain sector will have if are implemented taxes of 5% of the profit for R&D and quantity of used pesticide. Both evaluations are the most possible negative. Even very negative (1,75) the 5% tax per ton of fuel is with less negative impact according the other possibilities.

Although the negative impact of the farmers the implementation of those types of taxes their implementation may lead to positive effect over the environment. The implementation of 5% environmental tax per tons of fuel and 5% environmental tax on the use of pesticides are evaluated by the farmers as

measures that will have a strong positive impact on the environment. According to the respondents' view, the environmental tax of 1% per tons of fuel and 1% for the use of pesticides and investment of 5% of the profits for research and development would have also a positive impact on the environment (Figure 3).

Figure 3. Assessment of impact of taxes implementation on the environment



Key: 1 – low positive impact; 5 – high positive impact.
Source: own calculation.

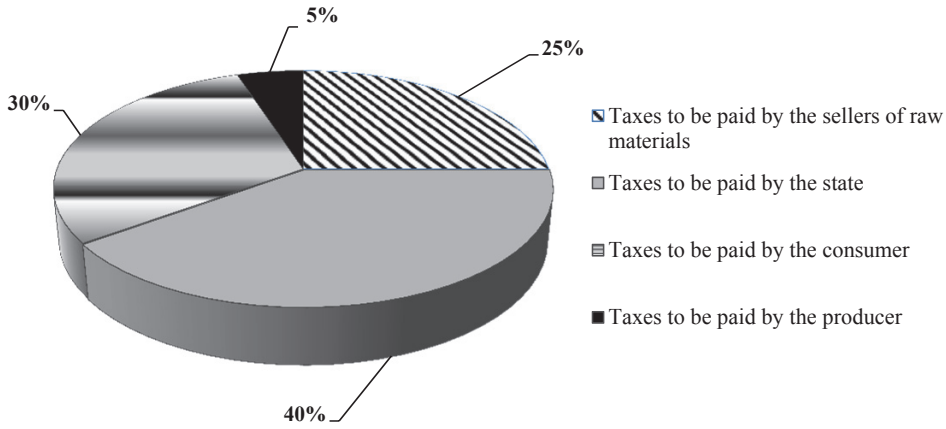
Figure 4 shows the distribution of respondent's answers to the question that should pay out the weight of the tax implementation. Grain producers state that the highest weight of restrictive measure should be taken by the state (40% of the respondents). 30% of them consider that the end user should pay the tax and 25% believe that it should be taken by the sellers of raw materials. Only 5% of the grain producers share the view that the tax should be paid by them. This information may find a conclusion that the grain producers are strictly profitable orientated structures and they are not willing to help to environment and take responsibility for their activities.

Grain producers evaluate environmental indicators and how their activity affects or is affected by a particular indicator (Table 7).

Evaluations show that the environment influences directly on the activity of grain producers. They consider that the problems with soil, loss of nutrients in the humus layer, deposition of deleterious substances into water will degrade the quality and quantity of their production. Indicators as the use of chemical fertilizers and chemical synthetic pesticides, soil erosion, acidification and soil de-humisation and soil contamination are evaluated as high influenced indicators by the grain sector. Low evaluation became indicators as use of water with high nitrate content and de-

terioration of habitats. According to respondents grain sector is highly affected from indicators as soil erosion, acidification and soil dehumisation, soil contamination, air pollution and the use of chemical fertilizers and chemical synthetic pesticides. It is not influenced by loss of habitat and biodiversity and use of water with high nitrate content.

Figure 4. Distribution of weight of taxes implementation



Source: own calculation.

Table 7. Assessment of some environmental indicators influenced by the grain sector and have influence on it

Indicators	How much grain sector influences? 1 – no influence 5 – high influence	How much grain sector is affected? 1 – not affected 5 – high affected
Loss of habitat and biodiversity	2.80	1
Abandonment of land	3.50	4
Deterioration of habitats	2	2
Soil erosion	5	5
Acidification and soil dehumisation	5	5
Soil contamination	4.2	4.8
Pollution of surface and groundwater	3.5	4
Air pollution	3	4
The use of chemical fertilizers and pesticides	5	5
The use of water with high nitrate content	1	1

Source: own calculation.

17.7. Conclusions and recommendations for improving agri-environmental assessment

Based on the analysis of changes in production, land and organizational structures of the agriculture, agri-environmental assessment of the Bulgarian agriculture and evaluation of the possible farmer's reaction to introduce environmental friendly practices are made general conclusions as follows:

- Compared with 2006, the last year before the accession of Bulgaria to the EU, the number of operators grew more than 13 times.
- Changes necessary for the transition to organic production are related to investments for the development of environmental friendly plant protection, development of new crop varieties and innovations in production technology.
- During 2007 and 2014 the agricultural sector is still the biggest air pollutant with ammonia and nitrous oxide.
- Between 2007 and 2014 the agricultural sector reduced the amount of gas emission by ammonia (73%) and methane (53%).
- The implementation of restrictions as 5% environmental tax per tons of fuel, between 1 and 5% environmental tax on the use of pesticides and between 1% and 5% of the profit to be invested for research and development would have a strong negative impact on agricultural holdings in economical aspect and highly positive impact on environment.
- Farmers consider that the weight of tax implementation should be paid by the state (40%), by the end user (30%), sellers of raw materials (25%) and only 5% state that the tax should be paid by the grain producers.

Based on the analysis of agri-environmental assessment and farmer's evaluation of possibilities for implementation of environmental practices could be made some recommendations as follows:

- Implementation of integrated production, whose main element is integrated pest management. By applying this method will be reduced the use of pesticides, excluding highly toxic and usage of selective, less toxic or biological preparation. This will impact positively on restoration of natural biological balance and regulation.
- In terms of conservation of land and overcoming the problems as erosion and soil pollution, acidification and dehumisation is necessary to introduce more stringent measures against the abandonment of land, better implementation of best agricultural practices, realizing a crop rotation, afforesting around agricultural land, etc.
- In regard with the protection of surface and groundwater and overcoming problems with their pollution are necessary milling industries which are di-

rectly related to the activity of grain producers to implement treatment plants and be able to use recycled water in the processing of grain. At the same time they must use products that are not deposited in water sources.

- Use of biofuels that emit lower quantity of emissions and renewal of machinery will impact positively on air protection. In this regard, the state support is indispensable in the form of subsidies and credits for the purchase of new equipment and modernization of farms.

References

1. Balmann, A., Valentinov, V., *Towards a Theory of Structural Change in Agriculture: Just Economics?,* 149th EAAE Seminar 'Structural change in agri--food chains: new relations between farm sector, food industry and retail sector' Rennes, France, 2016.
2. Boehlje, M., Eidman, V., *Farm management*, John Wiley & Sons, 1984.
3. Boehlje, M., *Structural Changes in the Agricultural Industries: How Do We Measure*, *Analyze and Understand Them*?, American Journal of Agricultural Economics, vol. 81, no. 5, Proceedings Issue (Dec., 1999), pp. 1028-1041.
4. Bojnec, Š., Latruffe, L., *Farm size, agricultural subsidies and farm performance in Slovenia*, Land Use Policy, no. 32, 2013, pp. 207-217.
5. Buckwell, A., *Where should the CAP go post -2020?* [in:] *The Political Economy of the 2014-2020 Common Agricultural Policy* edited by J. Swinnen, An Imperfect Storm. London: Centre for European Policy Studies, 2015, pp. 509-529.
6. Harizanova, H., *State and perspectives for development of agricultural structures in the grain sector*, ATL 50, Sofia, Bulgaria, 2015.
7. Harizanova-Metodieva, Ts., Metodiev, N., *Effectiveness of dairy sheep breeding in Bulgaria, Journal of International Scientific Publications: Agriculture and Food*, vol. 2, 2014, available at: http://www.scientific-publications.net.
8. Kay, C., Peuch, J., Franco, J., *Extent of Farmland Grabbing in the EU*, Study for the European Parliament's Committee on Agriculture and Rural Development, 2015.
9. MAF, *Rural Development Programme*, 2007, 2014, 2016.
10. Mugera, A.W., Langemeier, M.R., *Does farm size and specialization matter for productive efficiency? Results from Kansas*, Journal of Agricultural and Applied Economics, no. 43(04), 2011, pp. 515-528.
11. NSI, *Dynamic data of Emissions of dangerous substances into the atmosphere*, 2016.
12. Piet, L., Latruffe, L., Le Mouël, C., Desjeux, Y., *How do agricultural policies influence farm size inequality? The example of France*, European Review of Agricultural Economics, no. 39(1), 2012, pp. 5-28.
13. Van der Ploeg, J.D., Franco, J.C., Borras Jr., S.M.*, Land concentration and land grabbing in Europe: a preliminary analysis*, Canadian Journal of Development Studies/Revue canadienne d'études du développement, 2015, pp. 1-16.
14. Zimmermann, A. , Heckelei, T., *Structural Change of European Dairy Farms – A Cross-Regional Analysis*, Journal of Agricultural Economics, no. 63, 2012, pp. 576-603.

18 Successful certification schemes as a tool for marketing risk mitigation: case study – organic and traditional labels in B&H[1]

Alen Mujčinović[1], Aleksandra Nikolić[2], Mirza Uzunović[2]
[1] University of Sarajevo, Faculty of Agriculture and Food Sciences, Student, Bosnia and Herzegovina,
[2] University of Sarajevo, Faculty of Agriculture and Food Sciences, Institute of Agricultural and Food Industry Economics, Bosnia and Herzegovina
mujcinovicalen@hotmail.com, cloud.ppf@gmail.com, m.uzunovic@ppf.unsa.ba

Abstract

Nowadays, communication with consumers through certification schemes has become more and more important, especially for transitional economies and countries with high level of SMEs. Both, market and individual companies develop strong dependence on information sharing and adding more value through successful labelling. These conditions have made organizations to rethink their risk management approaches while special attention needs to be on a proper promotion of eco-labels. This paper analyses efficiency of eco-labels as a tool for marketing risk mitigation and the factors that influence consumer behaviour toward organic and traditional products in developing economies. The results of quantitative surveys indicate significant differences in consumer attitudes and behaviour for organic and traditional products and show the importance of new variables, which can influence the purchasing behaviour, label information use and consequently marketing risk level.

Keywords: consumer communication, organic and traditional food certification schemes, risk mitigation

JEL Classification: M30, M31

18.1. Introduction

The agriculture and food industry experiences fierce competition on the global markets, while these fairly new markets result with new opportunities, they also create new dimensions of uncertainties and risks in the supply chains [Ritchie and Brindley, 2000, as cited in: Faisal et al., 2006]. With these market conditions understanding the consumers' behaviour and expectations are key

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

factor for future development [Giraud et al., 2011]. Food system in 21st century faced radical changes, such as more complex supply chains, booming food services, changes in demographic situations, social situations, consumption behaviour and lifestyle. Also environmental conditions and changes in food production systems play an important role [Grunert and Wills, 2007; Luning and Marcelis, 2007]. More specifically, increased consumer awareness [Lin et al., 2005], several serious food crises and major changes in food law [Van der Meulen and Van der Velde, 2004, as cited in: Luning and Marcelis. 2007] put more and more requirements on food quality [Luning and Marcelis, 2007]. In same time market is evolving quickly, transactions move from the domestic sphere to the supermarkets while information asymmetry is growing.

Economic theory suggests that labelling reduces the information asymmetry between a seller and a consumer, allowing the latter to make purchase choices that are more consistent and favouring the correct functioning of the market [Bougherara and Grolleau, 2004]. Eco-labels help consumers to distinguish the organic product from other products, and emphasize that the labelled products are of superior quality. This implies that the importance of eco-labels in promoting green consumption is their ability (or disability) to transmit these messages to the consumers. For producers, labelling is a successful tool to achieve higher prices on the market, creating a positive image of the brand, creating good relations with public authorities and the opportunity to identify ways to reduce costs [Annunziata et al., 2011]. The problem arises when the market is still undeveloped, then eco-label should be promoted on a proper way in order to achieve above mentioned benefits. Despite the apparent benefits of food labels scholars have documented that consumers' actual use of food labels might be lower than their reported use [Cowburn and Stockley, 2005]; and consumers' lack of trust in food labels are used as aggressive marketing tools in food industry [Moorman, 1996; Mazis and Raymond, 1997; Szykman et al., 1997, as cited in: Lwin et al., 2015; Soo-Jiuan and Khai-Ling, 2007]. The assumption is that quality labels fail to have an impact on behaviour and food choice unless they are used by consumers [Verbeke and López, 2005; Grunert and Wills, 2007]. Therefore, the objective of this paper is twofold: (i) to analyse efficiency of eco-labels as a tool for marketing risk mitigation and (ii) to analyse the factors that influence consumer behaviour toward organic and traditional products in developing countries.

18.2. Research method

Rapidly changing business environment is creating new opportunities but also new risks. Any economic activity can potentially undergo the following risks: production, financial, marketing or climatic [Gerasymenko and Zhe-

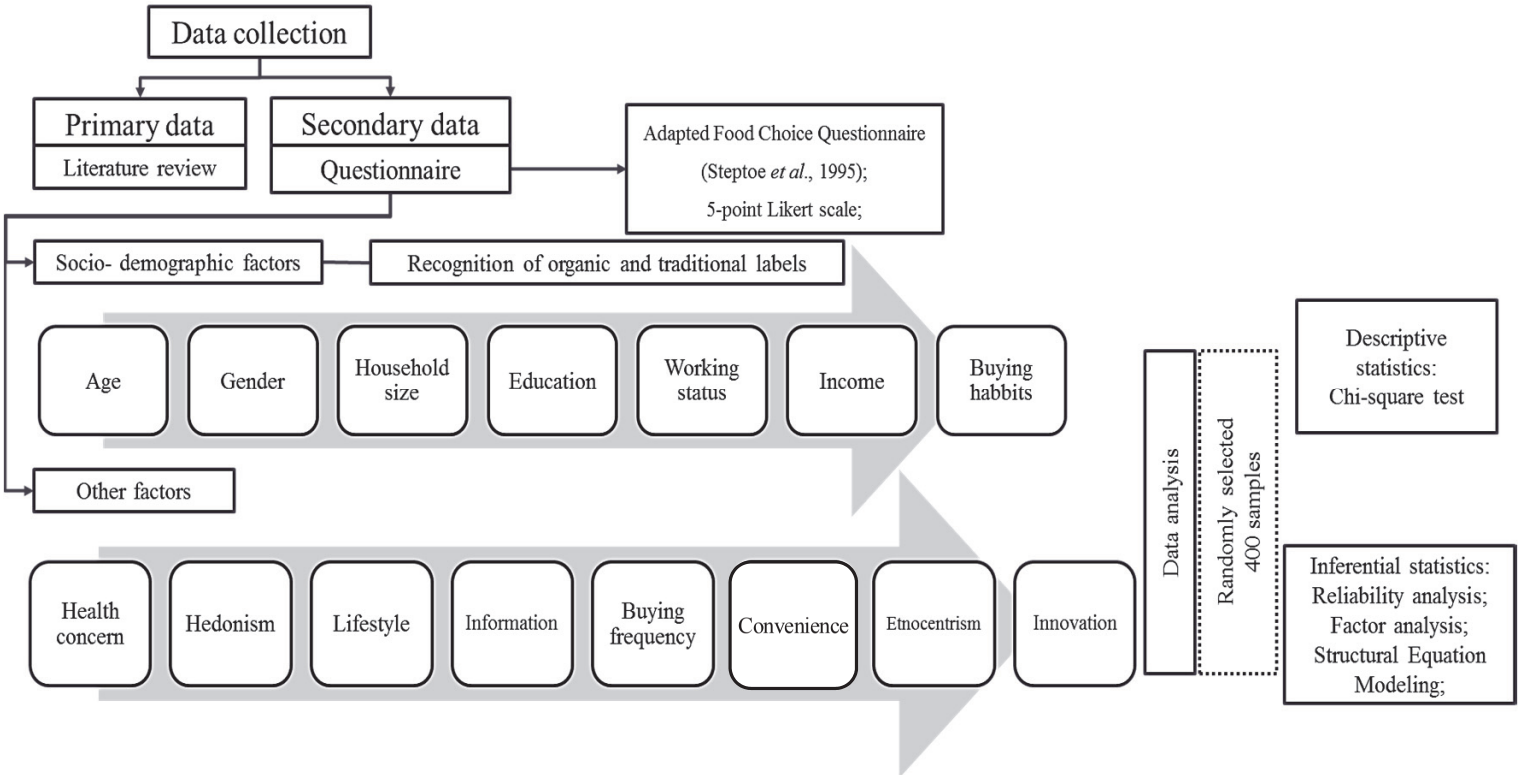
moyda, 2000]. From one perspective, risk is defined in terms of a consumer's perceptions of the uncertainty and adverse consequences of buying a product or service [Dowling and Staelin, 1994, as cited in: Faisal et al., 2006]. Risk management process is focused on understanding the risks, interaction with each other and minimizing their impact by addressing probability and direct impact [Norrman and Jansson, 2004, as cited in: Faisal et al., 2006].

The main purpose of this article is to investigate the factors that influence consumer behaviour toward traditional and organic products and to verify if labelling is a valid tool of direct shopping aid to consumers with a view to deriving inferences that may contribute to better strategic and tactical marketing decisions and consequently mitigate risk level. To collect data a questionnaire was developed and administered, with face-to-face interview, to a randomly selected sample of 400 consumers. In the present study, the food choice motives was analysed through Food Choice Questionnaire (FCQ) developed by Steptoe et al. [1995] with some modifications to suit B&H conditions. First part of questionnaire was made of questions regarding: the socio-demographic conditions of the respondents (age, gender, education, income, household size, working status, buying habit) and recognition of organic and traditional food labels. Second part of questionnaire is measured with a 5-point Likert scale, labelled from 1 (disagree with statement) to 5 (totally agree with statement) and was made of questions regarding: characteristic factors which influenced buying decision such as health concern, life style, buying frequency, ethnocentrism, hedonism, information, convenience and innovation. Research model is presented on a figure bellow.

Data analysis

Descriptive statistics, Chi-square test, Reliability analysis, Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) were used. All factors with Cronbach's alpha values lover than the minimum threshold of 0.70 [Nunnally, 1979] were excluded from the model. Goodness of Fit Index (GFI) will be reported, where values above 0.90 suggest an acceptable fit of the model [Bollen, 1989; Browne and Cudeck, 1993; Hair et al., 2007; Kline, 2011, as cited in: Verbeke et al., 2012]. The analysis was performed with AMOS 20 and IBM SPSS 20.

Figure 1. Research model



Source: Steptoe et al. [1995].

18.3. Results and discussion

Purpose of this study was to analyse efficiency of eco-labels as a tool for marketing risk mitigation and to analyse the factors that influence consumer behaviour toward organic and traditional products in developing countries. Results of organic and traditional-sign recognition are presented in table below.

Table 1. Organic and traditional sign recognition

Socio-demographic characteristics	Organic-sign recognition (%)	Significant level	Traditional-sign recognition (%)	Significant level
OVERALL RECOGNITION	52.80	n/a	22.80	n/a
AGE				
Less than 25 years	41.20		27.10	
From 26-35 years	52.20	.081	19.60	.683
From 36-55 years	56.20		21.90	
Over 55 years	59.30		23.30	
GENDER				
Female	55.20	.300	20.80	.312
Male	50.00		25.00	
EDUCATION				
Primary school	38.90		5.60	
Secondary school	51.70	.299[a.b]	25.00	.112[a.b]
Faculty	59.50		24.30	
Higher degree	52.60		21.10	
EMPLOYMENT				
Unemployed	35.00		11.70	
House worker	66.70		24.40	
Student	41.70	.005*	30.00	.175
Temporary worker	50.00		31.80	
Employed	58.60		23.60	
Retired	56.40		17.90	
HOUSEHOLD SIZE				
Living alone	46.70		16.70	
Living with parents	43.40		24.20	
Living with spouse	55.00	.130	16.30	.602
Living with spouse and one child	61.50		25.00	
Living with spouse and two children	60.20		25.50	
Other	46.30		26.80	
FREQUENCY OF BUYING FOOD				
Me only	62.10		20.00	
Mostly me	39.50		30.20	
Often me	59.30	.033*	19.40	.684
Rarely me	44.20		25.70	
Never me	55.20		20.70	
Other	41.70		25.00	
INCOME				
Significantly lower than country average	50.70		22.70	
Lower then country average	56.80		21.60	
Country average	53.30	.875	22.00	.887
Higher then country average	54.50		27.30	
Significantly higher than country average	52.40		28.60	
Other	33.30		11.10	

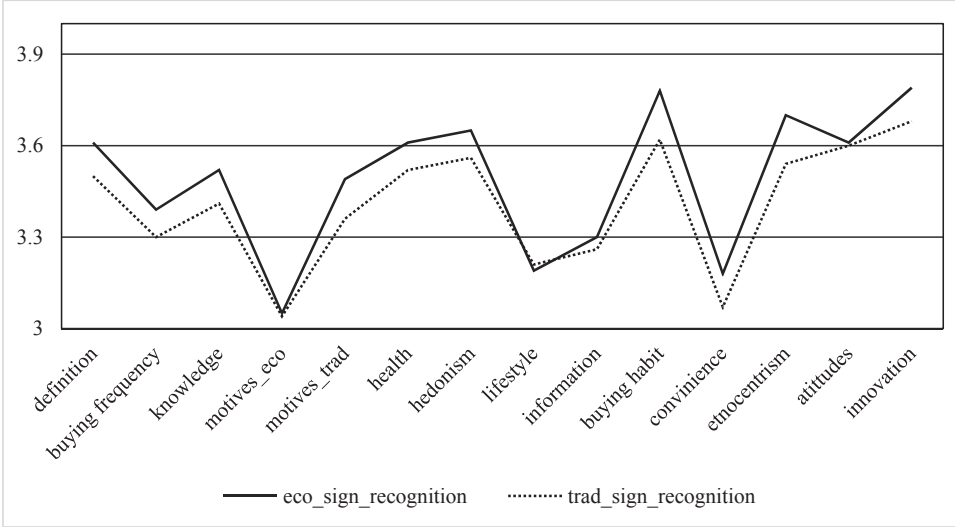
Source: own calculation.

Overall recognition of organic product labels in Bosnia and Herzegovina is on a higher level (52.80%) than the average in the EU (24%) [EC, 2012]. Traditional product labels recognition in Bosnia and Herzegovina is 22.80%, which is higher than average in EU (15%) [EC, 2012]. Degree of recognition/awareness of these two labels differs from country to country and it depends on a country specific orientation [EC, 2012; Verbeke et al., 2012; Grunert and Aachmann, 2016]. Situation in B&H indicates that consumers are aware of these specific labels but due to the weak promotional activities and lack of purchasing power [Cerjak et al., 2010; Renko and Vignali, 2010; Nikolić et al., 2014] only 3% of population can afford to buy products [Hanson, 2005].

The survey results show that age differences. gender as well as household size have not significant influence on a level of organic and traditional labels recognition. Noteworthy, socio-demographic factors, educational and employment level had significant influence on organic and traditional labels recognition. The percentage of respondents that had lower educational levels (only primary school) was found to have significantly lower level of organic and traditional labels recognition. This is in accordance with the EU study [EC, 2012] survey participant's employment level, reflected economic security and its influence on recognition of both organic and traditional labels is significant. The same difference with lower organic label recognition was found within of groups "unemployed" and "student". Survey results found the basically the same lower label recognition for the traditional group "retired" which is in accordance to the EU study [EC, 2012]. Buying frequency as a factor had significant influence only on a recognition of organic labels. Surprisingly, income as a factor in our case does not have significant influence on a recognition of organic and traditional labels which is registered in previous study in B&H [Nikolić et al., 2014]. These results imply the necessity to include other factors besides socio-demographic variables. New variables, such as trust in labels or actual usage of organic and traditional products may be included in order to get better answer on a question whether labelling can be used as an information tool.

Second part of this research recorded other factors that influence consumers' choice in B&H. Level of importance attributed to a set of characteristics of organic and traditional products is presented on a following figure.

Figure 2. Importance of other factors which influence consumers' behaviour

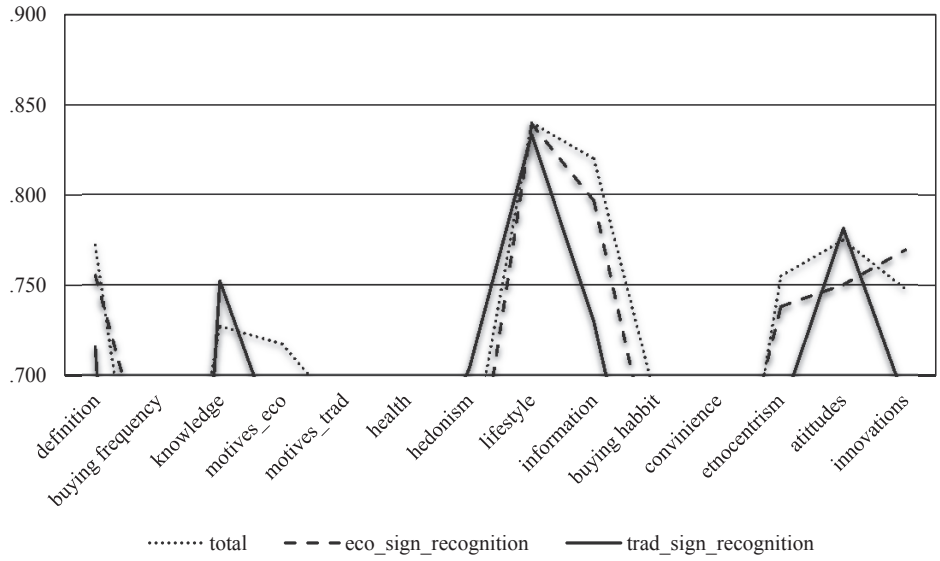


Source: own elaboration.

Results presented in Figure 2 showed that consumers in B&H neither agree nor disagree (value close to 3) with statements which represent specific factors. These results show fairly conclusively that consumers might not be aware of benefits from organic and traditional products/production and support hypothesis about the necessity to provide additional and more proper promotional activities for both organic and traditional products. To analyse the factors that influence consumer behaviour toward organic and traditional products in developing countries CFA and SEM were used. First part was to test reliability of all factors with Cronbach's alpha test and results of test are provided in following figure.

After exclusion of all factors with values lower than the minimum threshold of 0.70 [Nunnally, 1979] we proceed with CFA. Through the principal components analysis we tried to verify the existence of latent factors that summarize the motivations towards organic and traditional products. We found five key factors named as follows: information, specific concerns, family values, safety concerns, added value. These factors explain the 66% of cumulative variance. The first factor summarizes a set of variables referred to the reading gastronomic magazine and culinary news, being well informed – reading about the food and its quality, reading the information about what foods contain and visiting portals with daily events.

Figure 3. Crombach α reliability analysis



Source: own elaboration.

The second factor, describes consumers specific concern towards working conditions and child labour, environmental impact and animal welfare. The importance of these factors is also found in several other studies [Bjerke, 1992, as cited in: Schlegelmilch et al.; 1996; Brunsø et al.; 2002; Sakthirama and Venkatram, 2013]. The third factor refers to family values and to following statements: "Cooking a meal for me means taking care of my family" and "I prefer to cook traditional dishes from my region". Fourth factor, safety concern or health concern is often found as a most important factor in purchase of organic products [Magnusson et al., 2003]. Last factor is added value, referring to the superior quality of organic products or connection traditional products – tourism. This is also confirmed as an important factor in several other studies [Loureiro and Umberger, 2007; Resano et al., 2007; Dekhili et al., 2011, as cited in: Verbeke et al., 2012]. Factor loadings are presented in Table 2.

Table 2. Factor loadings for observed variables

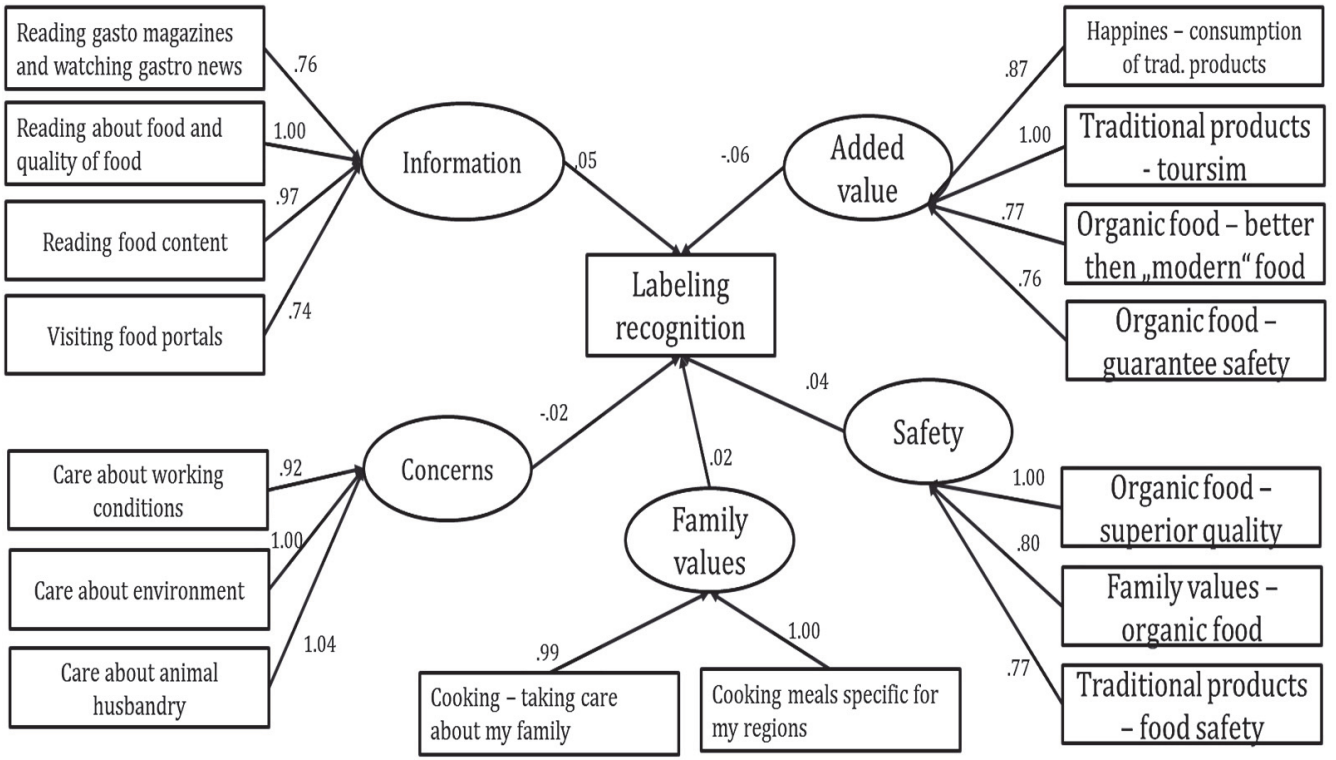
Factors	1	2	3	4	5
Reading gastronomic magazine and culinary news	.859				
Being well informed - read about the food and its quality	.842				
Reading the information about what foods contain	.739				
Visiting portals with daily events	.714				
Concern towards environment		.873			
Concern towards animal welfare		.846			
Concern towards working conditions and child labour		.838			
I feel happy and satisfied when we consume traditional products			.812		
Organic food is "healthier" than modern industrial food			.707		
B&H traditional products are original enough to attract the attention of tourists			.665		
Someone needs to guarantee that the product is organic / ecological			.603		
Organic food is more caloric comparing to the modern industrial food				.784	
Celebrations and family gatherings are incomplete without the organic food				.779	
Often I doubt in the safety of the traditional product				.618	
Cooking a meal for me means taking care of my family					.887
I prefer to cook traditional dishes from my region					.823

Source: own elaboration.

Figure 4 shows results of SEM analysis, where factors information, safety and family values have positive influence on labelling recognition, while added value and concerns have negative influence on labelling recognition.

Once again initial hypothesis with necessity to push for more promotional activities is confirmed. Consumers in B&H might be aware of organic and traditional labels, but due to the low level of promotional activities, lack of purchasing power, etc., they do not trust the message labels and the information that they disseminate. Another important factor based on the study that needs to be taken into consideration is value of GFI which is 0.865. This figure indicate that actual fit of model is not perfect (be above 0.9 where value of close to 1 indicate perfect fit) and additional/more appropriate variables should be included.

Figure 4. Result of SEM analysis



Source: Nunnally [1979].

18.4. Conclusion

Risk management strategies have to include an integrated approach to decrease possible losses from one or few types of risks or their combination. In order to achieve maximum labelling efficiency, it is necessary to conduct public information campaigns on organic and traditional logos used in that country and these campaigns should be carried out both by governments and by economic agents (farmers, distributors, retailers, processors, certification organizations, etc.) involved in the market of organic and traditional food products. The information and findings found in the case studies have shown that B&H consumers' recognize organic and traditional labels on a level higher than average consumers in EU but actual usage of labels may be significantly lower. We have shown that many of these factors can influence the effectiveness of current labelling recognition in the marketplace; some of these factors were the lack of purchasing power or lack of trust in labels which implies that there needs to be increased and more effective marketing campaigns to make labelling more effective in B&H.

The results of the multivariate analysis studies confirm that the use of labelling as an effective marketing and information tool depends not only on the socio-demographic variables, but also on a variables linked to the lifestyle, to involvement in particular social and environment themes and on the variables linked to the degree of confidence expressed toward the different sources of information. In order to mitigate marketing risk by targeting more efficiently consumers, we need to provide a more precise and useful profile of organic and traditional food consumers. This will lead to an in-depth understanding of the organic and traditional sector, the major forces shaping it, and the current market structure, as well as an understanding of the challenges faced by the main players of the organic and traditional food industry.

References

1. Annunziata, A., Ianuario, S., Pascale, P., *Consumers' Attitudes Toward Labelling of Ethical Products: The Case of Organic and Fair Trade Products,* Journal of Food Products Marketing, no. 17(5), 2011, pp. 518-535.
2. Bougherara, D., Grolleau, G., *Could Ecolabeling Mitigate Market Failures ?An Analysis Applied to Agrofood Products,* 2004 (No. BP 87999 – 26. Bd Dr Petitjean-21079 DIJON cedex).
3. Cerjak, M., Mesić, Ž., Kopić, M., Kovačić, D., Markovina, J., *What Motivates Consumers to Buy Organic Food: Comparison of Croatia, Bosnia Herzegovina, and Slovenia,* Journal of Food Products Marketing, no. 16(3), 2010, pp. 278-292 (https://doi.org/10.1080/10454446.2010.484745).
4. Cowburn, G., Stockley, L., Consumer understanding and use of nutrition labeling:

a systematic review, *Public Health Nutrition*, no. *8*(1), 2005, pp. 21-28 (https://doi.org/10.1079/PHN2004666).
5. European Commission, *Europeans' attitudes towards food security, food quality and the countryside,* 2012.
6. Faisal, M.N., Banwet, D.K., Shankar, R., *Supply chain risk mitigation: modeling the enablers*, Business Process Management Journal, no. 12, 2006, pp. 535-552 (https://doi.org/10.1108/14637150610678113).
7. Geradymenko, N., Zhemoyda, G., *New Challenges For Risk Management In Agri-Food Industry,* 113th EAAE Seminar *"A resilient European food industry and food chain in a challenging world",* Chania, Crete, Greece, vol. 4, 2000, pp. 17-23.
8. Giraud, G., Pugnard, E., Schaer, B., Stojanovic, Z., Ognjanov, G., Sitjema, S., Zimmerman, K., *FOCUS on FOOD Consumers in the Balkans,* Focus-Balkans, 2011.
9. Grunert, K.G., Aachmann, K., *Consumer reactions to the use of EU quality labels on food products: A review of the literature*, Food Control, no. 59, 2016, pp. 178-187 (https://doi.org/10.1016/j.foodcont.2015.05.021).
10. Grunert, K.G., Wills, J.M., *A review of European research on consumer response to nutrition information on food labels*, Journal of Public Health, no. 15(5), 2007, pp. 385-399 (https://doi.org/10.1007/s10389-007-0101-9).
11. Hanson, S., *Bosnia-Herzegovina Organic Products,Agricultural Situation and Market Update,* 2005 (https://doi.org/CH6064).
12. Brunsø, K., Fjord, A.T., Grunert, G.K., *Consumers 'Food Choice and Quality Perception*. *Consumers' Food Choice and Quality Perception*, The Aarhus School of Business Publ., Aarhus, Denmark, 2002 (https://doi.org/ISSN 0907 2101).
13. Lin, C.T.J., Jensen, K. L., Yen, S.T., *Awareness of foodborne pathogens among US consumers*, Food Quality and Preference, no. 16, 2005, pp. 401-412 (https://doi.org/10.1016/j.foodqual.2004.07.001).
14. Luning, P.A., Marcelis, W.J., *A conceptual model of food quality management functions based on a techno-managerial approach*, Trends in Food Science & Technology, no. *18*(3), 2007, pp. 159-166 (https://doi.org/10.1016/j.tifs.20-06.10.021).
15. Lwin, M.O., Vijaykumar, S., Chao, J., "*Natural" and "Fresh": An Analysis of Food Label Claims in Internationally Packaged Foods in Singapore*, Journal of Food Products Marketing, no. 21(6), 2015, pp. 588-607 (https://doi.org/10.10-80/10454446.2014.1000450).
16. Magnusson, M.K., Arvola, A., Hursti, U.K.K., Lars, A., Sjoden, P., *Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour,* Appetite, no. 40, 2007, pp. 109-117 (https://doi.org/10.1016/S0195-6663(03)00002-3).
17. Nikolić, A., Uzunović, M., Spaho, N., *Lifestyle pattern underlying organic and traditional food consumption*, British Food Journal, no. 116(11), 2014, pp. 1748-1766 (https://doi.org/10.1108/BFJ-02-2014-0085).
18. Nunnally, J.C., *Psychometric Theory,* McGraw-Hill, New York, Ottman, 1979.
19. Renko, S., Vignali, C., *Competitive Advantage of the Food Industry in the*

Balkans, Journal of Food Products Marketing, no. 16(3), 2010, pp. 261-261 (https://doi.org/10.1080/10454446.2010.485100).
20. Sakthirama, V., Venkatram, R., *An analysis on Food Choice Motives of Organic Tea in Coimbatore*, Journal of Contemporary Research in Management, no. 8(2), 2013, pp. 35-46 (http://www.psgim.ac.in/journals/ index.php/jcrm/article/view-File/259/241).
21. Schlegelmilch, B.B., Bohlen, G.M., Diamantopoulos, A., *The link between green purchasing decisions and measures of environmental consciousness*, European Journal of Marketing, no. 30(5), 1996, pp. 35-55.
22. Steptoe, A., Pollard, T.M., Wardle, J., *Development of a Measure of the Motives Underlying the Selection of Food: the Food Choice Questionnaire*, Appetite, no. 25, 1995, pp. 267-284 (https://doi.org/10.1006/appe.1995.0061).
23. Verbeke, W., López, G.P., *Ethnic food attitudes and behaviour among Belgians and Hispanics living in Belgium*, British Food Journal, no. 107(11), 2005, pp. 823-840 (https://doi.org/10.1108/00070700510629779).
24. Verbeke, W., Pieniak, Z., Guerrero, L., Hersleth, M., *Consumers' Awareness and Attitudinal Determinants of European Union Quality Label Use on Traditional Foods*, Bio-Based and Applied Economics, no. 1(2), 2012, pp. 213-229.

19 The risks of rural development in Ukraine[1]

Oleksandr Pavlov
Odessa National Academy of Food Technologies, Ukraine
pavlovodessa@mail.ru

Abstract

The aim of the study is identification and classification of the risks of rural development in Ukraine, characteristic of their specific features. To achieve the objectives of the study, the conception of rurality is formulated as a process of rural social development that takes place in rural areas. Ukraine is considered as an agrarian country, which has a huge agricultural potential. We characterize the risks of rural development in Ukraine: cognitive; psychological (mental); specific (spatial and sectoral); organizational and structural; institutional (political and administrative) economic and financial; environmental; social. Analysed model of rural development in Ukraine, the strategy 3+5 – Strategy of prosperous country and the policy of decentralization of state power. Basing on a comprehensive analysis of the risks of rural development in Ukraine it is concluded that they pose a real threat not only for food security, but also the national security of Ukraine. The main objectives of the strategy are: rural development and risk management of rural development in Ukraine.

Keywords: agrarian development, agriculture production, classification of risks, models of rural development, risks of rural development, rural territories

JEL Classification: R58, Q12

19.1. Introduction

Rurality is defined as a dynamic state of a holistic unity of its anthropic, material, social and spiritual components. Nummik [1979] noted as a continuous structural transformation of social life. There is a reduction to the natural and historical basis in rural areas and increase the role of human labour, materialized voluminous non-rural forms of human activity. This is connected with the earth (natural) area and place of business in the waning deductive sequence – from rural to semi-rural and non-rural. Rurality are defined a certain dynamic state of being as an integral unity of his anthropic, material, social and spiritual components.

[1] Article prepared for International Conference "*Risk in the food economy – theory and practice*" organised by IAFE-NRI (www.ierigz.waw.pl), 23-25 November 2016, Jachranka, Poland, http://ierigz.waw.pl/conference/international-conference-(23-25-november-2016)/program-konferencji

As indicated, Nummik [1979] a continuous structural transformation of social life, there is a reduction in the natural and historical basis in rural areas and increase in the role of human labour and non-rural forms of human activity. This connectedness with the land (natural) area and place of business the decrease in deductive sequence – from rural to semi-rural and non-rural.

Rurality, as the evolution of rural space, is associated with stage of nature and the development of agriculture. Bichanich [1972] introduced the concept of turning points (bifurcations) in the agricultural dynamics. Based on the analysis of changes in the factors of production, such as land, labour and capital, he divided the historical development of agriculture into three phases: subsistence agriculture; commodity market production; intensive land use and substitution of the natural fertility of capital. Later this concept was supplemented by Nefedova [2003], who defined the five stages of evolution of the countryside, which correspond to the stages of urbanization.

At all times, the attributes of rural identity were the peasantry (social group), agricultural labour (the main type of economic activity and the mode of existence of the peasantry) and village (settlement type, the space of life of the peasantry and other social spheres of the rural population). That is why rural development, primarily associated with the agricultural development of the rural space, in turn is determined by the degree of availability of natural resources and geographic location or factors "first nature" by Krugman [1991].

Gradually formed the image of rural territories as an object of rural development. However, economic studies did not take into consideration the differentiation of rural territories as the system object and space development of the agricultural sector with its core (agriculture) as the basic industry of these natural and socio-spatial formations. This can be done due to the expansion of the research field on the basis of inter-sectoral approach. The way of analysing rural discourse demonstrates the physical economy. In the centre is the physical economy. It is the idea about the main role of agriculture in the development of humanity as the principal activity ensuring the growth of wealth and the increase of matter [Rudenko, 2004].

If the physical economy covers the basics of natural science rural discourse, the other cross-sectoral scientific discipline – socioeconomic explores the relationship between the different spheres of public life through the prism of social and economic integration, social, spiritual and political processes. In the futuristic concepts rurality allocated a place on the sidelines of the historical development, as the first wave of agrarian [Toffler, 2000] or pre-industrial times [Bell, 1999] of the human civilization. The peasantry as the unfortunate brother

of primitive societies that civilization did not have time to absorb, there is nothing left except the material support of a privileged minority [Toynbee, 2003].

Another discursive rhetoric presented views of Shpengler, Braudel and Sorokin. Shpengler [2003] identified a peasant as an eternal man who preceded the culture, by artificially changing the landscape of farming activities and thus take root in the soil. Braudel [1995] suggested creative idea of the rural-urban continuum as the convergence of the towns and villages Sorokin [1929].

So, rural development –is a social process that occurs in the rural area, the object of which are rural territories. Historically, rural development was associated with peasant, agriculture and the village that prevail at a certain stage of development of civilization – agrarian society. In the industrial and post-industrial era, with the improvement of technical and technological level of society, the agrarian mode of production of material goods lost universality, but remained dominant in rural area. But the economic activity in rural area is not limited to agriculture. Also social services are rendered there – education, health, culture. Rural area – there recreational and environmental landscapes that form the environment as a place of residence and rest not only for the rural population. So rural development is associated with a certain area, economic, social and environmental components which belong to the various forms of social reproduction. As the object of rural development – rural territories perform important public functions.

During rural development in Ukraine there are internal and external challenges and threats, which strained the conditions of modern globalization. The main risks of rural development in Ukraine have the inner nature.

19.2. Identification of Ukraine as an agrarian country

The Organization for Economic Cooperation and Development (OECD) defines the level of rurality on demographic criteria (share of rural population in its total population). According to this criterion, almost all regions of Ukraine, with the exception of the Donetsk and Lugansk are predominantly rural. We also use such criteria as:

- population density;
- the proportion of the world's fertile agricultural land;
- agricultural production on 100 hectares of agricultural land;
- agricultural production per one inhabitant of Ukraine;
- the share of gross value added in agriculture production in gross value added in the region;
- the proportion of the population occupied in agriculture.

According to these criteria, out of the 24 regions of Ukraine 2 regions are predominantly urban, predominantly rural 6, the rest – a relatively rural.

According to the Institute of Economics and Forecasting of NAS of Ukraine agricultural national wealth of Ukraine in the prices of 2012 is estimated at 4795 billion UAH or $ 210 billion, including agricultural land – 431 billion UAH, production assets – 2128 billion UAH, human capital – 2236 billion UAH. To accelerate the development of the Ukrainian village the funds should be designated in the amount of $ 75 billion (by assessment of the Committee on Agrarian Policy and Land Relations of the Ukrainian Parliament).

Classification of the risks of rural development:

- cognitive;
- psychological (mental);
- specific (spatial and sectoral);
- organizational and structural;
- institutional (political and administrative);
- economic and financial;
- environmental;
- social.

The cognitive risk of rural development in Ukraine is carried out by the scientific community, much of which is used in research practice exclusively sectoral approach. According to their logic, rural development, in the best case, is artificially limited to the agricultural sector. And at worst, considered as a historically transient (preindustrial) stage of social development, that reminds of itself relevant manifestations in countries classified as agricultural where predominate agriculture and rural population. The peasantry is regarded as an anachronism and a social layer, conservative with respect to innovation.

This ignores the fact that the advent of post-industrial society does not replace the agrarian mode of production of material goods.

The psychological (mental) risk lies in the consciousness of different parts of the Ukrainian population, entrenched in certain mental images of rural areas, i.e. full of stereotypes and negative attitudes sometimes. Thus, public institutions perceive the rural natural and socio-spatial formations as a source of food and agricultural raw materials. The representatives of big business formed consumer attitude to the rural areas as a source of profitability. The predominant majority of the rural population perceives the rural space as a negative for life that is manifested in the migration of rural youth that their prospects binds exclusively to the cities. Only a small part of the peasants, living mainly in the suburban villages, rural areas identified as the vernacular (native) for them. The inhabitants of the cities of the second and third generations of rural areas evoke a sense of

nostalgia, while others use them as a place of rest, recreation and rehabilitation. In view of this, the challenge is in processing of social consciousness, not only farmers, but also the entire population of Ukraine on the basis of the enduring values of rural areas.

Specific spatial risks:

- an ordinary structure of the rural economy;
- inequality in investments between rural and urban areas;
- insufficient development of human capital;
- lack of competitiveness of the rural social space;
- territorial remoteness;
- depopulation and migration of the rural population.

Specific sectoral risks:

- dependence on climatic conditions and natural resources;
- price instability;
- slow capital turnover;
- significant dependence on the profitability of agriculture;
- discontinued technological cycle;
- the seasonal nature of production;
- inelasticity of demand for agricultural products.

The most threatening consequences has asymmetrical structure of agricultural production, where on one side there are concentrated large vertically integrated companies of holding type, and at the other – households (Table 1).

Table 1. Structure of agricultural business entities

	Agroholdings	Medium enterprises	Farms	Economy of the population
Quantity [thousand units]	0.2	6.8	40.7	4242.0
Average size [hectare]	55546.8	1065.6	109.2	1.52

Source: data of the State Statistics Service.

Despite the concentration of agricultural land in the corporate sector, a lack of financial support for small agricultural enterprises, households and farms, supply to the domestic market a significant part of agricultural production. The leading position is occupied by livestock production (Table 2).

Table 2 . Asymmetrical dual structure of agricultural production

Sectors	Share in production	
	agricultural products in general	including animal products
Corporate: •55.9 thousand enterprises, including 160 large agroholdings • 3,5 million people engaged	55.1	45.5
Individual: more than 4 million economy the population	44.9	54.5

Source: Data of the State Statistics Service.

19.3. The role of agricultural holdings in the agrarian development

The concentration of agricultural production of Ukraine has a positive impact, which is represented by a growth in labour productivity per person employed in agriculture in 2015 to 6.6 times in comparison with 2000, exports of agri-food products – 11.5 times, the expansion of foreign investment from USD 20 to 900 million.

The negative sides of the process include:

- the predominance in the structure of sown areas of industrial crops and cereals due to their high profitability (rapeseed make up the structure of their exports 98%, sunflower oil – 90%, corn and soybeans – 50%), low specific weight of fodder crops;
- reducing the number of animals in comparison with 1990 year by almost 3 times, organic fertilizers – 19.5 times, the number of employees of agricultural enterprises – 7.3 times [Gadzalo and Zhuk, 2015].

Agroholdings do not take part in the social development of rural areas. Their reception area are the cities in which live owners of these companies, and from 30% to 50% of managers of medium and large enterprises

The structure and the level of agricultural production

Vegetable sector – 70.3% of total production (in 2011 for the first time the production of plant products exceeded 1990 year level by 11.6%), of which:

- grains and legumes – 26.5%;
- technical cultures – 21.0%;
- potatoes, vegetables, melons and gourds – 18.1%;
- fruit, berry and grape – 3.4%.

Animal sector – 29.7%, of which:

- animal and poultry breeding – 14.1%;
- milk production – 11.2%.

Today animal production is carried out at 40% less, than in 1990.

19.4. Risk analysis – results and discussion

Institutional (political and administrative) risks

2007:

- State programme of development of the Ukrainian village for the period up to 2015 – has not been implemented.

2010:

- February – The Concept of the State Target Program sustainable development of rural territories for the period until 2020 (September – this conception has been cancelled);
- June – Sectoral program of socio-economic development of rural territorial community (model project "New rural community") – has not been implemented;
- Draft Conception of a comprehensive state reform program and agricultural development in Ukraine (not approved).

2013:

- The strategy of development of the agricultural sector for the period up to 2020.

2015:

- A single comprehensive strategy for the development of agriculture and rural territories of Ukraine for 2015-2020.

Economic and financial risks:

- the disparities in the development of vegetable and animal sectors;
- raw monoexport, which is dominated by grain and sunflower oil;
- price disparities in agriculture and the food industry;
- technical and technological backwardness of agriculture;
- imbalance in the innovative development of agriculture and the food industry;
- spatial discontinuity of agri-food sector.

Social implications economic and financial risk

The most threatening consequences has asymmetrical structure of agricultural production, where at the one pole are concentrated large vertical integrated companies of holding type, and at the other – farms of the rural population, which are in spite of the absence of cooperative relations are competitive.

A significant backlog of animal production negatively affected food security in Ukraine. In particular, meat consumption is not respected (34% of science-based standards), dairy (42%) and fish products (30%).

Financial and economic threat for rural development is manifested in the lack of investment support of agricultural production, lack of financial support for small agricultural enterprises, households and farms.

Environmental risks (soil condition)

The ecological status of rural areas continues to deteriorate as a consequence of a violation of the rules of farming. Failure to follow the optimal balance in the structure of sown areas of crops sowing forage crops decreased compared to 1990 by 5.2 times, rape – rose from 2000 by 4.7 times, sunflower – 1.7 times. In the forest-steppe and steppe areas under grain crops employs 60-90% of acreage. All this has a negative impact on the state of soil. In addition to violations of the rotation is not supported by the balance between crops and livestock. According to the EU rules, on 1 ha of agricultural land should be maintained one conditional head of cattle, and in Ukraine, the figure is 0.26.

Only in 1990, when the level of organic fertilizers was 8.6 tons per 1 hectare of sown area, and fertilizer nutrients – 170 kg / ha, was achieved simple reproduction of soil fertility. On the 75% of the area agricultural land since 1993 year, the humus content in the soils is 2-3 times below the norm. The annual loss of humus is to 0.65 tonnes per 1 hectare. The total loss of humus for the last 20 years is estimated at 453.4 billion UAH losses [Kravtsiv, 2015].

Table 3. Regions of export-oriented production and potential environmental disaster

Region	The area of land, thous. hectare	Subjected to erosion		Grains and oilseeds		The share of oilseeds in the cultivated area,%
		area, thou. ha	% of cultivated area	area, thou. ha	% of cultivated area	
Ukraine	41596.4	17003	40.8	22367	80.5	20.7
Dnipro	2514.6	1018	43.8	1675.8	88.1	29.0
Donetsk	2044.7	1356	66.3	1208.9	85.0	32.0
Zaporozhye	2246.6	1319	58.7	1398.5	88.0	37.5
Kropivnitskiy	2040.4	1029	50.4	1341.1	81.2	30.6
Lugansk	1910.2	1602	83.9	889.7	87.9	35.9
Nikolaev	2009.2	984	49.0	1301.5	86.7	32.3
Odessa	2593.3	1242	48.0	1501.6	84.2	23.6
Kherson	1970.6	631	32.0	952.8	72.0	28.2

Source: data of the State Statistics Service.

Using the prevailing part of agricultural land under grain, sunflowers and industrial crops has its consequences not only to the deterioration of soil quality, but also the transformation of the southern, eastern and east-central region to export-oriented production and potential environmental disaster (Table 3).

Social risks (state social services in rural territories)

Due to cuts in funding of social sphere is the destruction of the existing settlement network, weakens the value of residential rurality. During 1990-2000 on average annually disappeared 6 settlements, during the years 2001-2014 – 18. Since 1990, the rural population has decreased by 2,800,000 people, 407 villages had been removed from the register. In 369 villages, removed from the register, there is no population. The nine areas of average population of rural settlements is 247-377 people, the proportion of small villages – 29.8-50.8%, the density of the rural population – 11-20 people per 1 sq. km. More than 47% of households do not receive personal services, 41.8% – ambulance services, 28.5% – health care services, 10.6% of homes are unoccupied, 78% of villages are not provided with centralized drinking water supply, only 16.6% of villages have water supply, 1.9% – the sewage system [Kravtsiv, 2015].

Risk management of rural development

The risks of rural development in Ukraine should be identified as challenges and threats, which require drastic measures to revive and balance development of rural territories in the transition from international cooperation to international economic integration. To this end, implemented 3+5 – Strategy of prosperous country and the decentralization of state power, which leads to self-sufficient, financially sustainable integrated territorial communities.

3+5 – Strategy of prosperous country comprises

Three directions this strategy:

- land reform (launch a transparent land market);
- reform the state support (emphasis on small and medium-sized farms);
- reform of state owned enterprises (focus on profitability and new jobs). Five directions of this strategy:
- development of rural territories;
- market expansion;
- organic production and niche culture;
- irrigation;
- safety and quality of food products.

Policy of decentralization of state power

Decentralization of state power, which provides self-sufficient, financially sustainable integrated territorial communities for the establishment (Table 4).

Table 4. The number of integrated territorial communities in the context of the administrative-territorial structure of Ukraine device on 01.01.2017

administrative districts	490
cities	460(58)
settlements	885(297)
villages	28385(4805)
village councils	10279
total integrated territorial communities	407

Source: data of the Central Election Commission (the number of settlements that make up the territorial communities are given in parentheses).

Rural development models in Ukraine

1. The Community model – the components:

- the organization of life in the community-based;
- focus on the formation and use of resources (assets) northern communities;
- positioning of resources, both capital – physical, human, financial, social, natural, political, cultural;
- implementation of the strategy of rural development using local resources – the rate of the community as the subject of rural development plans, implemented and controlled with the assistance of the state.

2. Village preserves (monocentric) model – the components:

- system state policy development of agricultural production and rural territories;
- scientific and public provision of rural policy;
- investments in infrastructure from different sources;
- development of the institution of local government;
- support of socially responsible business.

3. Polycentric entrepreneurial model – the components:

- generator of rural development – entrepreneurship;
- recipient – the local community as a personal development environment for the benefit of the rural communities;
- the coordinator of rural development programs – institute for local self--government;
- the manufacturer shall “rules the game” – the state.

4. Rural model living arrangement – the components:

- development of cooperation and contracting in rural territories;
- state support for family farms;
- creation of a favourable investment climate for individual sector of the economy;
- creation for rural producers tax breaks;
- diversification of economic activities on the rural territories;
- the introduction of higher procurement prices for agricultural products supplied to processing plants;
- state protection and promotion of the natural and social environment of the village;
- reassessment of role of the rural territories in ensuring food and national security of Ukraine;
- formation of the new outlook on life on the rural territories and appropriate ideology population of Ukraine.

19.5. Conclusions

Based on this study we can conclude that the risks of rural development in Ukraine by our classified attributes go beyond traditional notions of economic risks. These risks by their nature and manifestations should be classified as complex, integrated risk that affects all aspects of rural life, the mentality and the sphere of knowledge. The paradox of the situation is the disparity between the current level of development rural areas in Ukraine and its potential. Ukraine has vast areas of fertile agricultural land, favourable natural conditions, a significant potential labour force, but uses them ineffectively. As a result, the government loses a significant portion of revenues. On predatory exploitation of land and other natural resources are cashing owners of large agroholdings companies.

On this basis the risks of rural development in Ukraine pose a real threat not only for food security, but also the national security of Ukraine. Therefore, this challenge requires adequate measures related to the development of the state policy of integrated rural development and related strategic management of rural development, with risk management as his integral part.

References

1. Bell, D., *The coming post-industrial society: the experience of social forecasting*, Moscow, 1999, pp. 956.
2. Bichanich, R., *Turning Points of Economic Development,* The Hague, Mouton, Paris, 1972, pp. 376.

3. Borodina, E.N., Prokopa, I.V., Popova, O.L., *Policy rural development community based in Ukraine: scientific report,* Institute of Economics and Forecasting of NAS of Ukraine, Kyiv, 2015, pp. 70.
4. Braudel, F., *Material civilization, economy and capitalism XV–XVIII centuries*. *– 2 t. [trans. from fr. G. Filipchuk]. The structure of everyday life: the possible and the impossible,* Osnova, Moscow, T. 1, 1995, pp. 534.
5. Gadzalo, J.M., Zhuk, V.M., *Scientific basis for development of the agricultural business and rural territories by village preserves model (scientific report)*. NNC IAE, Kiev, 2015, pp. 40.
6. Kravtsiv, V.S., *Territorial Development and Regional Policy in Ukraine: scientific report,* SI „Institute of Regional Studies named after M.I. Do-lishniy NAS of Ukraine", Lviv, 2015, pp. 246.
7. Krugman, P., *Geography and Trade,* MA: MIT Press, Cambridge, 1991, pp. 476.
8. Nefedova, T., *Rural Russia at a crossroads: geographical essays: mono-graph,* New Publishing House, Moscow, 2003, pp. 408.
9. Nymmik, S.Y., *Socio-economic spatial systems like the adjustable media. The experience of studying the socio-economic territorial complexes. Scientific notes of Tartu State University. Works on geography*, vol. XVIII, 1979, pp. 3-105.
10. Pavlov, O.I., *Rural context of the global economic development of Ukraine Modern science 5*, 2015, pp. 15-22.
11. Rudenko, M., *Progress Energy. Essays on physical economy,* Jura, Ternopil, 2004, pp. 412.
12. Shanin, A.V., *Concept village forming enterprise in the system of rural development of rural territories. Efficient Economy. Electronic scientific pecialized, edition 4, 2015,* ttp://www.economy.nayka.com.ua./?op=18r=3996.
13. Shpengler, O., *Decline of the West. In 2 t. [trans. from germ I.I. Mahonkova],* Iris-Press, Moscow, 2003, pp. 624.
14. Sorokin, P.A., Zimmerman, C.C., *Principles of Rural-Urban Sociology,* Henry Holt and Company, N-Y, 1929, pp. 284.
15. Toffler, E., *Third Wave [trans. A. Evsa],* Publ. house "Vsesvit", Kyiv, 2000, pp. 480.
16. Toynbee, A.Dzh., *Civilization before the court of history: a collection of A.J. Toynbee – 2nd bridles,* Iris Press, Moscow, 2003, pp. 593.
17. Zayats, V.M., *Entrepreneurial model of rural development Economy APC,* no. 11 (253), 2015, pp. 67-78.

COPY FREE

Print run: 250 copies, 17.6 publisher`s sheets
Printing and binding: EXPOL Włocławek