HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES- KAPOSVAR CAMPUS

FACULTY OF ECONOMIC SCIENCES

DOCTORAL SCHOOL OF MANAGEMENT AND ORGANIZATIONAL SCIENCES

Head of Doctoral School

Prof. Dr. IMRE FERTÖ DSc

Supervisor

Prof. Dr. NAGY IMRE CSc

SUSTAINABLE AGRICULTURE AS A BASE OF SUCCESSFUL FOOD PRODUCTION AND EXPORT IN HUNGARY.

BY

Ola Madallah Aljaafreh

DOI: 10.54598/001380

KAPOSVÁR

2021

Content

1. INTRODUCTION

The importance of this study can be determined through its theoretical importance by raising a modern topic that plays a key role in achieving the higher performance of the food and environmental security. As well, the economic and practical importance of this study is to provide solutions and proposals for the sustainable agricultural application in agriculture sector put in the research and put into practice, in order to improve the level of performance and excellence that will be reflected positively in the level of food production and the food export.

2. BACKGROUND OF THE STUDY

In the study of sustainable agriculture or any of the topics related to it, the ideas come back to themain source of the idea of agriculture first, which is productive and effective behavior for the continuation of life and maintenance of the balance of the planet dynamically. Secondly, from the economy, which is the engine of the production wheel of all kinds, agriculture is the basis formany economies of many countries around the world.

The origin of agricultural economics probably can be traced back to ancient Egypt, perhaps tothe first agricultural economist who was Joseph when he interpreted the dreams of the Pharaoh of Egypt and properly predicted seven years of feast and seven years of famine in Egypt that time. Scientifically, agricultural economics comes from two intelligent and rational streams in economic science. The first was the neoclassical political economy, which is related to enlightenment and a preoccupation with the land as a factor by the French Physiocrats in the 18th-century, where Francois Quesnay‘s (1758) classified and categorized the logical

Clarification of the conversion of land inputs to agricultural outputs and return, anticipating modern production economics, input-output analysis, and general equilibrium theory. The second was the theory of the firm applied to farm production, which had been carried out by an economic crisis and slump in American agriculture in the late 19th century, which was, later on, focused on the strategies for organized marketing of agricultural goods and commodities throughcombined bargaining and cooperatives.

Agricultural economics consider as an applied social science which deals with how producers, consumers, and the behavior of the societies which use scarce and natural resources in the production, processing, marketing, and consumption of food and fiber products. With the world'spopulation likely to reach 9 billion by the middle of 21st century, many organizations concerned with agriculture and food believe that there is an urgent need for 60 percent of food by 2050 to maintain all of these people, where possible this food should be produced where needed - in developing and agricultural countries. Therefore, these countries will have to increase their production significantly to achieve this goal, with resources scarcity and with an increase in the negative impact on the limited natural resources on which agriculture depends, especially water allocated for irrigation and livestock purposes, lands designated for crops and grazing, limited nutrients and fertilizers. In many of the places, the soil already suffers permanent damage, while water resources are overexploited or polluted by fertilizers and pesticides. Furthermore, diminished agricultural biodiversity as agriculture became industrial, all these conditions have prompted the world to pay attention to increasing global awareness of the fact that agriculture produces more than just the production of food, animal feed, and its impacts on climate and global human health and ecosystems. Nowadays, when the agriculture has been already well developed around the world, most of the well-being countries are trying to upgrade it to the next

level to make it more environmentally friendly, less harmful and more useful. This is called sustainable agriculture, which is the branch of sustainable development. Sustainable agriculture is the new management way of obtaining important and effective ways to get to the sustainable development. Also sustainable agriculture is the way to increasing the national income, which in turn will affect all members of the agricultural productive society.

3. RESEARCH OBJECTIVE AND QUESTIONS

Agriculture in Hungary is a strategic sector and as such its performance changes are dependent on the weather. In spite of the improvements in recent years, the potentials are largely unused, mainly because of technological weaknesses and lower irrigation rates. In terms of specific productivity per hectare, the EU has done poorly in that, and the improvement is essential. The expert farmers became old, and professional awareness and knowledge are mostly imperfect for small farmers, local agriculture supplies food outputs, but the ratio of processed products in the exports is little. Sustainability has been developed, but organic producing and precision farming has been spreading quite slowly (Szűcs, Vanó, & Korsós-schlesser, 2017).

The empirical research focused on, how sustainable agriculture becomes an applied reality between world foundations strategies, and the countries have tried to adopt sustainable agriculture, but they didn't focus on sustainable agriculture, food production, and food export, so this research has considered all of it as comprehensive work in the farm's level. This gap led usto propose the research questions as below.

The study seeks to answer the main question, "What are the possibilities for developing sustainable agriculture in Hungary? The following research questions will be addressed in order to guide the acquisition of data required to satisfy the statement of the problem:

1. What are the effective indicators of sustainable agriculture in Hungary?

2. What extent has sustainable agriculture influenced food production?

3. What extent has sustainable agriculture influenced food export?

4. What extent has sustainable agriculture influenced food security?

So the primary objective of this study is to examine the impact of sustainable agriculture on foodproduction and food export in selected Hungarian farms. The study specifically sought to:

1. Test the proposed model empirically and investigate the relationship between sustainableagriculture and food production.

2. Test the proposed model empirically and investigate the relationship between sustainableagriculture and food export.

3. Examine the relationship between selected variables that shared between sustainableagriculture by its indicators and food security by its determinants in Hungary in the long term.

4. Evaluate the effective indicators of sustainable agriculture in Hungary.

HYPOTHESES

This study tries to meet the needs of the agricultural sector in Hungary for its influential role in economics and society. This sector has the components of the application of all types of cultivated farms in Hungary. the importance of this study can be determined through its theoretical importance by raising an important topic which plays a key role of achieving the higher performance of the food production and exporting, the economic and practical importance of this study is to know the obstacles through the application of sustainable agriculture work to put solutions and proposals for this type of sustainable work. This research focuses on useful practices. In order to improve the level of performance and excellence that will be reflected positively in the level of agriculture. On the other side, this study will play a key role in developing the farmers' capabilities to solve the dilemmas that it faces in its agricultural work to adopt sustainable production, in order to achieve additional capabilities to meet the current and future challenges and achieve superior performance. The findings of the study have the potential to help decision-makers of the agricultural sector and ministry of rural development in Hungary to develop strategies that will enable them to improve the farmer competency to reach the sustainable agriculture easily.

The following are the hypotheses considered for the study:

1. H1: Sustainable Agricultural indicators have positive relationship with food security
2. H2: Indicators of sustainable agriculture effect has increased in Hungary.
3. H3: There is a positive relationship between sustainable agriculture, food export and food production in Hungary.

5. RESEARCH MATERIALS AND METHODS

The study utilized a quantitative research methodology to determine the extent to which sustainable agriculture by the indicators and tools, which influences food production and food export, agricultural sustainability assessment for the development of sustainable agriculture has needed a unified approach of modernistic science blended with proficient knowledge and active sharing of stakeholders. Therefore, Roy and Chan (2012) suggest the integral of approaches with the participatory tactic in sustainability assessment, which essentially helps to combine a comprehensive strategy for the sustainable agricultural framework.

This study used a survey questionnaire for collecting primary data. The survey questionnaire was distributed to farm owners in Hungary. The survey questionnaire was divided into five sections, namely, respondent and firm information, sustainable agriculture tools, sustainable agriculture dimensions (economic, environment, social, and political), agriculture export sector, and agriculture production sector. The measurements were developed based on an extensive review of the literature (Valkó, 2015; Rovira et al. 2015; Muema, et al. 2018; Dong et al., 2016; Fami, et al., 2007; Gaviglio, et al., 2017; Mavrogiannis et al., 2008). All measurements used a five-point Likert scale. The sample was selected randomly from the complete list of farm owners, Hungarian food and beverage exporters and producers. An online survey took place during February -April 2020 and yielded 106 usable responses.

According to the research questions and hypotheses, this study used the Statistical Package for the Social Sciences (SPSS) software version 23 and the Analysis of Moment Structure (AMOS) software version 24 to test the reliability and validity analyses, and descriptive statistical analyses. In addition, this study used Partial Least Squares Structural Equation Modeling (PLS- SEM) in order to test research hypotheses. SEM is commonly used in the social sciences because of its ability to explain the relationships between unobserved constructs (latent variables) from observable variables (Rahman et al., 2015). SEM is comparable to common quantitative methods, such as correlation, multiple regression, and analysis of variance to estimate and testthe relationships among constructs.

In this study also by the secondary data, the empirical investigation used Principal Components Analysis (PCA). PCA is a statistical multivariate methodology used to study large sets of data. This method reproduces a great proportion of variance among a big number of variables by using a small number of new variables called principal components (PCs). Components were extracted and rotated using the varimax method in order to facilitate the interpretation. High absolute values of loadings of the variables on the PCs imply that the indicator has a large bearing on the creation of that component.

Thus, we considered all the variables that scored more than 0.50 as being related to the definition of the component (Li & Wang, 2014; Jolliffe, 2002). In this study also by the secondary data, the historical approach will be used to identify and analyze the reasons for the relationships, among the variables, as well as the study of their direction and growth; the collected data was subjected for analysis by using VAR model on Gretl program (version, 2017).

In order to get results for this study, quantitative research approach is employed. This deals with quantifying and analyzing variables using specific statistical techniques to answer questions like who, how much, what, where, when, how many, and how by utilization and analysis of numerical data (Apuke, 2017). Quantitative research is used for testing of hypothesis, and to find out the cause and effect along with making the prediction. This traditional scientific research method generates numerical data and also used to find out the association between two or more variables, using statistical methods to test the strength and significance of the relationships (Apuke, 2017). To address the purpose and objectives of the study primary and secondary data isused.

Bird, (2009) mentioned that to collect the primary data a study needs to adopt the survey questionnaire method. Survey questionnaire is a common and fundamental tool to obtain information on sustainable agricultural practices in Hungary and how it has impacted its export of food crops. Close-ended questions are largely used in the questionnaire. Close-ended questions give respondents a limited set of particular responses to choose from. These questions are considered appropriate when the respondent has a certain answer to give and when the researcher has a limited set of answers in mind, when in detailed narrative information is not necessary or when there is a limited number of ways to answer a question, so these questions which are used in this survey research covered by four main types exist for close-ended questions which are Binary, Ranking questions, Multiple choice, and Checklist (Sreejesh et al., 2014). The questionnaire included the design to measure the variables of the study by using a five-point Likert scale. The scale ranges from 1= strongly disagree to 5= strongly agree. The questionnaire was electronically distributed to the selected group of respondents through email. Responses from 105 respondents were received and analyzed. The online survey was done

between the period 15th January 2020 and 27th April. To be responsible, the research provided an option for the respondents to request for a copy of their responses in case they deemed fit.

This study adopted the survey questionnaire method to collect the primary data. Creswell, (2003) states that in general, researchers and scholars adopt a quantitative research often employ questionnaire method because it is considered an economical and efficient method to gather quantitative data concerned to a given population for the purpose of generalizing the result. Furthermore, Quantitative research commonly employs survey method as it is considered the most appropriate for collecting data (Creswell, 2003). This study adopts a web-based survey for collecting data from the sample of the study. Online questionnaire was developed using Google- Forms tool. According to Grohmann and Kauffeld (2013) questionnaire is often used while adapting survey method. The online questionnaires were distributed through e-mail designed to collect the primary data from the Hungarian farmers and food producers.

To appropriately address the research questions and hypotheses, this study adopted the Statistical Package for the Social Sciences (SPSS) software version 23 and the Analysis of Moment Structures (AMOS) software version 24 to test the reliability and validity analyses, and descriptive statistical analyses. In addition, this research used Partial least squares structural equation modeling (PLS-SEM) in order to test research hypotheses. SEM is commonly used in the social sciences because of its ability to explain the relationships between unobserved constructs (latent variables) from observable variables (Robert, 2007). SEM is comparable to

common quantitative methods, such as correlation, multiple regression, and analysis of variance to estimate and test the relationships among constructs.

One of the reasons for adopting quantitative methodology in this study is that the method is suitable for use in hypotheses testing of relationship between independent and dependent variables (Valkó, 2015; Rovira et al. 2015; Muema, et al. 2018; Dong et al., 2016; Fami, et al., 2007; Gaviglio, et al., 2017; Mavrogiannis et al., 2008). The purpose of this quantitative method is to verify the research hypotheses., a quantitative research approach is appropriate when specific hypotheses are tested, concepts are defined as distinct variables, procedures are standard, and analysis occurs using statistics, tables, and charts. This study meets these criteria. This study uses a primary data and secondary data to address the purpose and objectives of the study. This study adopted the survey method to collect the primary data. (Roy & Chan, 2012) states that in general, researchers and scholars adopt a quantitative research often employ survey method because it is considered an economical and efficient method to gather quantitative data concerned to a given population for the purpose of generalizing the result.

Furthermore, this study also employed the use of secondary data in an attempt to achieve the overall research objectives. Consequently, the collected data was subjected for analysis by using Gretl program (version, 2017). Results were summarized cointegration relations to examine the relationship between the variables, using VAR model, the study analyzed the dynamic relationship between Macroeconomic variables which have been chosen to be the link between sustainable agriculture and food security by the selection of some indicators of sustainable

agriculture (Emission gas Greenhouse, Fertilizers consumption, Organic Farming, Agriculture Area).

In addition Principal Components Analysis (PCA) as a statistical multivariate methodology is used in this study because it makes use of large sets of data. This method reproduces a great proportion of variance among a big number of variables by using a small number of new variables called principal components (PCs). As a result components were extracted and rotated using the varimax method in order to facilitate the interpretation. High absolute values ofloadings of the variables on the PCs imply that the indicator has a large bearing on the creationof that component. Thus, the research considered all the variables that scored more than 0.50 as being related to the definition of the component (Li & Wang, 2014).

6. RESULTS OF THE RESEARCH

This paper analyzed the dynamic relationship between Macroeconomic variables which have been chosen to be the link between sustainable agriculture and food security by the selection of some indicators of sustainable agriculture (Emission gas Greenhouse, Fertilizers consumption, Organic Farming, Agriculture Area) and some other related variables (Hungarian Population, Real gross domestic product). Subsequently, to examine the effect of each variable in a long timeseries (1980-2016) through each other's, also the effects of those variables on FPI, In contrast, the GDP had a positive relationship with all variables except organic farming, which make the opposite side with the study (Nkomokat et al.,2019) of that considered the GDP affected positively with all macroeconomic and environmental variables.

The results showed that the data of variables which had been selected in this study depending on (Dick Fuller) tests, that all are stationary, also there is long term relationship between all seven variables. Furthermore, there is a significant positive impact of EGG, AAH, F, GDP, and P on FP, while the effect of on FPI was insignificant. The recommendation is increasing and improving organic farming with an effective method to reach the massive food production with sustainable products. The results indicate the positive relationship between greenhouse gas emissions and the use of fertilizers and the agricultural production index, where this result corresponds to the study (Mihaela et al.,2019.) of greenhouse gases that concluded a positive effect between greenhouse gases resulting from agricultural consumption and fertilizers, which explained this increase to the slow increase in the volume of irrigated agricultural lands. In the results as well, the relationship was negative in relation to organic farming with the rest of the variables. This is a logical result in respect of the relationship between the use of fertilizers and the agricultural production index positively, while the use of fertilizers was harmful with the production of organic agriculture because the fertilizers used are inorganic or the using extensively for non-biological fertilizers. This result is also compatible with the study (Mariangela et al.,2019.), which concluded that the emission ratios differ with the use of multiple-source fertilizers, which recommended the encouragement of the recycling of agricultural waste, thus preserving the soil from depletion and preparing it for more organic production. On the other side the positive relationship between growth population with the food production index, it will cause big challenges to maintain food security with the sustainability at the same time particularly with the vulnerable population, because of food insecurity occur when estimated per capita food consumption for a consumer at a certain income level shorts of nutritional target of 2.100 calories per person per day depending on (Thome et al.,2019). The

food production should be increased more than the rising population, with sustainable ways toget sustainable agriculture and food security in parallel with each other.

Principal component analysis (PCA) is a multivariate method that tests and analyses the observed data table which are described by various inter-correlated quantitative dependent variables. It aims to extricate the significant input from the statistically observed data to represent it as a group of new rectangular and orthogonal variables which called principal components. Furthermore, it also shows the pattern of likeness between the observations and the variables as points in spot and points maps (Wang et al., 2017). In this study, the indicators of theevaluation of sustainable agriculture were divided into three groups as they are divided into many studies and scientifically approved into environmental, economic and social indicators as well. Based on that, these indicators were chosen according to the availability of statistical data for each of them and thus the goal was defined for each indicator with the effect of an increase or decrease in sustainable agriculture as shown in Table (4). The PCA model is a distinct model in reducing a large number of indicators to be limited and strongly demonstrating the presence of indicators with high or high impact after entering data and obtaining results through the PCA model (Yu & Chang, 2000).

Principal components of the PCA on the environmental indicators in a total of 22 variables. Five principal components with eigenvalues greater than 1 were retained for further analysis (Table 5). The rotated factor (Varimax) matrix of independent variables is also given in (Table5). The first principal component (PC 1) explains 35.35% of the total variance associated indictors emission of ammonia in agriculture (.888), emission of sulfur oxides in agriculture (.823),

emission of non-methane volatile organic compounds in agriculture (.917), emission of methane in organic (.723), use of inorganic fertilizers –Potassium (.803), share of arable land in UAA (.848), livestock density (livestock unit /UAA) (.938), and grazing rate (fodder area) (.676). Its opposed indictors CO2 emission (-.953), use of inorganic fertilizers – nitrogen (-.585), bird index of farmland species (-.927).

The second principal component (PC2) explains 67.97% of the total variance associated indicators: emission of greenhouse gases in agriculture (.858), emission of nitrogen oxides in agriculture (.917), emission of methane in organic (.541), emission of nitrous oxide in agriculture(.917), use of inorganic fertilizers –nitrogen (.744), irrigable area in UAA (.528), biomassproduction in agriculture (.898), and share of mixed crops –livestock farms (.826). The third principal component (PC3) explains 80.02% associated indicators: nitrogen balance per hectare of UAA (.933), Phosphorus balance per hectare of UAA (.933). Its opposed indicator share of a not-utilized area in the agricultural area (-.891). The fourth third principal component (PC4) explains 86.18% associated indicators: water use in agriculture per UAA (.733), the irrigablearea in UAA (.745), and share of organic farming (.691). The fifth principal component (PC5) explains 90.94% of total variance associated indicators use of manure per hectare of UAA (.925).

The economic indicators, the PCA carried on 6 variables of the economic dimension of which 2 principal components with eigenvalues greater than 1 were retained for further analysis (Table2).The first principal component (PC1) explains 72.22% of the total variance associated indicators: gross value added (.985), gross fixed capital formation (.743), crop output /animal output (.961),

factor income (.961), and research and development in agriculture (.980). The second principal component (PC2) explains 95.64% of the total variance associated indicators: gross fixed capital formation (.579), agricultural income (.986).

Principal components of the PCA on 3 social indicators of which 2 principal components with eigenvalues greater than 1 were retained for further analysis (Table 7). The first principal component (PC 1) explains 46.88 % of the total variance associated indicators: labor force in agriculture (.928) and the rate of unemployment in the thinly populated areas (.732). The second principal component (PC2) explains 90.15% of the total variance associated indicators: rate of net migration of rural population (.955) and with opposed indicators: rate of unemployment inthe thinly populated areas (-.584).

Testing the second hypothesis shows that there is a positive relationship between sustainable agriculture and food export in Hungary. A regression analysis was applied to determine the impact of the independent variables on the corresponding dependent variable, this study was limited to identifying sustainable agriculture in Hungary by analyzing indicators only, and there is not any comparison between Hungary with other countries with regard to this field, which is distinct from the study of (Birovljev & Kleut , 2016).

The objective of the study was to understand the importance of sustainable agriculture and its resulting influences on food production and food export. Sustainable agriculture here is

operationalized to include sustainable agriculture tools as well as dimensions (economic, environmental, social and political). The researcher believes that these factors all together influence food production and food export. Findings of the study indicated that sustainable agriculture tools have no influence on agricultural production. In the same wave length sustainable agriculture has been proven to have no significant impact on agricultural production. The results suggest that sustainable agriculture in its current form does not really contribute tothe increase in agricultural production as well as food export. Benefits of the food production and its corresponding export are not associated with the sustainable agriculture tools. It could be that even though the tools are being applied, they may be ineffective in their applications. Another reason could be that the farmers do not do a holistic application of the tools.

In respect of the dimensions of sustainable agriculture, the economic, environment as well as social dimensions all have significant and positive impact on agricultural production in the country and food export. They are significant perhaps because they represent very important factors when a country considers sustainable agriculture. It is safe to assume that the monetary, cost-benefit analysis and all other economic considerations are widely influencing factors in the decision to enhance sustainable agriculture. It is also not surprising to know that the environment plays an active role in positively influencing agriculture production. The environment represents the field of play where agricultural activities take effect. In this case there is the need to ensure appropriate maintenance of the environment to enhance its longevity to serve other generations beyond the current one. On the environmental effect of agricultural production and export, Reganold, Papendick and Parr (1990) acknowledge the damaging effects of soil erosion and the need for its prevention. This could have a lasting effect on agricultural production. Social

dimension has also been seen to positively influence food production and food export. This indicates that the social activities of the farmers are necessary catalysts for sustainable agriculture. The findings here indicates that farmers see themselves as modern ones and as such would likely want to adopt sustainable agricultural practices and to also ensure that the workers on the farm work in a safer environment. It also suggests that farmers are ready to approve the use of a more convincing sustainable agricultural practices since sustainable agriculture methods improve the credibility of the farmers in the society. This is supported by the view expressed by Pharm & Road (1987) that economic viability, environmental soundness as well as social acceptance of agricultural production all have the hallmark of ensuring food production.

However, the political dimension has a negative influence on food production and export. This means that the agency does not either provide adequate information on how to apply sustainable agricultural practices or encourage farmers to adopt same. Encouragement could come in the form of subsidies or loans, in which case are absent. From the results, it is safe to assume that the continuous use of any agency to help in providing information or encourage farmers on sustainable agriculture in its current form brings about a detrimental effect. It is therefore vital to overhaul the activities of any agency responsible in this regard.

7. CONCLUSION AND SUGGESTIONS

Sustainable agriculture has a positive influence on food security so when we work to improve sustainable agriculture we are at the same time working to improve on food security. Food security can therefore be achieved where sustainable agriculture becomes effective. Sustainable agriculture includes the investment of available natural resources, the employment of all potential opportunities for the rural population, and agricultural raw materials to increase agricultural exports in order to reduce the balance of payments deficit. There are many indicators which affect sustainable agriculture in Hungary. However, it is found that the economic, social and environmental indicators have proven to be effective in sustainable agriculture in Hungary. Sustainable agriculture is the necessary means to achieve comprehensive development because it is an important source for improving agricultural production by quantity and quality as well as maintaining the natural resource base.

The study further revealed sustainability of agriculture is a vital aspect of many societies in the world, and Hungary is not an exception. In many studies, the concept of sustainable agriculture is looked at in respect of the impact of its application on the society, without examining the relationship between the basic components of the sustainability process that begins with farmers through the producer and the exporter to reach the consumer. The purpose of the study is to examine the existence of sustainable agriculture, and the effect of sustainable agriculture on food production and food export in Hungary. Findings suggested that sustainable agriculture largely (with the exception of tools) influence food production and export.

8. NEW SCIENTIFIC RESULTS

1. This section shows the empirical results of the data analysis, which begins with the summary of the unit root test the stationarity of the variables used to test the empirical study. Augmented Dickey-Fuller (1979) tests were employed. Table (1) shows that the variables expressed at the level are non-stationary but when all the variables are first differenced there is evidence that all the variables are stationary.

Table 1: Unit roottest results **variable**

	Level		**1st difference**	
	No Trend	**With Trend**	**No Trend**	**With Trend**
FPI	-0.147	-0.132	-0.010*	-0.032*
P	0.042	0.098	0.045*	0.044*
GDP	0.087	0.020	-0.031*	-0.030*
OF	-2.85696	0.032	-0.023*	-0.021*
F	-0.000	0.058	-0.033*	-0.058*
EGG	0.802	0.875	0.660*	0.635*
AAH	-0.074	0.078	-0.009*	-0.082*

The next step is to test if there is a long-run relationship exists among the variables by using a cointegrating relations method. Table 2 presents the Johansen test for the cointegration relations among all seven variables, on the basis of trace statistics and the maximal eigenvalue statistics at 5 percent. The trace statistic reveals that there is one cointegrating relationship among seven variables. Since the trace statistic considers all of the smallest eigenvalues, it possesses more power than the maximum eigenvalue statistic. Johansen and Juselius (1990) recommend the use of the trace statistic when there is a conflict between these two statistics. Therefore, this result indicates that there is a long-run relationship between these seven variables. In other words, the variables have also cointegrated the equations of the VAR, including the lagged values of the variables in levels to capture their long-run relationships.

Table 2: Cointegration test results

Null hypothesis	**Trace statistics**		**Maximal eigenvalue statistics**	**Critical Values (5%)**
Trace			**Max-Eigen**	
r=0	131.13	41.635	153.57	42.085
r ≤1	89.493	32.216	111.49	41.595
r ≤2	57.277	23.255	69.893	25.501
r ≤3	34.022	21.505	44.392	21.791
r ≤4	12.517	9.6242	22.601	13.151
r ≤5	2.8930	2.7557	9.4497	6.8504
r ≤6	0.13732	0.13732	2.5994	2.5994

8. PUBLICATIONS IN THE FIELD OF DISSERTATION

Paper in scientific journals

1. Ola, M. A. (2017). The role of food marketing in sustainable agriculture (case study of Hungary). Kaposvár, Hungary: Kaposvár University, pp. 1-13. , 13 p.
2. Ola Al Jaafreh, Imre Nagy (2018). The Environmental Challenges, Problems, and Management: A Case Study of Jordan. Journal of Zbornik Radova Departmana Za Geografiju Turizam I Hotelijerstvo, 47: 1 pp. 53-70. 18 p
3. Ola Al Jaafreh, Imre Nagy (2020). Food Security and Sustainable Agriculture: A Case of Hungary. American-Eurasian Journal of Sustainable Agriculture, 14: 1 pp. 1-13. , 13 p, DOI: 10.22587/aejsa.2020.14.1.1.
4. Ola Al Jaafreh, Imre Nagy., 2020. Evaluation of sustainable agriculture in Hungary/American- Eurasian Journal of Sustainable Agriculture. 14(2): 11-22.DOI: 10.22587/aejsa.2020.14.2.2
5. Ola, M. A. (2020). Sustainable Agriculture, Food production and Export: A Case of Hungary.

Full paper in conference proceedings

1. Ola, M. A. (2017). The role of food marketing in sustainable agriculture (case study of Hungary), 6th. International Conference of Economic Science, Kaposvár University,Kaposvár, Hungary, ISBN 978-615-5599-42-2.

Abstract in Conference proceedings

1. Ola, M. A. (2018). The Role of Women for Sustainable Agriculture in Hungary. 3rd Summer Seminar in Marketing "Marketing and Consumer Behavior: Current Challenges", Faculty of Management University of Warsaw July 6, Warsaw, Poland.
2. Ola, M. A. (2018). The Environmental Challenges, Problems, and Management: A Case Study of Jordan., 3rd International Young Researcher Scientific Conference "Sustainable Regional Development -Challenges of Space & Society in the 21st Century", Szent István University, Gödöllő, Hungary, ISBN 978-963-269-730-7.
3. Ola, M. A. (2017). Sustainable Agriculture as a Base of Successful Food Production and Export in Hungary. Workshop supported by the European Association for Comparative Economic Studies University of Szeged, Hungary 23rd-24th March 2017.
4. Ola, M. A. (2019). Evaluation of Sustainable Agriculture by Economic, Environmental and Social Indicators in Hungary. Faculty of Economics and Business Administration, University of Szeged 5–6 April 2019 Szeged, Hungary.