

# E-Agriculture: Montenegro Case

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## Abstract

The use of information technology in the field of agriculture is one of the biggest challenges in the field of agriculture in economic transition in Montenegro. Montenegrin society has made significant progress in the development of agriculture, but there are difficulties in the implementation of modern technologies in all phases of agricultural production. The importance of ICT application in agriculture is very significant from the standpoint of reductions in manufacturing costs, yield increase, protection of the environment, etc. This paper will deal with the problems and proposed solutions (examples) for the application of ICT in the production process, in the process of planning and reporting within the agricultural sector. The research focuses on a comparison of the current situation in the Montenegrin agricultural sector with the situation at the EU level as well as several global initiatives. ICT application in agriculture is also important from the point of view of producers (small and large), and from the standpoint of the state in terms of monitoring the implementation of planned activities. Therefore, it is crucial for Montenegro to keep developing in this field. This paper could also serve as a guideline for the Government in implementation of development policies in the e-Agriculture field.

**Keywords:** e-Agriculture, ICT, food production, sustainability, efficiency

**JEL classification:** O390, Q160

## Introduction

Agriculture is one of the pillars of Montenegrin economy, and along with tourism and energy it has been marked as a priority area of future development of this country.<sup>1</sup> Due to its size, Montenegro is unable to run on economy of scale principles, but its international competitiveness in tradable agricultural goods has to be based on quality and organic production, which also implies that Montenegrin agricultural sector has to maximize its productivity or output per worker.

When it comes to increasing productivity, as the first optimal solution, one can think of applying concepts and solutions that provides information and communication technology (ICT), as one of the modern tools and platforms for broad exchange of knowledge, experience and information. It is proven that utilization of ICT increases productivity in all sectors of economy.<sup>2</sup> The same applies for agriculture.

Problem occurs when it comes to applicability of that kind of technology in this sector, especially in Western Balkan region. If we divide the whole industry into primary, secondary and tertiary, lagging of ICT application within the primary

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<sup>1</sup> According to official documents of Government of Montenegro such as Economic Reform Program, Development Directives, Guidelines of Macroeconomic and Fiscal Policy

<sup>2</sup> See: Spiezia, Vincenzo (2012), "ICT investments and productivity: Measuring the contribution of ICTS to growth", OECD Journal: Economic Studies, Vol. 2012/1; Bloom et al. (2012), „Americans do I.T. Better: US Multinationals and the Productivity Miracle“, American Economic Review 2012, Vol. 102 No. 1, pp. 167–201.

industry is evident. However, the newest trends show significant steps in the primary industry sector (Novkovic et al., 2013).

As usual, concepts' definitions are different from reference to reference, from author to author. Officially accepted definition of concept *e-agriculture* involves the conceptualization, design, development, evaluation and application of innovative ways to use information and communication technologies (ICT) in the rural domain, with a primary focus on agriculture. (FAO, 2013) So, in order to simplify, *e-agriculture* = *ICT tools* + *agricultural production*. Applicability of ICT solutions in agriculture can be developed in many areas that will be further elaborated throughout this paper.

Therefore, this paper aims to analyze current situation when it comes to degree of utilization of ICT concepts and solutions in agricultural sector in Montenegro, as well as to propose policy measures and authors' proposal on how to improve status quo.

There were many books and articles used in the process of writing this paper, such as: Caspedes, L. (2013), Mesaric, J. (2009), Miller, C. et al. (2013), Popovic, M. (2010), Sideridis et al. (2010).

## Methodology

In order to explain and elaborate abovementioned goals of the paper, we apply desk research methodology as well as studying relevant scientific literature, policy proposals and analysis provided by both international and domestic researchers, professionals and institutions. Comparisons are made on qualitative basis, because no numerical data have been assessed or analyzed within the presented material.

After thorough analysis of possibilities for development and current processes that are being developed in the world, usually supported by World Bank and United Nations, we analyzed and compared current practice in Montenegro and based on comparative and deep analysis, practical proposals have been drafted and presented in the paper. Material used in this research are mostly official Government or documents produced by International Government Organizations (IGOs) such as United Nations (UN) and its agency for Food and agriculture (FAO), World bank, and others. Besides this material, academic sources and analysis have also been vastly used to perform this research. Quantification of all positive and negative effects and results of cost-benefits analysis of broader ICT appliance in agriculture is beyond scope of this paper, but sets out foundation for future discussion in academic as well as official circles.

## Results

Based on an analysis, it is concluded that ICT is used in agriculture all over the world, but not in the extent that ICT services offer. It is true that due to the traditionally low profit margin and vast Government support to agriculture sector all over the world, one could question rather expensive investment in technology that is not primarily linked to food production process. However, with the support of United Nations' agency Food and Agriculture Organization (FAO), some ICT concepts started to be vastly implemented in the agricultural processes. FAO primarily focused its work on Monitor and Evaluation (M&E) and developed several likewise systems in the world (India, Latin America, Bangladesh, etc.).<sup>3</sup>

Concepts that are currently being developed by FAO and World Bank are, as stated, focused on monitoring and evaluation of processes, or, to simplify, data

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<sup>3</sup> Available at:

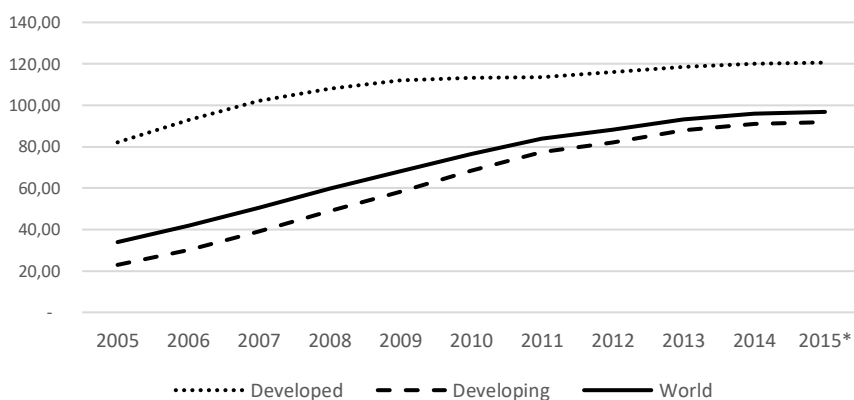
[http://www.ictinagriculture.org/sites/ictinagriculture.org/files/eAg\\_Sourcebook\\_3\\_Jun2012.pdf](http://www.ictinagriculture.org/sites/ictinagriculture.org/files/eAg_Sourcebook_3_Jun2012.pdf)  
(accessed July 5<sup>th</sup> 2015)

collection, analysis and formulation of adequate measures that could improve current situation. While developing this concept, data collection and data reliability were posed as crucial point and concern. However, positive impulses do come from the ICT market, where it could be easily noticed that mobile penetration raises even on a monthly basis, in all parts of the world. Mobile signal coverage is also improving, so organizations decided to pursue model of SMS based data collection, utilization of online data forms and common share points (tools and projects such as iFormBuilder, Frontline SMS, Smartagro, etc.) and, finally, analysis of the collected data by professionals and academics that actually provide counselling services to the primary production in terms of adequate and timely chemical protection, kinds and differences among crops, etc. All these solutions and initiatives are no more than a decade old, so it would be hard to make any long term forecast of its' real impact, but, according to the analysis of stakeholders included in those projects, there is significant room for optimism.

Having in mind difficulties and gaps in internet coverage and insufficiently fast and reliable connection, e-agriculture incubators decided to use mobile phones and SMS as a platform for collection of data, which is the first step of the whole e-agriculture concept that should analyze available information and give action proposals to farmers.

Figure 1

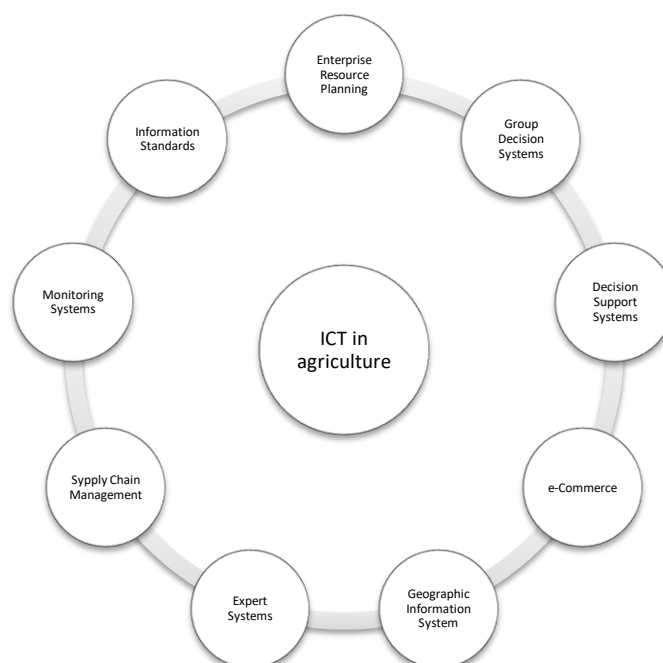
Mobile-cellular telephone subscriptions, per 100 citizens



Source: ITU World Telecommunication/ICT Indicators database

Although significant improvements have been made, authors believe that there is a lot more space for ICT to develop in the agricultural sector. Diagram of possibilities for future improvement is present below the paragraph. Utilization of several ICT opportunities such as Enterprise Resource Planning, Supply Chain Management, Geographic Information Systems, but also Groups Decision Systems (for cooperatives in agriculture) and many other could significantly boost productivity in agriculture. Additional benefit would be lowering costs, but also tackling environmental issues through adequate pest and timely treatment. ICT solution such as e-Market for agricultural products could increase visibility of food producers and become so needed bridge between agriculture and other sectors of economy (tourism, catering industry, etc.) that maximizes profits for both parties in the transaction.

Figure 2  
ICT in agriculture



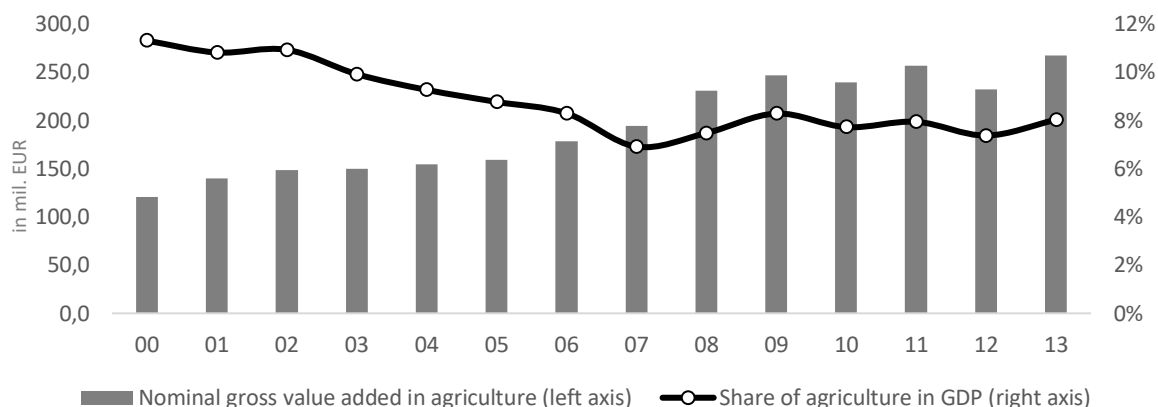
Source: Author's illustration

Around the world and even in the Western Balkan region there are examples of ICT utilization even beyond the scope of simple knowledge sharing platform. Farmers in the US vastly use Global Positioning System (GPS) in order to organize, monitor and improve field work. One of the examples is that GPS coordinates help them to automatize pest spraying process, as well as more rationale use of chemicals which directly influences decrease of expenditures and mitigated environmental impact of chemicals. One of the brightest regional examples of ICT in agriculture is website *farmia.rs*. This platform has a purpose to overcome a gap in supply chain – e-Commerce website (buying and selling) of agricultural products, more specifically animals – livestock. This project has huge regional potential and expanding component. This platform could be easily 'exported' to other regional markets (Montenegro, Bosnia and Herzegovina, Croatia, and Macedonia) due to the same language base and accessibility of this platform. Broadening of the current Farmia's business model (inclusion of market for crops, seeds, compost, etc.) and positive business externalities (establishment of supplementary businesses – transportation, advising, and market for services in agriculture) could significantly improve agricultural sector and even contribute to its growth and development in the whole WB region.

## Discussion

When it comes to agriculture, Montenegro has a lot of potential, and, as stated at the beginning of the paper, agriculture is labelled as one of three pillars of future economic and social development in Montenegro. As it could be seen on a graph, nominal output of agricultural production has been increasing almost constantly since 2000. This data series also captures changes in food price, but data still supports the claim that agriculture is growing in real terms as well.

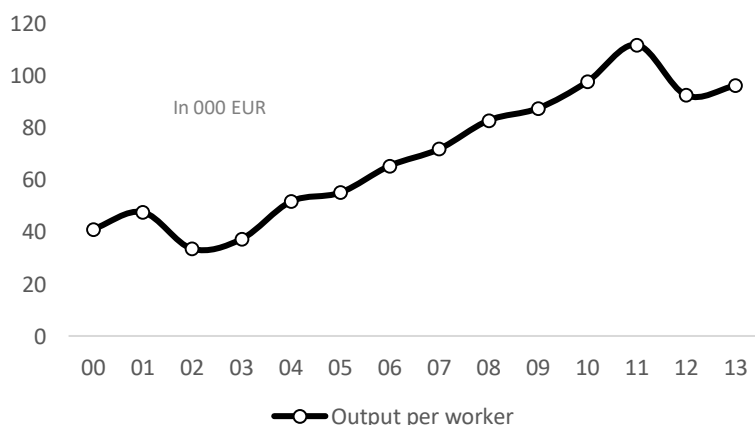
Figure 3  
Agriculture is growing in Montenegro



Source: Author's illustration, source of data: Montenegrin Statistical Office - Monstat

On the other side, share of agriculture sector to total output is gradually decreasing due to the fact that Montenegro changed its development model from production to more service-based economy. However, agriculture will stay significant as part of an economic chain that ends up in tourism and capitalizing produced food through tourist expenditure. That economic chain represents the cheapest 'export' of agricultural products and switches their type to tradable goods.<sup>4</sup> Montenegro will pursue a goal of providing as much as possible agricultural goods in order to support consumption during tourist season thus narrowing trade balance in this type of products, but also during whole year.<sup>5</sup>

Figure 4  
Output in agriculture per worker<sup>6</sup>



Source: Author's calculation, source of data: Montenegrin Statistical Office - Monstat

<sup>4</sup> Literature usually classifies agricultural products and food in general into non-tradable export goods due to their relatively short lifetime/expiration date

<sup>5</sup> Montenegro runs unsustainably high current-account deficits of around 15% GDP i.e. it imports much more than it exports, and significant portion in that deficit is due to food and import of agricultural products

<sup>6</sup> In 2010 Monstat changed methodology and classification of Employment data series and adjusted to NACE-Rev 2 methodology

At the same time, number of workers in agriculture also increased, but the output increased more. This fact brings to a conclusion that productivity of labour in this sector also increased. Observation like this is easily supported by the fact that Montenegro's agriculture is mostly developed in small to medium family farms and rather low starting level of mechanization in this particular sub-sector of agriculture. Implementing modern machines and chemicals in order to increase yield per area is a first productivity shock that occurred in Montenegrin agriculture in last two decades. Second shock is about to come and it is related to vast ICT utilization for agricultural purposes.

### *e-Agriculture development in Montenegro*

Montenegrin agricultural production is mostly concentrated at public company Agrokombinat '13. Jul' Podgorica which is one of the biggest vineyards in Europe and certainly the biggest vine producer in Montenegro that also produces some other products such as peaches, fish, and other. Other significant companies in agricultural sector include 'Goranovic' Niksic, 'Mesopromet' Bijelo Polje, 'Martex' Cetinje and others. These are market leaders in agricultural sector. Other producers are mostly dispersed in small to medium family farm.

Market leaders are strong Montenegrin companies and big employers that use ICT services in administrative and decision making process, so one can claim that first steps in establishing functional e-agriculture in Montenegro has already been made. The challenge still remains in the area of agricultural production which is where significant improvement still has to be made in order to increase productivity of working force. Monitoring of agricultural processes and automatic transmission of data to decision makers or advisors could significantly improve timely and adequate resource management. Vine producing company still does not possess weather and soil non-stop monitoring system, while this type of ICT solution could accurately measure supplements that grape needs so the adequate products and measures could be planned in order to fill the gap to perfect development conditions.

In public sector, Ministry of Agriculture and Rural Development is in charge of all aspects of agriculture and nature (water management, woods management, agricultural production, etc.). Significant improvements have been made in this field, but also leaving space for improvement. Montenegro established national registers of food, wine and olive producers, national registry of woods, water resources, and other. Still, the National strategy on agriculture did not foresee any significant investment and promotion of ICT in agriculture, although some countries in the region did (Novkovic et al., 2013). In the following period Montenegro will primarily focus on attracting EU funds for reaching EU standards in agricultural production. Huge potential is also seen in clustering i.e. joining of producers in order to improve their market access, promotion, branding, but also increase productivity by knowledge sharing and larger use of machinery in production process. Significant room is left for utilization of ICT services, and these are not treated as part of any official development strategy in this sector.

## **Conclusion**

Montenegro has a huge, and still not used potential in developing ICT services in agricultural sector. It is 100% electrified country, with mobile penetration of 160% (World Bank data, 2013) and with internet penetration of 57% (World Bank data, 2013). So, the basic infrastructure is in place, although there is still space for improvement in terms of rural area 3G signal coverage and lowering internet price. Significant share of sophisticated ICT services (ERP, SCM, sophisticated non-stop



monitoring systems, and similar) in small to medium farms should not be expected due to the costs of equipment needed to support those systems and low rate of return that those farms usually have, but also due to lack of knowledge in such level of production. However, clustering, as the main development measure of Montenegrin Government in agricultural sector, could also give some results in this field.

Big companies/leaders on agriculture market in Montenegro will continue using and improving their ICT solutions primarily due to their need for increased productivity and output per worker ratio.

Expectation is that further harmonization with EU legislative will also make it easier for agricultural producers to use concepts of e-agriculture, and that technological progress will solve the isolation and knowledge gap that currently exists.

## References

1. Caspedes, L. (2013), "How ICT tools are improving efficiency of agricultural development", available at: <http://www.theguardian.com/global-development-professionals-network/2013/jan/24/data-collection-evaluation-technology-agriculture> (accessed July 5<sup>th</sup> 2015)
2. Government of Montenegro – Ministry of Agriculture and Rural Development (2014), "Strategy on Agriculture Development and Rural Area 2014-2020", Podgorica.
3. Mesaric, J. (2009), "ICT u poljoprivredi i njihov značaj u budućnosti poljoprivrede i ruralnih područja" ("ICT in Agriculture and Its Importance in the Future Development of Agriculture and Rural Area"), Osijek, available at: <http://bib.irb.hr/prikazi-rad?rad=465638> (accessed July 5<sup>th</sup> 2015)
4. Miller C., Saroja V., Linder C, (2013), "ICT uses for inclusive agricultural value chains", Food and Agriculture Organization of the United Nations, Rome.
5. Novkovic, N. Vasiljevic, Z., Matkovic, M. (2013), "E-concept of an Agricultural Extension Service", Agriculture & Forestry, Vol. 59 No. 2, pp. 187-198, Podgorica.
6. Popovic, M. et al. (2010), "Implementacija geografskih informacionih sistema (GIS) u Crnoj Gori" ("Implementation of Geographical Information Systems (GIS) in Montenegro"), Infofest 2010 publication, Budva.
7. Sideridis, A., Koukouli, M., Antronopoulou, E. (2010), "ICT and farmers: lessons learned and future developments", Journal of Agricultural Informatics 2010 Vol. 1 No. 2, pp. 35-41.
8. Vark, C. (2013), "How might open data in agriculture help achieve food security?", available at: <http://www.theguardian.com/global-development-professionals-network/2013/nov/25/open-data-food-security-agriculture> (accessed July 5<sup>th</sup> 2015)
9. World Bank (2011), "ICT in agriculture – Connecting Smallholders to Knowledge, Networks and Institutions", e-Sourcebook (report n. 64605).

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