ASPECTS ON THE NEED OF REENGINEERING THE ENTITIES ACTIVATING IN THE AGRICULTURAL SECTOR

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Abstract

In order to take pertinent decisions, the Manager of the agricultural entities must analyze and evaluate concrete data on what should be collected on site. This is possible through precision agriculture, which uses the technological development in order to increase the crops yield and to make efficient the managerial activities.

The implementation of such technologies, either software or new equipment or machines requires great investments. Investments have been performed at the Romanian agriculture level, through non-reimbursable financing, but they have not been enough in order to reach an optimum exploitation of the obtained agricultural areas. This paper aims at performing an analysis of the macroeconomic factors from agricultural sector in order to identify the relations which can determine the acceleration of the dynamics of the investments.

By processing the data put at disposal by the National Institute of Statistics through the Economic Accounts for Agriculture, a dashboard presenting the Gross Fixed Capital Formation for machines and machinery was obtained. The variables of the table have been statistically analyzed by using Grelt software in order to fulfill the established objective

Keywords: Precision agriculture, capital, sustainable development, Smart farming technologies

JEL Classification
O13, Q16, Q14

Introduction

Today, a fundamental role is played by the performance of economic entities, as the competition for each market segment of the economic sub-systems has become ever closer, and the mechanisms of globalization eliminate the weakest from the context. The chance of survival in this competition increases considerably for those economic entities that discover and reduce their vulnerabilities very quickly and, moreover, implement certain performance tools that make it easier to locate, explain and solve various management gaps. The increase in competitiveness must not be omitted in this struggle, so that the various impediments that can emerge in the success of the economic entities, such as the imperfect and constantly

changing legislation, the very strong impact of politics on the economic processes, the general instability in the society (all characterizing the business environment in Romania) can be overcome much easier. Climate change manifested on the planet directly affects the agricultural sector (Barnes et al., 2019). According to FAO (2013) studies, the main actions of the agricultural producers against climate changes are the implementation of new agricultural production technologies and practices such as modern efficient irrigation techniques, new plant varieties well adapted to climate change, flexible pest control systems or improved techniques for early warning in critical situations.

The European Agricultural Machinery Industry Association CEMA (2014) draws attention on the importance of the concept of efficient agriculture in the context of world population increase, being absolutely necessary to implement some measures through which to produce more, but with much smaller costs and which would strictly comply with environment protection measures. CEMA also states that the future is represented by the Smart farms and by using smart equipment.

Due to applying new technologies in agriculture, the farmers can obtain high outputs of the crops, varieties with improved strength and grounds which store larger nutritive substances (Warutere and Verkooijen, 2011).

By analyzing the information available at the level of the databases of the National Institute of Statistics of Romania, of the Ministry of Agriculture and Rural Development and of the Ministry of Internal Affairs (vehicle registration database), there is a decrease in the equipment's age in the last 10 years, but in the same time is imperative to increase the major investments for the renewal of the agricultural machine and machinery fleet.

The implementation of efficient agriculture implies both the existence of a modern machine and machinery fleet and their compatibility with the available IT solutions and applications that are absolutely necessary for an efficient management of the companies / entities operating in the agricultural sector.

The objectives of the paper are to analyze the macroeconomic indicators that aim at the dynamics of gross investments in agricultural area. By analyzing these indicators, it is desired to establish a relationship between the factors that influence the tendency of increasing the need of reengineering of the machine and machinery park.

Methodology

The actual global economic environment, through its specific elements, imposes to economic entities new performance standards which exceed the economics area. Taking into consideration the macroeconomic developments, we consider that the neglecting of the various social, technological and environmental aspects can lead to the registration of some losses in the financial statements of the economic entities which activate in agriculture domain and not only.

We plan to analyze the development of Romanian agriculture at a macroeconomic level, dynamic in the period 2008-2017. The analysis was carried out using the following variables: relative gross fixed capital formation for machinery and equipment (MGFCF) in relation to the value of production at branch level (VAP), fixed capital consumption (FCC) and the value of the equipment (EV).

The production of the agricultural branch is determined according to the Eurostat methodology for the Economic Accounts for Agriculture and includes: the value of all agricultural product outputs (including the value of wine production obtained in agricultural units without industrial winemaking facilities) and the value of agricultural services performed by specialized units.

Consumption of fixed capital takes place gradually through its participation in several production cycles. Gross fixed capital formation represents the value of the durable goods acquired by resident units for the purpose of later use in the production process.

Following the application of the stated reasoning will result a useful scoreboard in the opinion of the authors, the managers of the agricultural entities as well as the regional authorities for establishing the future directions for the development and implementation of support measures in the less favored areas, taking into account the sustainable development.

The used and processed data were taken over by the authors from the site of the National Institute of Statistics of Romania, Economic Accounts for Agriculture (EAA) section. EAA represents a system of interconnected accounts which supply a systematic, comparable and as complete as possible image of the economic agricultural activity. EAA have included in their structure the production, operation, income accounts of the enterprise and the capital account.

For this study, the authors have used the capital accounts which include the Gross Fixed Capital Formation and the production accounts comprising the non-finance assets' added value. The processing of the data obtained was performed with the help of Gretl software having as purpose the identification of the statistical links which exist and develop between the variables approached in the study.

The authors had in view the following main objectives for the issuance of the present study:

1. Evaluation of the structure of agricultural development in Romania based on the macroeconomic indicators reported during 2008-2017

2.Identification of the relation between the index that determines the increase of agricultural machinery and equipment and the other gross investment dynamics' indices.

The study's diagram is represented by the 2 level structuring of the performed analysis, distributed as follows:

The first part of the research presents the study of the specialty literature, by identifying some important facts which limit the implementation of efficient agriculture.

The second part consists in the conceptualization of the model, based on the results depicted from the operational study, in the analysis of results and formulation of conclusions.

Factors obstructing/influencing the transfer from traditional to precision agriculture

In accordance with the study performed by Bewley (2010) on a sample of 229 milk producers from Kentucky, USA, the main factors responsible for the low adaptability of producers to the new zoo-technical technologies have been identified: the lack of information on the technologies available on the market (55%), not identifying quickly the cost-benefit ratio (42%), information excess, without farmers knowing how to use it (36%) or shortage on available time in order to learn to use the technology (31%). Starting from this study, Atzori (2013) proved that these factors are closely related to the professional training of the agricultural entity managers and that the level of their education can represent an important factor in the implementation of an efficient agriculture.

The study performed at the level of 227 agricultural entities from Germany (Paustian, 2016) presented the fact that 69% of the farms that hold agricultural areas larger than 500 ha had adapted to the efficient agricultural requirements, as compared with a weight of only 9% in case of farms having agricultural areas between 1 and 99 ha.

Another study, based on the comparison between two German farms from different areas present the impact of implementing efficient agriculture per regions and the changes generated by this factor at the level of company's management (Meyer-Aurich, 2008). One of the farms held a surface of 1560 ha and the second of only 150 ha. The technologies used for the first farm are represented by the cartographic management of crops according to the soil type, based on output maps and on using aerial photographs, and for the second, technologies based on sensors used for the management of nitrogen usage had been implemented. The usage of sensors' technology had a moderate influence on the company's management system, while the system's implementation based on map plotting has led to a significant reorganization of the farm.

At United Kingdom level, the research made by DEFRA (2013) on a sample of around 2.800 agricultural farms found that the main factors for the non-usage of efficient agriculture are similar to the ones met in USA and Germany. The study has revealed that most of the managers of the entities are over 40 years old and that the agricultural farm represents a family business in 77% of the cases.

Within the main technologies used by the British farmers, the greatest weight is held by GPS guiding technology (83%), map plotting on site (GIS) (41%) and usage of images through satellite (51%) (Holland, 2015).

The engineering in agriculture and the technical level of machines and equipment is in close connection to the volume and quality of the agricultural production.

At the Romanian agriculture level, one of the problems that obstruct the engineering and that generally manifests at small farms level is represented by not knowing the development possibilities and the insufficiency of resources in order to develop (Gimbășanu, 2017).

Model presentation

Starting from the need to increase investments in retrofitting, we analyzed dynamically the main indicators of the EAA that concern the equipment park during the period 2008-2017. The results were centralized in table no. 1.

Table no. 1. Segregated analysis

Millions of lei

	Value of agricultural production (VAP)	**FIXED CAPITAL CONSUMPTION (FCC)**	**EQUIPMENT (EV)**	**GFCF OF MACHINES AND OTHER EQUIPMENT (MGFCF)**
2008	66.994	7.590	4.379	1.166
2009	59.928	7.346	3.770	889
2010	64.453	8.251	4.687	1.642
2011	76.509	10.049	6.438	2.046
2012	64.259	11.440	7.539	1.861
2013	78.464	11.940	7.876	2.044
2014	74.524	13.437	9.196	2.411
2015	68.750	12.789	8.485	1.758
2016	69.349	11.160	6.893	1.355
2017	78.494	10.517	6.251	1.455

Source: elaborated by the author

Following to analyzing the date from Table 1 within Gretl statistical software, the following equation for defining the relations between variables resulted:

$$\^{} MGFCF = + 0.0276* VAP + 0.725* EV - 0.482* FCC \quad (1)$$
$$(0.0112) \qquad (0.267) \qquad (0.233)$$

$$T = 10, \text{R-squared} = 0.987$$
(standard errors in parentheses)

Following to testing the least squares model, it resulted that there is a significant statistical relationship between the variables analyzed.

It is observed within the model that p-value registers values smaller than 0.5, fact which confirms that there is a significant statistical relationship between the analyzed variables. The model's consistency is also proven through the R-squared value which is close to 1.

Model 1: OLS, using observations 2008-2017 (T = 10)
Dependent variable: MGFCF

	Coefficient	Std. Error	t-ratio	p-value	
VAP	0.0276489	0.0111682	2.476	0.0425	**
EV	0.725279	0.266820	2.718	0.0298	**
FCC	−0.481648	0.232782	−2.069	0.0773	*

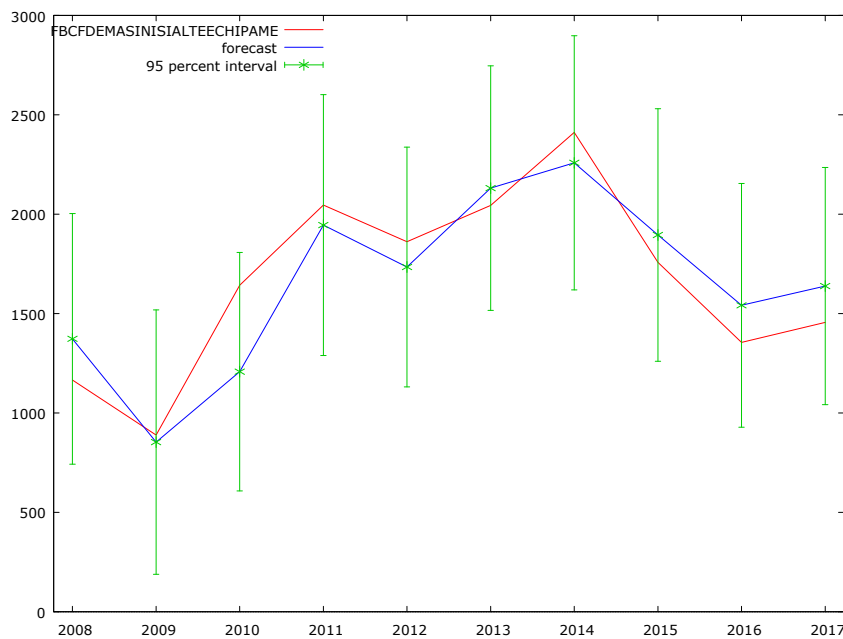|			
Mean dependent var	1662.755	S.D. dependent var	457.5291
Sum squared resid	377150.1	S.E. of regression	232.1176
Uncentered R-squared	0.987229	Centered R-squared	0.799814
F(3, 7)	180.3709	P-value(F)	5.45e-07
Log-likelihood	−66.87845	Akaike criterion	139.7569
Schwarz criterion	140.6647	Hannan-Quinn	138.7611
rho	0.229106	Durbin-Watson	1.380212

Fig. no. 1. Graphical representation of the confidence interval
Source: elaborated by the author

Discussions

The implications of using Information Technology in agriculture to limit costs by monitoring and optimizing with digital maps and the synergies between them and the agricultural machinery, actions which lead to productivity increase at the same time, become a strategic priority for any agricultural entity.

The decisions of the agricultural managers must include a systematic analysis of all available information, which is only valuable when centralized to present a picture of the

link between decision and effect. The establishment of good management patterns is an advantage of IT systems that cannot be provided by the classic management systems, given the large amount of information that needs to be processed.

The current agricultural management systems used in the domestic market have been adapted to support farmers' work, from providing the necessary analyzes up to the possibility of automatically creating reports that must be done and for comparing the resources used on farms in similar areas. Automatic data processing by means of sensors mounted on agricultural machinery is a solution designed to reduce the time of data processing, the time for their introduction and to reduce both the administrative staff costs and the risk of human error (Panturu, 2014). The monitoring of pesticides and fertilizers used, reported to the crop type, as well as the automatic completion of the Fertilizer Register and of the Phytosanitary Registry prove the usefulness of such an IT solution (Zarco-Tejada, 2014).

The impediment in purchasing this software is the lack of the necessary financial resources and the practical implementation difficulty is due to the sporadic use of computer technology and the difficulty in acquiring IT procedures for farm management by Romanian farmers, far from their comfort zone.

Another important problem among small farms is the lack of a managerial culture that reveals the importance of accurate records. In some farms in Romania there is no centralization of the activities that take place at the farm level or at the level of written evidence, and the reports are made based on the situation memorized by the manager. The level of training of farmers in Romania is mainly represented by practical experience without the implication of the educational factors. According to the study conducted by the European Commission on Farmer Families at European Union level (2016), the number of Romanian farmers aged over 50 is 40%, making it difficult to attract them to modern technology and computerized agriculture.

Conclusion

The necessity of the present study started from the desire to understand and explain the changes occurred at the management style level which must be achieved by the entities from agricultural level in order to resist on the market in competitiveness conditions. We consider that a viable solution is the translation of the Romanian agriculture to an efficient agriculture, as presented also in the durable development policies provided by the European Union. But in order to achieve this endeavor, it is required the reengineering of the machinery and equipment fleet, as well as the adoption of some software integrated solutions which can bring extra value to the managerial activity. In the authors' opinion, the first step would be the reengineering of machinery and equipment which would influence the profitability and agricultural output. The synergy between efficient machinery and managerial softs represent the key precision agriculture implementing equation. The performed analysis presented the potential of the gross investment dynamics in agriculture at macroeconomic level. Gross fixed capital formation for machinery and equipment is statistically influenced by the value of recorded agricultural production, the value of equipment and machinery and the consumption of fixed capital.

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