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Mechanism for the dissemination of agricultural technologies in Romania

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Abstract:

This research is concerned with outlining the strategies supporting the mechanisms of the dissemination of agricultural technologies in Romania. The problem in Romania in this respect is dueto a lack of a mechanism of dissemination of the agricultural technologies caused by a lack of the extension of knowledge from the units responsible for itsuch as lack of consultancy services and directions. This has affected the understanding of the importance of agricultural technologies by farmers. In an attempt to solve this problem, Romania has adopted a number of strategies for the dissemination of agricultural technologies among farmers and specialists. Among these strategies is encouraging the Management Entity of the Cluster "Sviluppo Insieme si Vince" that created IND AGRO WEST, the first innovative cluster for research and development in Romania, aimed at achievement of modern agriculture equipment, appropriate to Romanian soil (Sviluppo, 2014). Another strategy is finantially supportinginnovations and projects conducted for addressing the issue of agricultural technology dissemination through funding and financial support. For example, Climate smart agriculture is one of the key topics for the almost 3,000 innovation projects that are expected to receive funding from the Rural Development budget. Around EUR64 million will be dedicated to precision farming and digital technologies in the agriculture sector under the Horizon 2020 Work Programme for 2016-2017 while EUR30 million will be invested in the implementation of an Internet of Things Large Scale Pilot on “Smart farming and food security” (Michalopoulos, 2016). Another strategy is creating institutes that are concerned with the dissemination of agricultural technologies in Romania. The mission of the National Research and Development Institute for Machines and Installations for Agriculture and Food Industry is to carry out scientific research (fundamental and applicative), innovations in the field of processes, technologies and technical equipment leading to the mechanization and automation of agricultural works and the food industry, in the context of harmonizing the whole activity with ANCS policies. It is also important for Romania to search for collaboration with other countries such as Netherlands that runs many projects to transfer to Romanian farmers' a better understanding of technology. Dutch is another important country to collaborate with in order to transfer Dutch farmers’ knowledge to and technological novelties to Romanian young entrepreneurs. Overall,dissemination of agricultural technologies in Romania among specialists as well as farmers is essential in order to raise their awareness towards the latest knowledge and mechanisms of running agriculture. To achieve this goal, there are a number of strategies, as outlined in this research, that must be considered, with a special focus on establishing institutes for workshops and training courses, providing financial support, and collaborating with other countries.

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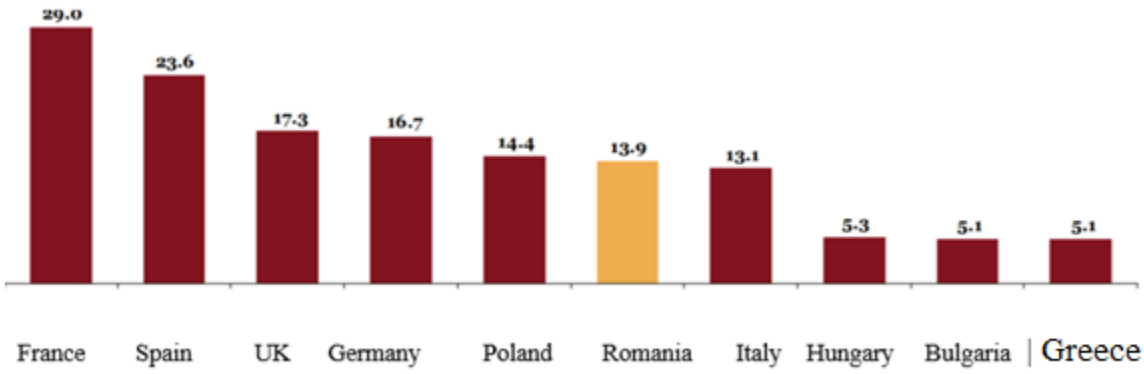
Throughout the development of mankind, a major branch of economic activity was represented by agriculture. Agricultural research has played a particularly important role in increasing production and in rational exploitation of existing resources when the population of the planet is constantly growing and the exploited agricultural fund is limited and with clear tendencies of deterioration. In this background, the mechanization of agriculture has played and continues to play a fundamental role from a technical, economic and social point of view, especially in highly industrialized countries, offering substantial cost savings, increasing the quality of works, and creating new products especially in the energy field. Romania occupies an important position in the whole of agriculture European Union, ranked 6th in the EU from the perspective of the agricultural area used, as seen in the figure below:

Figure 1. The top ten EU countries from the perspective of the agricultural area used



Source: Eurostat

Developing and modernizing agriculture is a natural and necessary process provides food for a healthy, well-nourished population. There is concern in all countries for the intensification of agricultural production, starting various work programs of technological and social-economic nature. These actions can have an effective completion if the essence is taken into account, mainly that agricultural territory and plants must be grown as an ecological system, as a unit. Hence, the territory must be seen throughout its complexity, its inner and outer ties. However, the symptoms of low capitalization in agriculture are numerous and significantly affect yields. E.g, technological facilities of agricultural holdings are underdeveloped:

• Less than 2% of holdings in Romania have a tractor, one of the basic technological endowments in the agricultural field, towards compared with 84% of the Czech farms

• In addition to quantitative aspects, remains a difference of level of equipment quality in Romania is running a large number of already written and equipment purchased second-hand. Thus, in 2012, about 73.1% of the tractors and 69.6% of the grain cereal harvesters were older than 7 years, according to data provided by the Ministry of Agriculture and Rural Development

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• The main obstacle to the technological endowment of Romanian farmers is the reduced area of agricultural holdings, which does not allow the efficient use of modern technological means, nor does it justify their investment in terms of the harvests obtained According to APIA data (Agency for Payments and Intervention in Agriculture), as against the previous years, the number of farmers owning between 1-10 ha diminished with 3%, and thearea owned by them diminished with 3.5%. At the same time, the number of farms owning 10-100 ha increased with 2% and the area increased with 5.8%.

Table 1. Farms in Romania in 2010

Sizes	Number farmers	Area - ha -	Weight -% -	Average size of the farm - ha -
1 - 10 ha	1,087,853	3,000,720.74	31.25	2.95
10 -100 ha	61,182	1,580,530.10	16.47	25.80
Over 100 ha	11,994	5,018,822.24	52.28	418.40
Total	1,161,029	9,600,073.08	100.00	8.83

APIA data (Agency for Payments and Intervention in Agriculture) (2010)

Analysis of the laborresources has been carried out through thefollowing indicators (calculated for all 27 EUmember countries in 2010):

- labor consumption per hectare;
- used agricultural area per capita

Table 2. Estimation of agricultural labor (2010)

Nr. Crt	Country	Population total	UAA - hectars	Labour Input: (1 000 annual work units)	Labor input/ UAA	Farm workers	Percentage of population occupied in agriculture
1	Romania	21,355,849	13,306,130	1,598.0	0.120	7,156,930	33.513
2	European Union (27 countries)	503,930,191	171,604,320	10,134.7	0.059	24,960,390	4.953

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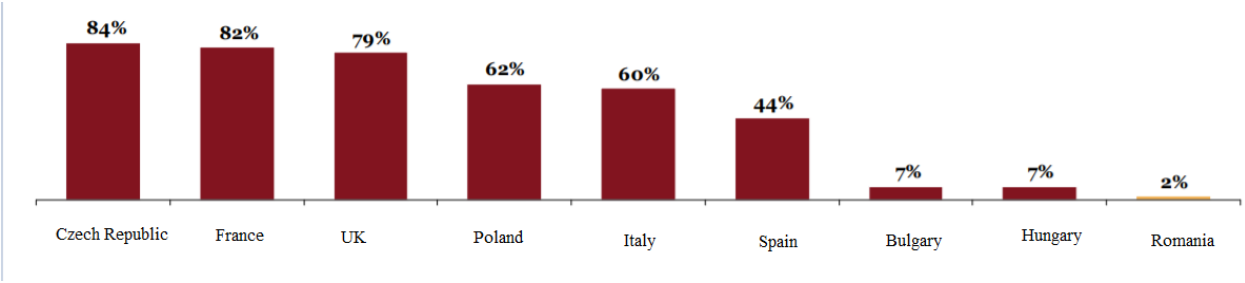
3	Pondere (%) Romania/ UE-27	4.24	7.75	15.77	203.35	28.67	676.60

Source (Eurostat)

The level of technological endowment of farms in Romania is well below the EU average and this limits performance production, as seen in the figure below:

Figure 2. Share of farms with a tractor



Source: Eurostat, 2013

If, 20 years ago, research in the field of agricultural machinery and tractors was focused exclusively on the development of mechanical and possibly electrical constructive solutions, today everything turns around the hydraulic, electro-technical, electronics, and more recently in the field of computers and software process. The latest trends appear to be "Precision Farming" and, more recently, of "Smart Farming". With the development of information systems, communications technologies and their expansion for widespread use, computers and computerization in agriculture has all the way open. There is no mechanized agricultural process that does not benefit from computerized assistance that optimizes working parameters and produces high quality work-related indices, comfort and safety in the user-friendly working process, fuel mining and labor and, last but not least, a negative impact on the environment. The year 2017 seems to be a special one for Romania given that we can find concrete and updated data on the evolution of Romanian agriculture - the structure of farms and farmers in Romania, as well as aspects related to soil management practices, irrigation and agricultural technologies. This, as a result of a study by the National Institute of Statistics, a survey carried out during 2017 on agriculture, zootechnics and rural development, the reference period being the agricultural year 2015-2016, namely the interval 02.10.2015 - 30.09.2016. Regarding agricultural technologies and orientation towards agricultural specialization, until the end of the NIS study in December 2017, some trends can be outlined both by the data from APIA and by the commercial figures of the last years. An important step in the development of the technologies of mechanization was the use of satellite communications in agricultural applications using GIS (Geographic Information System) and GPS (Global Positioning System). The correlation of the position of the machines and the tractors with the existing controllers in the process computers has developed at an accelerated pace the precision of work and the quality of the executed works. With these systems, today we know exactly

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how much macroelements are needed, and how it was fertilized on a square meter, as it was herbicidated and later as it was harvested exactly in the same position. The concept of "precision farming" implies the regulation of inputs into the agricultural system (seeds, fertilizers, pesticides) so as to distribute where exactly what is needed when needed. Measuring the different working parameters through sensors and transducers, analyzing the information received through the information systems and specific software and sending orders for changing other parameters on tractors and agricultural machines created the "Smart farming" system. Examples are extremely numerous, with all major tractor and agricultural machinery companies making their own contribution to the development of these systems. From developing tractors and intelligent machines, however, incompatibilities have also emerged in the formation of aggregates in the sense that a certain tractor from company X can not work from the point of view of operating software with a machine built by company Y. To eliminate this shortcoming the ISOBUS system has been developed whereby tractors and agricultural machines irrespective of the manufacturer are compatible and can be controlled and ordered from a single terminal located in the cab. ISOBUS (ISO = International Organization for Standardization) is based on CANBUS communication (CAN = Controller Area Network). The data is stored and can be downloaded to the office computer, making it much easier to manage the farm. The concept of Smart Farming is not new, it is just an extension and better materialization and integration into the practice of the Precision Farming concept. Precision agriculture requires very precise regulation of inputs into the agricultural system (seeds, fertilizers, pesticides) so as to distribute where exactly what is needed when needed. Measurement of different working parameters by sensors and transducers, analysis of information received through specific information systems and software and sending orders to change other parameters on tractors and agricultural machines have created the Intelligent Agriculture system based on the use of logical schemes and programs very well-defined process, which aims at increasing the quality indices of the works performed simultaneously with the reduction of the human factor-induced errors. Most agegates are driven by GPS systems, and for each operation they can be mapped using the GIS method.

Some of the benefits of Intelligent Agriculture development are:

- self-supervision of aggregates or self-propelled machinery by GPS
- automatically maintaining a preset adhesion force
- modification of real-time working in the soil works according to the amount of vegetal debris existing on the surface
- changing the working time in real time in sowing and placing the seeds in the area with optimal humidity
- detection of plants and weeds and their distinction
- automatic correlation of the speed of travel as required (material flow, degree of baking, plant density, etc.)
- monitoring and control of each nozzle in phytosanitary treatments
- filler optimization and residue management of phyto-sanitary treatments

To exemplify past applications, only a few news items have been selected at the HANOVRA AGRITECHNIKA exhibition in November 2011. Also WindControl" has been developed to offset the influence of wind on the distribution of solid chemical

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fertilizers by centrifugation. The goal is to even fertilize even in windy conditions. The fertilizer machine is equipped with a weather station that measures the parameters of the dominant wind and its direction in the area of the distribution disk. A control mechanism, combined with control software, changes the rotation speed and spreading angle to the distribution discs. Account shall also be taken of the physico-mechanical properties of the materials distributed and the speed of their flooding. These data are stored in the process computer, so it is possible to use these properties to develop a corresponding computational model. The data taken by the weather station mounted on the car is used to calculate the necessary corrections in the process computer and the distribution unit, and the imprinting process is adjusted accordingly. The result is a transversal distribution pattern that remains stable even under the influence of wind. This optimizes the fertilization process and helps prevent pollution. The possible period of application is also extended (Dumitru, 2000). Another promising technology are drones, which have emerged as one of the most promising technologies, used to monitor fields investigating moisture and nutrient deficiencies in crops has massive potential for farmers while the highly advancedimaging equipment spots details too subtle for the human eye to detect (van Vark,2015) According toAnthea McIntyre, member of European Parliament, as the global population rises, satisfying the demand for healthy food and optimal nutrition is one of the biggest challenges facing the world. Technological innovation is a vital part of the solution. Agricultural technologies, in particular, have thepotential to make farming more productive and more sustainable".(FoodDrinkEurope, 2015). As can be seen in the figure below, the value of agricultural production in Romania last year amounted 3.95% of the total production in the European Union. France, whose agricultural production is estimated to 18% of the EU's production ranks first, followed by Germany with 13% of the total, Italy - 12.3% of total, Spain - 10.47% of total and the UK - 7.8% of the total (Lupu, 2015).

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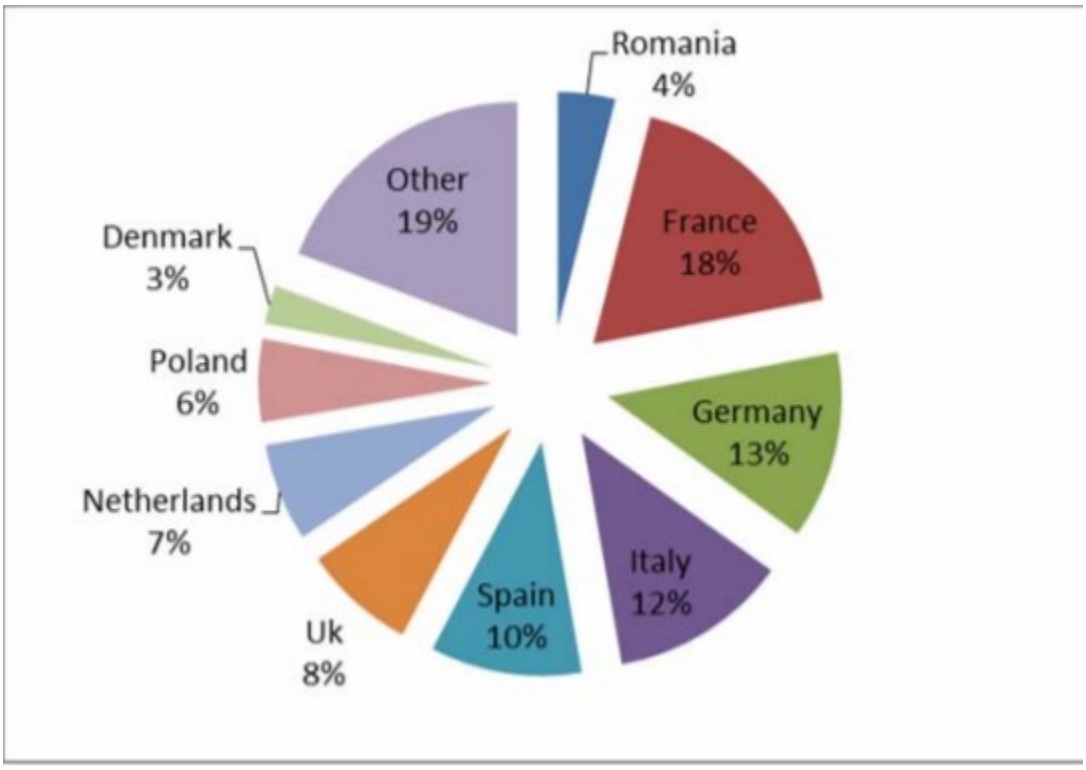

Figure 3. Structure of agricultural production in EU-28

Source: (Rickard, 2015).

Climate smart agriculture is one of the key topics for the almost 3,000 innovation projects that are expected to receive funding from the Rural Development budget. Around EUR64 million will be dedicated to precision farming and digital technologies in the agriculture sector under the Horizon 2020 Work Programme for 2016-2017 while EUR30 million will be invested in the implementation of an Internet of Things Large Scale Pilot on "Smart farming and food security" (Michalopoulos, 2016). In 2013 the Management Entity of the Cluster "SviluppoInsiemesi Vince"created IND AGRO WEST, the first innovative cluster for research and development in Romania, aimed at achievement of modern agriculture equipment, appropriate to Romanian soil (Sviluppo, 2014) Sustainable agriculture involves technological changes, but most importantly managerial changes. Technology should maintain productivity while reducing environmental impact, whilemanagerial changes should improve the economic accessibility of food.Romania's agriculture could be amongst the most productive ones in Europe if the status of the natural resources is to be considered. In fact, however, Romania's agriculture is low performingand fails to be attractive for strategic investors (Hapenciuc et al., 2014). There are also institutes

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that are involved in the dissemination of agricultural technologies in Romania. The mission of the National Research and Development Institute for Machines and Installations for Agriculture and Food Industry is to carry out scientific research (fundamental and applicative), innovations in the field of processes, technologies and technical equipment leading to the mechanization and automation of agricultural works and the food industry, in the context of harmonizing the whole activity with ANCS policies. INMA has a rich activity and experience in research on the development of agricultural machinery in Romania, having as reference date the year 1927 with the establishment of "The Station for the Testing of Machines and Agricultural Baneasa Tools" within the Institute for Agronomic Research of Romania - ICAR. Through successive transformations, in 1996, following the assessment made by the Ministry of Research, INMA was established(INMA, 2008). The strategic objectives of the Institute consist of: scientific substantiation of the processes in agriculture and the food industry in order to achieve new technologies of mechanization, tools and technical equipment compatible and competitive with the European research area specific to the concepts of sustainable agriculture and food security; of the performances of the processes, technologies and equipment for agriculture and the food industry, meeting the EU requirements and regulations in order to capitalize on Romania's agricultural potential, the use of renewable energy sources (biomass, biofuels), technologies and equipment for use in terms of efficiency, protection of life, health and the environment; dissemination and technological transfer to the economy of research results for rural development and quality improvement support of CD activity in agricultural machinery companies and training of users of technical equipment in order to increase the diffusion and development capacity of advanced technological technologies; Strengthening the technical research base, carrying out interlaboratory tests and external partnerships for the connection INMA's research into the European research area, including integration into technological platforms at European level, increasing the professional training of the human resource and improving the structure, improving the organizational structure of the institution to enable scientific partnerships with similar institutes in the European space(INMA, 2008). In achieving the goals set by INMA's development strategy, human resources have an important contribution both in balanced structure and motivation of staff at the same time with qualitative and responsible involvement, an essential role for young researchers. From the point of view of technical-scientific and experimental recognition through accreditation, INMA's research infrastructure is materialized through research, testing and experimentation laboratories in accordance with EU rules and directives that verify the scientific and technical competence of ideas, solutions, equipment and new products with high-quality technical equipment and highly qualified staff (INMA, 2008).

I. CONCLUSIONS

In Romania, most of the new agricultural technologies are presented in agricultural fares, where companies like AgroConcept, IPSO Agricultura, AgriAliantaAgritehnica, General Leasing, Apan Agriculture Equipments, NHR, MecanicaCeahlau, Serv Class, MaschioGaspardo, Green Expert, Farm Tech, Tadis Agro, BergeratMonnoyeur, IRUM, Agrisorg, Arterius Business, Evak, Javier Camara, Romvac, Agroland, Biotrend Plus, Cronos Consulting, GroupamaAsigurari, Riela, Sere Transilvania, BRD, Credit Agricole, GrundfosPompe Romania, Jarex Filter Technik, Cantar

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Prod, Hanna Instruments, Media RomGrup, Novus and Star Lubricants can promote their products. According to Pohrib and Petrache, (2011), in Romania, there is a lack of a mechanism of dissemination of the agricultural technologies caused by a lack of the extension of knowledge from the units responsible for it, such as lack of consultancy services and directions, so universities and research institutes must compensate for it. Also, according to Dovleac and Balasescu (2016), for developing the agriculture sector, Romania needs to search for collaboration with other countries. So, Netherlands runs many projects to transfer to Romanian farmers' a better understanding of technology, given that" innovation is the key to the sector development in the future. Dutch farmers' knowledge and technological novelties may be so transferred to Romanian young entrepreneurs. The goal is to give the support of Romanian farmers for more effective costs, for being able to cope with market conditions through counseling for sustainable investment. The Netherlands can play an important role due to the experience with cooperation between businesses, including farmers, research institutions and authorities (EurActiv, 2015). This compensation however seems to have effect only on agricultural scientists and researchers, not a direct impact for farmers. So workshops for agricultural extension addressed directly to farmers at fares would be something to take into consideration.

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