

## **PROMOTING PRECISION AGRICULTURE EDUCATION IN SUB-SAHARAN AFRICA: UNDERSTANDING THE ENABLERS AND THE BURDENS**

### **#9403**

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### **ABSTRACT**

Adopting Precision Agriculture tools and strategies can significantly accelerate agricultural transformation in sub-Saharan Africa (SSA) but burgeoning population and minimal technology advancement has slowed down SSA's progress toward attaining food and nutritional security. Climate change and the COVID-19 pandemic have increased the need for more resilient, productive, and profitable agriculture to ensuring food and nutrition security. Precision agriculture offers innovative approaches to harnessing soil and water resources in a more efficient and economic ways to increase crop yields in an environmentally friendly manner. With almost 60 percent of the region's population under the age of 25, education of youth in precision agriculture is crucial. This review paper focuses on the enablers and burdens of precision agriculture education in Africa. The paper presents a summary of ideas and findings from literature review, focus group discussion and key informant interviews. The study showed that Precision agriculture Education, if strategically implemented, can grow very rapidly, leading to increased enrolment and skills development as well as increased youth involvement in SSA African agriculture leading to higher crop yields and farmer incomes. The dominant enablers identified included Africa's youthful population and increasing growth in telephony and access to the internet, while the most important constraints included lack of infrastructure and limited knowledge and skills in PA technology. We conclude that if policy makers, local authorities, and managers of educational institutions in SSA stimulate PA integration into existing curriculum and create the needed enabling environments for PA growth at different levels in agricultural training institutions, SSA agricultural production systems will yield food and nutritional security outcomes, while creating jobs and enhancing livelihoods of the rural poor.

### **INTRODUCTION**

Education is the surest way to overcome Africa's socio-economic development challenges. FAO (2007) pointed out that there is a direct link between food security and education of rural youth, and that education can also help to improve farmers' livelihoods. In most parts of Africa, agriculture education is not prioritised and so it is often viewed as the preserve for underachievers. Furthermore, the quality of agriculture education in SSA is often low, and there is limited availability of well-motivated and highly skilled faculty, especially in poorly endowed or in less prestigious universities and colleges (FAO/UNESCO, 2003; World Bank, 2008). Precision Agriculture offers enormous potential to accelerate agricultural transformation in sub-Saharan Africa (SSA). Integrating PA into existing agricultural training institutions eventually increase agricultural productivity and profitability, contributing to sustainable development, through food security and increased farmer incomes. Investments in PA skill training and education is likely to empower Africa's youth with new knowledge and sharpen their skills for highly paid jobs. Romanov et al. (2016) opined that PA allows agriculturalists to observe, evaluate and control farming operations. Paustian and Theuvsen

(2017) and Swinton & Lowenberg-DeBoer (1998) reported that PA offers a lot of economic and environmental benefits through accelerated transformation of Africa's agrifood systems for shared prosperity and enhanced livelihoods. However, global adoption of PA is low, particularly in developing nations (Paustian & Theuvsen, 2017). Agriculture a major course in many African universities, but the number of students interested to pursue agriculture continues to decrease across the region. The declining numbers of agriculture students raises concern and so the underlying causes need to be identified so that the challenges could be addressed accordingly. Integration of PA into existing agricultural education in Africa can attract more youth, significantly increase enrolment, and promote capacity development for a more productive agricultural industry. However, the success of PA education in Africa is dependent on curriculum re-engineering, outreach, and tailored skill training, which requires skilled faculty, availability of ICT and internet facilities and an enabling policy environment. This paper presents an overview of the perceptions of faculty, undergraduate and postgraduate students from two Ghanaian universities about PA education in Africa. The paper further examines enablers and barriers to precision agricultural education in Africa.

## MATERIALS AND METHODS

The study involved a desk review of literature including FAO and World Bank reports, a focus group discussion (FGD) and a survey involving faculty, postgraduate and undergraduate students randomly selected from two Ghanaian public universities: the University of Cape Coast and the Technical University of Cape Coast, respectively. The literature review was followed by a focus group discussion and survey using a semi-structured questionnaire information to facilitate triangulation of results. The survey involved undergraduate students, postgraduate students and faculty from agriculture or agriculture-related departments qualitative and quantitative data. Data obtained from the study was analysed and presented mainly as descriptive statistics (frequency, percentage, and mean values).

## RESULTS AND DISCUSSION

### Demographics of the respondents

The results showed that about 76% of the students were male. This is in accordance with an IFPRI (International Food Policy Research Institute) study, which concluded that women are underrepresented in Africa's agricultural research and higher education (Beintema and Di Marcantonio, 2010).

**Table 2.** Demographic of the respondents.

Gender		Designation		Highest level of Education			Number of years of university education university	
Male	Female	Faculty	Students	PhD	MSc	BSc	>5 years	< 5 years
530	170	70	630	30	70	600	60	640

The survey revealed that most of the respondents had no or very limited knowledge about PA. However, most of the respondents (students and faculty alike) agreed that the impact of PA on Ghana's agricultural industry will grow as new ideas and opportunities spread. Furthermore, majority of the respondents had no knowledge about the components of PA education, with only 14% claiming to know what they are.

### Perceptions of PA Education in SSA

The respondents showed a high level of consensus on their perceptions of PA education in Africa. Responses to specific questions asked during the FGD are summarized in Table 2.

**Table 3.** perceptions of PA education in sub-Saharan Africa.

Perception	Yes	No	Don't Know
Is PA critical for accelerated transformation of the agrifood systems, and shared prosperity and enhanced livelihoods in Africa	83%	17%	-
There is inadequate skilled PA faculty, tools, and facilities in Ghanaian universities	87%	13%	-
There is limited financial commitments and regulatory policies towards integrating PA into existing program in universities	86%	14%	-
The extension services in Ghana lacks the capacity, skills, and competencies to promote PA services	60%	22%	18%
There is lack of equipment and logistics to stimulate PA Education and outreach in Ghana	70%	9%	21%
The media is interested and adequately psyched to promote PA education and outreach in Ghana	39%	27%	44%
Promotion of PA education and outreach is low because of a disjoint existing between academia, industry, and the media	59%	10%	31%
The success of PA education in Ghana is highly dependent on curriculum reengineering to include PA technology and skills training	59%	4%	37%

The study showed that there is a general perception that PA education can accelerate development of Africa's agrifood sector, but that there is inadequate skilled PA faculty, tools and facilities in SSA universities, Further, it was generally perceived that there is limited financial commitments and regulatory policies towards integrating PA into existing program in SSA universities.

### Enablers, Barriers, and opportunities for PA Education in SSA

The study indicated a widely agreed perception that efficient curriculum, as well as provision of ICT and Geosciences equipment and logistics can stimulate PA education in SSA. Furthermore, most of the respondents agreed that PA education hinges on curriculum reengineering and availability of ICT and internet facilities. Although mobile technology penetration and internet access is growing steadily in SSA it is still expensive, and combined with limited and unreliable electricity supply, low ICT literacy levels and lack of financial resources to secure the use of ICTs (World Bank, 2011), integration of PA into existing education can be hindered. The focus group discussion revealed that Ghana has a youthful population, who are keen to pursue technology-based education. But the main challenge facing PA education is limited access to PA information and education, which highly limits the acquisition of knowledge and skills and development of entrepreneurial skills. Regarding opportunities, the study indicated that the youth are enthusiastic to be empowered with modern PA technologies" (MIJARC/IFAD/FAO, 2012). Furthermore, increasing availability of smartphones and expanding internet access coupled with increasing access to secondary and tertiary education is likely to stimulate interest in PA education.

## The way forward

While the challenges identified are complex and interwoven, a strategically structured PA education that ensures access to the right information through integrated training approaches and provide solutions through adoption of modern agricultural practices and deployment of ICT offers a great potential to increase agricultural productivity and profitability. Results from the FGD showed that each category of respondents had different priorities in terms of what would promote accelerated PA education in Ghana. The FGD showed that faculty prioritised training, infrastructure, and industry-academia linkages; postgraduates were more interested in PA research while undergraduate students were more inclined towards PA skills, scholarships, and skilled faculty.

Transitioning traditional farming to digital agriculture in an era of fast technology growth and dynamic agricultural economy, agricultural universities in SSA need to adapt their curricula and integrate improved technology, communication, and entrepreneurial skills. However, IUCEA (2015) and other organizations across Africa repeatedly show that regardless of the need for technical skills, employers place much greater importance on ‘soft skills’ (Kalufya and Mwakajinga 2016; Ngalomba , 2018). Thus, it is crucial to train agriculture graduates in ways that enable them to continually adapt to a complex and changing ecosystem, by providing them opportunities that ensure their inclusion in networks that promote co-learning and sharing of scientific, technical and market information. Building the skills of both educated and uneducated youth to work along the agricultural value chain has the potential to solve the problem of youth unemployment and, at the same time, increase agricultural productivity. Rapid technological evolution requires a culture of continuous learning and an agricultural education and training system properly focused on both how to learn and what to learn. Such a system must employ innovative e approaches that will position agriculture graduates to lead change, to be adaptable and efficient. Universities should enhance the skills of graduates in ways that will empower them to respond to rapidly changing technological, environmental, and structural conditions. They must be innovative and capable of adapting their PA knowledge and skills to complex and changing food systems.

The integration of PA technologies in higher education offers the potential to equip agriculture graduates with the needed skills that will make them employable in a rapidly expanding agricultural industry. Although PA education and training as crucial to optimize PA’s contribution to agricultural development, most universities in Africa will find it hard to stay ahead of the rapid advances in technology associated with PA adoption. Therefore, it is critical to assess and prioritise the PA-training needs of students studying in agricultural universities in Ghana. In accordance with Mondal and Basu (2009), we suggest that significant attention should be given information technologies, such as global information systems (GIS), global positioning systems (GPS), remote and proximal sensing, robotics, and variable rate technology (VRT), that are needed detect and manage spatial and temporal variability. In terms of skills and technical knowledge required for PA education in Ghana, Presently, the wide array of precision agriculture technologies (PAT) including GNSS technology, Geographic Information Systems, yield monitors, soil sampling tools, remote sensing tools, farm management applications, and variable rate application technologies are available (Paustian & Theuvsen, 2017; Robertson et al., 2012)

PA Education is a potentially effective approach to teaching agricultural skills and providing capacity-building trainings for agriculture graduates, but it should be done in ways that will always transmit the necessary skills, and result in good employment outcomes. There is often a mismatch between the kind of training offered and the requirements of the labour market in an evolving agricultural sector (Kalufya and Mwakajinga, 2016)., Thus, there is an urgent need to strengthen existing universities to establish linkages with the key players in SSA’s agricultural industry. Linking universities with industry is critical to identify knowledge

and skills that meet the needs of industry, facilitate participatory research, and enhance results dissemination to solve local problems. It is equally important to connect universities with labour market opportunities and to strengthen partnerships with employers to ensure that the PA skills that will be developed in graduates respond to labour market needs so that they become employable.

## CONCLUSION

Although, efforts to transition traditional agriculture training to PA education in Ghana' will not come easily, responses offered during the FGD and interviews offer a glimmer of hope that there are workable solutions to overcome the challenges faced by young women and men trying to engage in agriculture as a source of sustainable livelihood. The study concludes that a PA education that builds the technical knowhow and skills of SSA youth, while enabling access to financial services, and niche markets and opportunities to actively participate in policy dialogue and developmental agenda setting is likely to increase youth's involvement in the agricultural sector, resulting in increased productivity and profitability. Thus, PA education should be integrated existing undergraduate and postgraduate agricultural programme, focusing on skill training in data science, geographic information systems (GIS), remote sensing, and artificial intelligence. Finally, governmental policies in SSA should emphasize training and re-training of faculty, support staff, as well as provision of ICT and internet infrastructure and funds for successful implementation of PA education in agricultural universities across SSA.

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