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Socio-economic determinants of agricultural mechanisation in Africa: A research note based on cassava cultivation mechanisation

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ABSTRACT

While global agricultural mechanisation is on the increase, societal resistance has left its adoption stagnant in developing countries. Optimizing the successful adoption of mechanized processes in these countries involves amongst other things, identification of salient problems and adequate planning to prevent them. This note highlights some possible causes of perceived societal resistance to mechanized farming in light of the limited progress in the mechanisation of one of Africa's leading crops, cassava (*Manihot esculenta* Crantz). Potential approaches to improving the development and adoption of mechanisation for this crop and region as well as the research gaps preventing adoption success forms the discussions in this note.

1. Introduction

While it might seem exciting and gratifying to introduce new, ground-breaking agricultural technologies into developing societies in order to improve the quality of life and enhance food security, it may be erroneous to assume that the introduction of such technologies will not meet with some level of resistance by certain sectors of the society. The introduction of any technology can have either positive or negative effects on a society, depending on the rate at which it is introduced and adopted by the society and the expected skill level of the new technologies' target users. The adoption of agricultural technology by a farming population would normally depend to a large extent on the society's socio-cultural and economic ideologies as well as the application of these technologies to local production systems (IFAD-FAO, 2005). Few sub-Saharan countries have high agricultural mechanisation adoption rates, largely because of the abysmal failure of prior efforts to ensure the continued adoption of new farming technologies by the farming population once initial government support came to an end (Mrema et al., 2008; Pingali, 2007) and also due to societal resistance especially to biotechnological related innovations; all despite documented gains (Pinstrup-Andersen et al., 1999; Owombo et al., 2012; Parente and Prescott, 1994).

In Africa, agriculture (primarily subsistence) has been by far the single most important economic activity; employing about two-thirds of the workforce in sub-Saharan Africa. By this means, it contributes an average of 30 to 60% of the region's gross domestic product (GDP) and constituting about 30% of the value of exports (SRID, 2011). However, with a prediction of as much as 98% contribution to the increase of the world's population by 2020 coming from Africa, most of the developing countries of Africa will become increasingly urbanized and face food security challenges. The successful implantation of mechanisation, therefore, has an impending positive implication for food availability and job creation on a global perspective. Using cassava as model crop, we highlight some of the possible causes of agricultural mechanisation stagnation in the African region.

1.1. Cassava cultivation and mechanisation

Cassava (*Manihot esculenta* Crantz) is grown all over the world and in Africa is the most produced ahead of sugar cane and maize (Fig. 1a,b) (FAOSTAT, 2016). Common amongst the lowland tropics, sub-humid tropics of West and Central Africa, it is a primary source of calorie for about two-fifths of Africans (Oni and Oyelade, 2014). Its cultivation produced the largest number of calories per hectare of any crop; it grows on poor soils, and it has a high resistance to drought, pests, and diseases (Nweke et al., 2002). With these characteristics, its cultivation steadily expanded in almost all of the last two decades particularly in western and central Africa; displacing yam (*Dioscorea* sp. L.) cultivation in many areas and improving its significance as more than just a famine reserve. Over 90% of cassava production takes place on small farms and accounts for about 26% of cash income from all food crops (IFAD-FAO, 2005).

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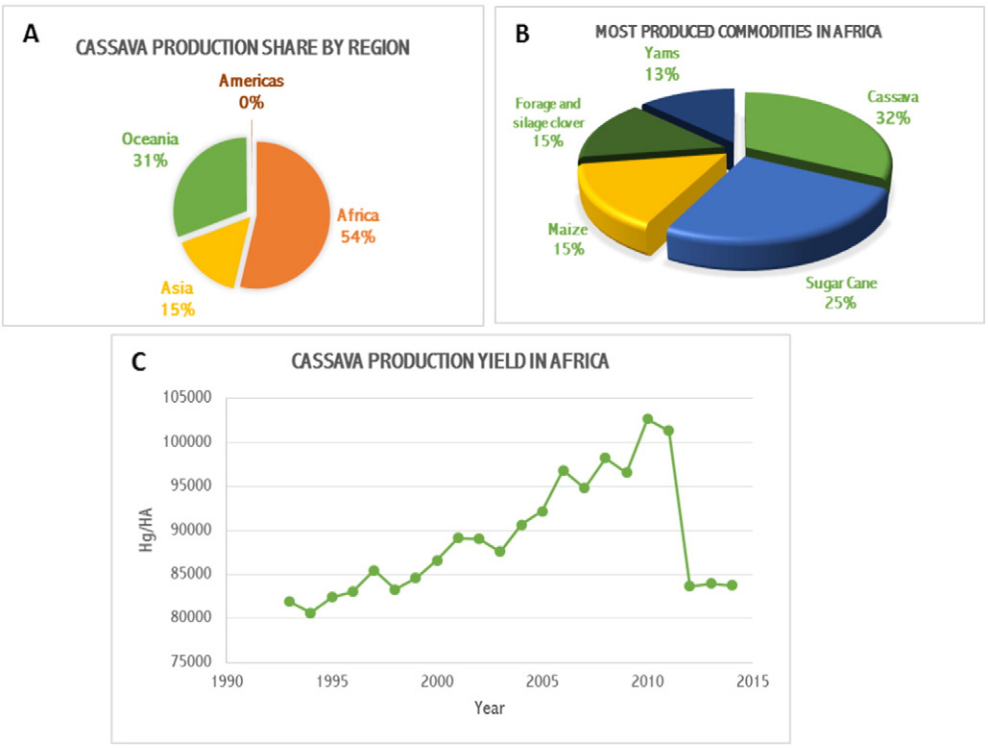

Fig. 1. Cassava production statistics.
(Source: FAOStat 2016 Database)

It is all thus logical that the mechanisation of cassava cultivation is explored and driven to technological levels that can sustain growth and cater to the growing African population. Experience and data have shown though that the mechanisation of cassava cultivation processes is relatively difficult in execution and adoption (ref), solutions for the automation of the cassava cultivation process existed and are being developed further every year. Land preparation systems, irrigation systems, transportation systems as well as pest and diseases management are readily available and are adaptable for cassava cultivation. Also, specialized machinery such as the stem planting machines, cassava root collector, cassava harvester (Lungkapin et al., 2007) are being developed to improve the mechanisation process.

Unfortunately, the progress made technologically often does not translate into actual field realisations, and it is very convenient to point outrightly (erroneously) at the expensiveness of these technologies as the culprit for this negative correlation. However, in most cases, tied to the economic limitation is the social aspect as it concerns the users of these technologies. In Africa, heavily influenced by tradition, religion and education, the lack of proper considerations for these social factors in the introduction of technology into cassava farming and by extension other agricultural practices, has led to an almost non-existent adoption level. While these factors are not entirely unique to Africa, their effects are seemingly stronger in the continent when compared to other less developed regions of the world. For example, fertilizer use is far less in Sub-Saharan Africa than it is in other less developed regions. In 2007, average use was just 13 kg/ha compared with 208 kg in Asia and Latin America (WorldBank, 2007). Irrigation accounts for only 5% of the cultivated area, compared to more than 38% recorded in other countries in Asia and Latin America. Tractors per 1000 ha are a paltry 28 as against 241 in other parts of the world (FAO and UNIDO, 2008).

These constraints are however not the same across Africa, even though some general common problem areas exist. Most efforts by the government to encourage agricultural mechanisation in Africa have been in the area of tractors utilisation, and they are not meeting expectations (Ashburner and Kienzle, 2009; FAO, 2013). Today, the rate of use of agricultural machinery is still below that which is considered necessary to meet the rising demand for food (Mrema, 2011). For instance, the use of manual (hand) power dominates in central Africa while draught animals dominate in western and eastern Africa. On average hand power still dominate in the continent (Clarke, 2008). Combined, hand and animal power contribute close to 90% of the agricultural work efforts in four (central, western, eastern and southern) out of the five regions of the continent (Clarke, 2008; FAO and UNIDO, 2008).

Already effects of lapses in the failure of mechanisation adoption can be seen in a reduction of Africa's leading crop (cassava) production by as much as 18% between 2011 & 2014 (Fig. 1C). It is, therefore, paramount that more researchers begin to develop applicable models and also create information on the critical socio-economic determinants to cassava mechanisation adoption that will help technologists and government policy makers solve this nagging problem that can lead to greater fallouts in the future. The information obtained from this will, in general, assist in the improvement, development and introduction to and adoption of mechanisation in this continent.

2. Critical factors affecting mechanisation adoption in Africa

The need to have food security is critical and the inability of countries in Africa to mechanize agriculture has remained a daunting task that has frustrated efforts at improving crop yields and by extension, prosperity. There are factors that have always undermined the efforts in this direction and these factors are critical because they form the nexus and basis for the inability of African countries to adopt mechanization. Therefore, these factors affect every facet of the aspirations of African developmental efforts. They relate directly to the traditionalistic outlook of the continent including the religious and communal values that may likely inhibit infusion of change and prosperity. Although the process of change may be inherently painful, acceptance of change can be particularly difficult especially as they depend on the internal dynamics of social and cultural structures of a society. In other words, new technology does not change