

Engaging agriculture in e-government, E- agriculture potentials and its contribution in economy

Pierre Alassaf¹, Gábor Zsigmond Szalay²

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ABSTRACT

The rapid development in Information Communication Technologies accompanied with digital transformation of governments toward e-government reveals of great opportunity to engage this development in the agriculture sector in what called e- agriculture which introduces a revolution in this sector and gives innovative solutions to the anticipated problem of world hunger in future.

This paper aims to reveal of the potentials of e- agriculture, strategies of its implementation and the practical initiatives in this regard, also, the paper estimates the degree of implementing ICTs in agriculture sector worldwide compared to other economic sectors. This study finds that there is a negative relation between E-government Development Index, ICTs use, Government on-line Services Index and e-Participation Index in a country and agriculture sector contribution in economy, Also, it finds that engagement of ICTs in agriculture section is still far away behind other economic sectors as the increasing development of ICTs adoption in a country has been related with a declining of agriculture contribution in economy whereas other economic sectors have increased their contributions.

1. Introduction

Agriculture which has been neglected for decades, it is now coming-back to take first attention globally as a key vehicle to reduce poverty and as an economic growth leverage (Timmer 2005, Hailu n. d).

In near future, as population of the world are increasing rapidly, agriculture is stands for a big challenge to feed the anticipated ten billion inhabitant and have to increase its production of food about 50%, more specifically, by 2050 global production of agriculture should be increased by 60% to meet the anticipated needs, 80% of this increasing would come from crop yields production raise (Alexandratos & Bruinsma 2012, FAO website), but this is not an easy mission if we know that the increasing in agriculture yields are slowing (Alston & Pardey 2014), and “conventional” way in enhancing effective and efficient agriculture is going to reach its limits. This new situation need a new way of thinking and take every opportunity to go out of the box, here, the new development in ICT and its applications of huge potentials, give a real opportunity to agriculture to have a new revolutionary raise by using the great potentials of new technology

¹ Pierre Alassaf

Szent Istvan University, Doctoral School of Management and Business Administration.

pierrealassaf@hotmail.com

² Gábor Zsigmond Szalay

Department of Applied Informatics, Institute of Economics Methodology, Faculty of Economic and Social Sciences.

szalay.zsigmond.gabor@gtk.szie.hu

since it provides a wide range of applications and tools that can be easy to use by farmers and in the same time affordable with a reasonable cost, suiting agriculture sector that have a modest financial possibilities especially in developing countries, this novel perspective of agriculture called e- agriculture.

Taking in regards the significant jump of developed countries in transforming its government toward e-government, these e-governments is promising for a high chance of development especially among less developed countries to leapfrog over obstacles (UN 2016) and build a modern e-government provides its e-services for a sustainable development, here, for those developing countries- witch most of their economies depends on agriculture and have a high population growth rate especially in rural areas (Fuglie 2018) are threatening their future with possible hunger (FAO 2018)- developing agriculture sector considers a solution, So, directing e-governments and ICTs applications in enhancing agriculture is a high priority for those countries particularly and to the world in general for starting a new age of revolutionary e-agriculture (Awuor 2016) which is more than a collection services of e-government for farmers and rural regions but it covers a comprehensive range infrastructure, services, relations, knowledge and products supplied by government (FAO 2017, Maumbe 2009).

The main objective of this study is to shade the light on engaging ICT in agriculture and the anticipated potentials of e-agriculture in enhancing agriculture production and solving the anticipated future world hunger.

Also, this study is involved in estimating the degree of integrating ICT in agriculture sector compared to other economic sectors and its effect on agriculture sector contribution in economy.

2. Background

2.1 E-agriculture concept

E-agriculture is a new domain or discipline concerns in optimizing the development of agriculture and rural areas by improved engaging of information and communication technologies. In other words, e-agriculture concerns in finding innovative solutions using information and communication technologies (ICT) for developing agriculture and rural areas by framing concepts, designing, developing and evaluating a new application.

This concept has been adopted by World Summit on the Information Society (WSIS) and has been set in its Declaration and Plan of Action as an action line, The Food and Agriculture Organization of the United Nations (FAO) was set to facilitate e- agriculture action lines and to facilitate the initiating e-Agriculture Community initiatives (FAO n. d).

In 2007, one of the most important initiatives set up by FAO with 13 partners to support e-agriculture notion in practical applications is e-Agriculture Community of Practice (ACP) which is an open global platform for exchanging the knowledge, data, thoughts and sharing resources about engaging ICTs for developing sustainability in agriculture, this community is open for individuals interested in e- agriculture who belong to different disciplines as ICTs experts, farmers, researchers, politicians, businessmen and any other stakeholder, 170 countries with more 14 thousand members are involved in this society to improve policies and find practical applications of ICTs to develop agriculture and enable the rural regions environment to be a more convenient place to live and work, this in turn effects on agricultural process (Ntaliania 2009), some examples of such enhancements is starting Family Farming Knowledge Platform and Farmer Field Schools.

Also, the ACP conducted international forums concerning food security and agriculture solutions those mentioned initiatives are designed carefully to reach wide diversity of targeted groups over the world (WSIS 2019a).

2.2 Practical perspectives of e- agriculture in e-governments plans

As much as it looks easy to talk about integrating ICTs in agriculture as it hard to be implemented, especially in those countries which depends on agriculture in its economy as they are generally poor countries and have a sever lack in potentials to implement e- agriculture, taking in regards, that the lake of knowledge and expertise are great barriers to practice e- agriculture (EU SCAR 2015, Herbold 2014).

Here, it is important to breakdown the role of e-governments and its ICT tools in initiating e-agriculture, this breakdown is important to enhance the understanding of the concept of e- agriculture and interpret the resulted ideas into practical directions and projects.

The following directions have been discussed by FAO (2017) as steps for building national e-agriculture strategies:

E- agriculture as a framework for regulating policies: engaging ICT gives a powerful tool to set, evaluate and spread new relevant policies and monitors its implementations (Singh et al 2017).

E- agriculture as empowerment tool and capacity developer: engaging ICT enables more vulnerable people to engage locally, creating by that new opportunities for new business in rural areas and making those areas a better place for working and living (Yonazi et al 2012).

E- agriculture as a platform for providing insurance and access to financial services: engaging ICT enables inhabitants of rural areas from reaching financial services easily, providing a secure way for saving, and bringing enhanced instruments for risk management and insurance that can rural inhabitant afford (Singh et al 2017, Kloepfinger-Todd and Sharma 2010).

E- agriculture as platform for tracing food safety: engaging ICT provides a huge pool of accountable and updated data, this data accompanied with developed application can efficiently trace the food and nutrition issues complying the international standards.

E- agriculture as an innovation system: engaging ICT shorten the distance among various stakeholder of agriculture as farmers, researchers, academic institutions, agents, marketplace, business players and policy makers, making it is easier to communicate and exchange their needs and directions (Rudgard et al 2011).

E- agriculture supports sustainability in agriculture: engaging ICT provides the suitable knowledge, information and accessible applications for applying innovative and sustainable agricultural methods like protecting plants, health-care of animals and using applications as climate smart solutions (Syiem 2015).

E- agriculture as a tool for risks, early warning and disaster risks management: engaging ICT supplies on-line and real time anticipated risk information- like agro-meto information system- with ongoing advice for dealing with risks before and during their happenings and provide the suitable directions to deal with disasters' consequences, all that offered in real time and on-line observation (Zyl et al 2014).

E- agriculture as a platform for enhancing access to marketplace: engaging ICT makes it easier for farmers and small business in rural area to access marketplace for better knowledge of new inputs, market conditions, prices and best time for trading a specific product (Cleene, S 2014, Warren 2004).

2.3 E-agriculture strategies

From previous paragraph where the importance of e- agriculture was breakdown into different perspectives of e- agriculture implementation aspects, e- agriculture national strategies can be derived to put an comprehensive plan for increasing agricultural productions especially in food within a timeframe to meet the increasing needs of food and anticipated national population growth, and providing new incentives with facilitating new innovative technologies for exporting Agri-products, also, these strategies aims to create new markets, promoting social protection, de-centralizing the trading and driving innovation in agriculture, besides, strategies should have the capacities to monitor and correct the implementation of its plans to ensure farmers' accessibility to the market, transparency and efficiency of savings and loan processes and other financial services (Jainzik & Pospelovsky 2014), , optimum decease monitor and mitigation for corps and animals, best applying of disaster prediction and weather forecasting, and right execution of many other remote services supplied by e-governments to the agriculture communities especially those in far rural areas.

Developing countries have started in implementing and adopting serious strategies at national level for implementing e-government services especially in e-learning, e-commerce and e-health but there were no developing country except four out of all has adopted an e- agriculture strategy on national level in the year 2012 (ICT 2103).

This lagging in adopting e-agriculture strategies may come from the current potentials of the agriculture sector, that agriculture is still behind the other economic sector in development and have a deficit in financial support from private sector especially in developing countries, also, the role of multinational enterprises in supporting researches and developments in agriculture sector is still modest comparing to other economic sectors as they considered more profitable and have a faster capital turnover, besides, investment in agriculture is a high risk investment (Miller et al 2010).

The mentioned weak investment in agriculture will cause lagging of implementing e- agriculture which in turn keeps the private investment in agricultural projects modest, and this will keep agriculture lagged-off once again and so on , here, governments over the world have the responsibility to break this repeated circle of lagging and low investment in agriculture, by global collaboration to provide suitable financial support for an evolutionary implement of e-agriculture which enables a real jump in agriculture sector development to be a modern and profitable sector in a way attracts investments, those investments in turn get involved in developing the sector and new circle of interactive mutual benefits starts.

Figure1. illustrates the declining in agricultural sector contribution in economy in the vast majority of world regions.

Figure 2. is showing the continuous declining of agricultural sector contribution in economy in favor of increasing other economic sectors.

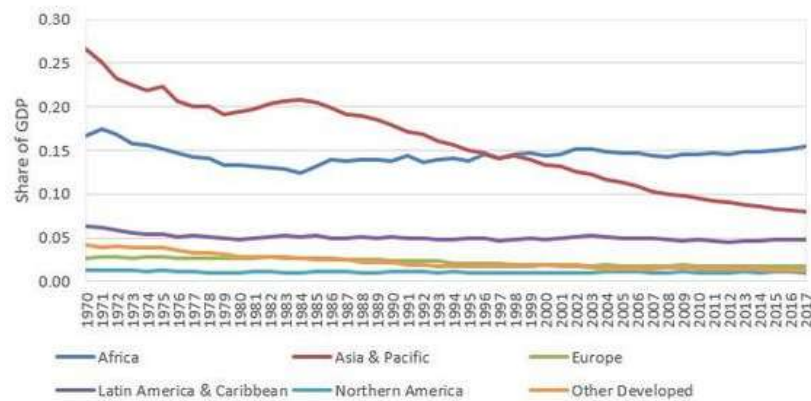


Figure 1. Agriculture contribution in economy as % GDP by region. (Source: United Nations Statistics Division and Food and Agriculture Organization <http://www.fao.org/economic/ess/ess-economic/gdpagriculture/en/>)

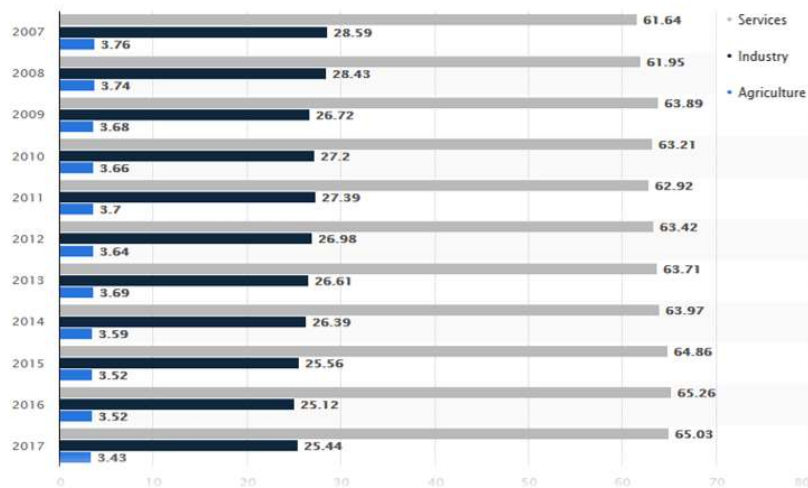


Figure 2. World economic sectors contribution in economy as percent of GDP between 2007- 2017. (Source: Statista website, <https://www.statista.com/statistics/256563/share-of-economic-sectors-in-the-global-gross-domestic-product/>)

3. Applying innovation for SDGs in agriculture

3.1 Innovation for SDGs in agriculture

Broadband Commission for Sustainable Development Goals 2025 has setup international joint strategy to come over digital divide created by the rapid developments in ICTs, this strategy will give a drive forward digital transformation and implementing e-governments, SDGs 2025 have ambitious targets summarized by Sharma (2019) as the achieving all countries worldwide by 2025 national plans or strategies for implementing broad-band coupled with the a proper allocated financial resources, this broad-band should be accessible and affordable in developing countries at no more than 2% of monthly GNI per capita, also by 2025 internet should be accessible by 75% of people globally, 65% of developing countries’, and 35% of poorest countries’ population, taking in regards gender equity, and the important thing is enabling minimum 40% of people worldwide to use financial e-services.

These SDGs in technologies is a leverage for e-government implementation and optimizing its services in all sectors. So, applying SDGs in agriculture sector enables to transform ideas to actions, builds multiple relations among various stakeholders and affords accessible networks, continuous applying and testing new technologies, on-line monitoring and correcting plans executing and increasing potentials of the agricultural and the food system. The precise and effective execution of these SDGs in agriculture will decrease poverty, enhance rural areas livelihood, provide more food security, sustainable solutions, optimized dealing with risks and disaster and engaging most vulnerable groups in the process, finally SDGs create more productive communities.

An example of integrating ICTs in agriculture for sustainable agriculture is the joint initiative of FAO and Google, that enables google earth to analyze geospatial data for farming reasons, another example led by FAO in collaboration of telecommunication company Telefonca is applying Internet of things with using remote sensing to increase agricultural water productivity (WSIS 2019b), applying these goals in serve of agriculture sector for providing sustainable agriculture and national and global food security, needs to address obstacles that faces executing these goals and draw strategies and plans for practical implementations, this drove World Summit on the Information Society WSIS to adopt action lines C7 and C3 for enabling e- agriculture, the subject of next paragraph.

3.2 World Summit on the Information Society WSIS actionlines C7 and C3 for enabling e-agriculture:

Discussing the opportunities of enabling e- agriculture drives this paper to highlight two of action lines adopted by World Summit on the Information Society WSIS, C3 and C4, the first concerns in accessing to information and knowledge, which is very important determinant of spreading e- agriculture especially in developing countries even in some rural area of developed countries, the second; C7 concerns in engaging ICTs apps in governmental services in a shape of e-government also this action is very important in enabling e- agriculture since governments has the key role in supporting agriculture, at the same time it has the major responsibility in enabling such strategic development projects such as e-government and its various directions like e- agriculture initiatives, So, C7 action line have specific targets can be summarized in distributing needed information systemically in means of ICT for issues concerns food, forestry, fishing, husbandry of animals and agriculture, providing by that for all stakeholder- particularly in rural areas- an easy access information, updated and ready to use (WSIS 2019a).

3.3 E-agriculture policies in developing countries

As discussed in the paragraph 2.3 that most of developing countries haven't defined comprehensive strategies nor policies to integrate ICTs in agriculture to build their national e-agriculture, for instance, in 2012 only those countries; Côte d'Ivoire, Ghana, Mali and Rwanda of all developing countries have adopted governmental national strategies and put defined policies for e-agriculture, the vast majority of these policies have been evolved with the collaboration of international organizations like 'United Nations Development Program', 'International Telecommunication Union', 'United Nations Economic Commission for Africa' and 'Food and Agriculture Organization' and put terms on agricultural strategies on sectorial basis, those policies differs according the conditions of the targeted country or region, for instant FAO and ITU have unleashed common program in 2013 called e- agriculture strategy guide for assisting countries to build national inclusive e- agriculture strategies by setting up documents of guidance polices depending on-demand basis (Kolshus et al 2015).

This role of international organization is very important for developing countries in setting up their e-agriculture policies to leapfrog over access and achieve the aimed agricultural revolution especially that those countries have a lack of expertise, facilities and knowledge in policy making regards (EU SCAR 2015).

4. Study hypotheses and Methodology

This paper tries to find the relation between agriculture sector change and the development in applying ICTs in countries over the world, more specifically, does the level of applying ICTs and e-government implementation in a country have a significant relation with agriculture contribution in economy.

Hypotheses of this study are:

H1: Is there a relation between the development of ICTs engagement in a country and agriculture sector contribution in economy.

H2: Is there a relation between e-government development in a country and agriculture sector contribution in economy.

Measuring the variables:

To measure agriculture sector contribution in an economy this study has chosen agriculture, forestry, and fishing, value added (% of GDP) to interpret the agriculture contribution in economy.

For measuring the development of ICTs engagement in a country this study has chosen the ICT access index, ICT use index, overall ICT index, on-line participation index, government on-line services index, On-line Service Index, telecommunication infrastructure index, that indicis are the main scales used by United Nations different researches to evaluate the development of ICTs in a country.

For measuring e-government development in a country this study has chosen E-government Development Index (EGDI) level and E-government Development Index (EGDI) score, those indicis are the main scales United Nations different researches to evaluate the e-government development in a country.

Testing hypotheses:

For testing the relations and hypotheses of the study, correlation test will be applied to test the relation between agriculture, forestry, and fishing, value added (% of GDP) in the year 2018 from one side and development of ICTs engagement in a country in the year 2018 on the other sides. The selected year (2018) for collecting data of the sample is providing the most recent data that needed for conducting the test.

The data for analysis gathered from World Bank data website and from UN government knowledgebase. The sample covered most of the world countries that have available data for analysis.

Correlation test splits into two tests, the first one applied on a sample of 120 countries, the second applied on a sample of 169 countries, the difference in samples depends on the availability of information provided by countries needed for analyzing.

Limitation of the study:

The test conducted depending on only one year; 2018, which is provides most recent data that needed for conducting the test, this limitation can be a subject of future research that can observe relation change of study variables over the years.

5. Results and Discussion

The collected data about agriculture, forestry, and fishing, value added (% of GDP) from (“World Bank data website”, n. d) and development of ICTs engagement indices in a country were gathered from (“UN government knowledgebase website” n. d) and (“ World Bank TCdata360 website” n. d).

Those data analyzed using SPSS program by conducting correlation analysis, the results showed in the following table1. and table.2

Table 1. Correlations EGDI score, E-Participation Index, On-line Service Index, Telecommunication Infrastructure Index and Agriculture, forestry, and fishing Value Added (% of GDP) in 2018

		EGDI Score 2018	E-Participation Index	On-line Service Index	Telecommunication Infrastructure Index
Agriculture, forestry, and fishing Value Added (% of GDP) 2018	Pearson Correlation	-.610**	-.388**	-.423**	-.640**
	Sig. (2-tailed)	.000	.000	.000	.000
	N	169	169	169	169

** . Correlation is significant at the 0.01 level (2-tailed).

Table 2. Correlations between EGDI level, ICT access Index, ICT use Index, Government on-line services Index, On line e participation Index, Overall ICTs Index and Agriculture, forestry, and fishing value added (% of GDP) in 2018

		EGDI level 2018	ICT access Index	ICT use Index	Government on-line services Index	On line e participation Index	Overall ICTs Index
Agriculture, forestry, and fishing, value added (% of GDP)	Pearson Correlation	.735**	-.262**	-.262**	-.664**	-.622**	-.218*
	Sig. (2-tailed)	.000	.004	.004	.000	.000	.017
	N	120	120	120	120	120	120

** . Correlation is significant at the 0.01 level (2-tailed).

From table. 1 It can be noticed that there is a strong negative relation between Agriculture, forestry, and fishing, value added (% of GDP) from one side with each of EGDI number and Telecommunication Infrastructure available in a country (Pearson factor is -.610, -.640 respectively).

Also, the relation between Agriculture, forestry, and fishing, value added (% of GDP) with each of E-Participation and On-line Services available in a country are negative relation with medium strength.

Table. 2 returns almost the same result of the existence of a negative relationship between agriculture sector contribution in economy presented by value added (% of GDP) with ICTs development in a country presented by ICT access index, ICT use index and overall ICT index (weak relation), and by Government on-line services Index, on-line participation index and e-government development level (strong relation).

As a result, the two hypotheses of research are accepted and there is a moderate negative relationship between the development of ICTs engagement in a country and agriculture sector contribution in economy.

Also, there is there a strong negative relationship between e-government development in a country and agriculture sector contribution in economy.

The relations strength estimated from the average of relations strength of components of ICTs development and e-government development in a country from one side and agriculture contribution in economy on the other side, they are $r = -0.435, -0.672$ respectively.

Explaining results: The previous results for a superficial analysis may have no information to provide or no interpretation on the reality, but a deep look can tell us that whenever ICTs application and e-government implementation rise in a country the less of agriculture sector contribution in economy, this can be explained in two approaches:

First approach is the leaders countries in ICTs and e-government development- who showed high ICTs and e-government development indices- are not concentrating on applying this development in agriculture sector as they are not an agriculture economies and the benefit of this development goes in enhancements in other sectors that their economies depends on especially if we know that the top 10 countries in EGDI level in the year 2018 due to UN e-government survey (2018) are industrial countries besides to their advancement in tourism and research and development sectors.

So, the new technology enabled an expansion of other sectors contribution in economy on the expense of agriculture contribution, this is affirmed by the discussion in the paragraph 2.3 about the declining of the agriculture sector contribution in economy in favor of increasing other sectors' contribution, see figure 2.

Second approach looks to the matter from this study's objectives point of view that shows there is no enough engagement of ICTs in agriculture which affirms the notion discussed about the slack in adopting e-agriculture strategies, the necessity to integrate ICTs in agriculture and the importance for e-governments to adopt e-agriculture as an important service for agri-development.

This lagging in adopting e- agriculture is demonstrated especially in private sector, because ICTs engagement in agriculture needs a lot of support for research and development with a little opportunity of feasible revenues that private sector seeks, in this regards, there are a modest initiatives for integrating technology in agriculture in shape of e- agriculture such as FAO initiatives but if the world want to face the anticipated world hunger in future and increase agriculture production, governments over the world with collaborations of global organization should focus on finding serious supporting for engaging new technology in agriculture.

Conclusion

The negative relation between e-government developing level, ICTs development indices, e-participation, Government on-line Services from one side with agriculture sector contribution in economy of a country on the other side, led the study to conclude that the adoption of e-agriculture as strategic solution for anticipated food deficit in the future is still modest, and the engagement of ICTs in agriculture section is still far away behind other economic sectors which benefits from these new technologies and increased their contributions in economy in expense of agriculture sector, this situation drives to another conclusion that governments over the world have the responsibility with the collaboration of global organizations to provide suitable financial support for an evolutionary e-agriculture projects which would enable a real jump in developing agriculture sector to be a modern and profitable sector in a way attracts private investments which in turn get involved in developing this sector again, and new circle of interactive mutual benefits starts.

Also, this paper concluded that countries who have a highest engagement of ICTs and highest e-government development are not concentrating on applying this development in agriculture sector as they aren't agriculture economies, and the benefit of this development goes to enhance other sectors that their economies depends on.

Also, browsing the international collaboration initiatives to exploit the great potentials in developing agriculture revealed of real opportunities in optimizing agriculture sector to find innovative solutions for future anticipated world hunger and reaching a sustainable e- agriculture.

This study recommends to extend this study and perform tests on a repetitive basis to be an observe tool of e-agriculture development, this tool helps in estimating the degree of success in e- agriculture strategies and plans implementation, in addition to that, this article recommends that international organizations put more efforts in finding financial support to develop e-agriculture which in turn raise agricultural process productivity and efficiency to the level enables agriculture sector from attracting business and international enterprises to invest in this sector as much as other economic sectors.

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