CHALLENGES OF LOWLAND MECHANIZATION THROUGH SAWAH ECO-TECHNOLOGY IN NIGERIA

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ABSTRACT

The total area under cultivation and the timeliness and efficiency of accomplishing crop husbandry tasks is strongly influenced by the amount of available farm power and its efficient use. The increased usage of farm power for cultivation creates further demand for related agricultural machinery for harvesting and storage and generates employment opportunities in the agricultural service industry.

It is therefore the opinion of many that due to the economic level of majority of farmers in developing countries like Nigeria, in transforming from the presently predominant hand- tool technology to a full blown large scale engine power technology, there has to be an appropriate intermediate technology. In the past this has been viewed as the animal draft technology. However, the introduction of two-wheel tractors (power-tillers) in many countries is proving to be a better and more appropriate intermediate technology.

Also, it is now a wide believe and a well known fact that Sawah eco-technology is a key requirement to achieving rice green revolution in Sub-Saharan Africa, to put into use the long neglected and fallowed lowland which has enormous potential and to combat environmental challenges such as flooding and global warming.

The Paper examines the experiences, challenges and constraints encountered in the dissemination of this proven technology and also prescribes proven methods for effective technology transfer to stakeholders, NGOs and farmers.

KEYWORDS: ***Challenges, Mechanization, Sawah, Eco-technology, Lowland, Power Tiller***

1.0 INTRODUCTION

1.1 Background

Africa is the largest continent in the southern hemisphere; it has enormous ecological diversity, embracing two temperate zones, two sub-tropical zones and a tropical region. This geographical situation allows people in Africa to grow diverse crops. The 655 million Africans are agriculturally based. The main foods consist of the coarse grains (sorghum, millet, maize), wheat, rice, root and tuber crops (yam, cassava, sweet potato, potato, and taro), (Ademiluyi, 2010).

Nigeria has a total land area of 98 million hectares of which 53 million hectares is cultivable land area. Thus, agriculture in Nigeria is the most important sector of the economy from the standpoint of rural employment, sufficiency in food and fibre, and export earnings despite the subsequent discovery of oil. Available records indicate that 40% of the population of Africa (Nigeria inclusive) live below the international poverty line of US $1 per day (de Hann and Yaqub, 1998). If this figure is anything to go by, it becomes necessary to adequately address the situation.

MAP OF NIGERIA

Small-scale farmers are estimated to account for the cultivation of about 90% of the total cultivated land area in Nigeria, producing about 90% of the total agricultural output (CTA, 1997). This category of farmers still depends on manual labour to carry out their various farming operations. However, with labour demand at critical crop production stages, high labour cost and food demand for the teaming population of over 140 million with an annual growth rate of 2.5%, the introduction of agricultural labour saving devices to Nigerian agriculture is indispensable.

Though successive administrations in Nigeria have made concerted efforts aimed at achieving self-sufficiency in food and fibre production, these efforts have failed to achieve their intended goals. There are many factors responsible for this. A major one being the lack of an integrated and appropriate labour saving agricultural tools and machines.

Therefore, the need to develop and introduce more labour saving devices on Nigerian farms in particular and in Africa South of Sahara in general, has never been more critical than now. The educated youths regard their certificates as excuses to shun farming because of the arduous nature of agricultural production activities.

Also, knowing fully well that increased land productivity (greater output per unit of land) generally depends on the application of higher technology and a higher level of knowledge and management ability, crop production and processing technologies are instruments of farm management and as such, changes in mechanization level can have a multiplier effect on output per unit of land.

Per capita food production has declined in Africa for the past 30 years and farm productivity in Africa is just one-quarter the global average. Today, more than 200 million people are chronically hungry in the region, and 33 million children under age five are malnourished. The vegetation of forest and grassland are being deflated gradually due to grievous damage, but the speed of desertification is accelerated; the natural disasters such as drought, storm of sand and dust occur frequently; farmland is reduced and soil degenerated; water resource is decreased greatly and environment pollution is aggravated. All these impact the **sustainable** development of agricultural productivity.

1.2 REASONS FOR DECLINE IN PER CAPITAL FOOD PRODUCTION IN SSA

The reasons for the declining trend in per capita food production and degrading ecological environment include:

Farmers' reality: For many small scale farmers, the bottom line of their activities is survival. This means that decision making in food production, i.e. cropping pattern, implement choice, land tenure etc are essentially based on risk avoidance because they have very little control over either their economic or natural environments, extremely limited alternatives exist for them.

Mechanization: Many farmers do not have access to the appropriate technology and inappropriate technology particularly tillage practices can quickly degrade soils, thereby, threatening a nation's productivity and food security.

Global Warming: Part of the factors that has led to degrading ecological environment in Africa is global warming, otherwise, called the green house gas effect. Emission of carbon-monoxide (CO) from automobile exhaust, bush burning, chloro-flouro carbon (CFC) from refrigerant uses have been linked to the depletion of the ozone layer. Following this are series of floods in several low-lying countries, excessive solar ultra violet (UV) radiation, abnormal rise in water table and destruction of rainfall pattern. All these lead to crop failure for resource-poor African farmers.

Population Growth: Population in Africa has grown at a faster rate than food production in the past three decades and this has led to a decline in per capita food production.

Poor Market: Among the challenges facing accelerated food production in Africa are poorly developed markets, lack of investment, and poor infrastructure in rural areas. Despite this, there exist opportunities that can be tapped to help end chronic hunger and food problems. On the other hand, the farmers should be able not only to sell his or her produce, but to sell it at economically competitive prices. Because of the poor price polices that prevail in Africa, what could have been the farmers' profit and motivating factor to sustainably increasing production, end up in other people's pockets (Middle men and consumers), hence, the farmers remain with no capital to re-invest.

Poor Extension Services: The extension system in Africa has been more oriented to the delivery of technical messages (some of which even the extension workers themselves do not understand), with little or no regard for the needs and aspirations, let alone the reality of the farmers.

Poor Governance: Governance in Africa is often punctuated by coups and counter-coups. This instability leaves no room for good governance as leaders bear no genuine allegiance to the populace.

Poor Research capability: Research institutions in Africa are not adequately funded to have significant impact on the agricultural sector of the economy

Poor education: Literacy level and efforts in Africa are very low. This has slowed down adoption and adaptation of improved techniques and materials for accelerated food production.

Poor Policies and Projects Implementation: If there is anything in Nigeria, it is not well articulated program, projects and schemes in all areas of development especially agriculture. What is lacking however, is the sustainability of the programs.

1.3 RAISING AGRICULTURAL PRODUCTIVITY IN SSA

To turn things around, there is need for urgent focus on raising agricultural productivity. More investment is needed to improve soil and water management of rain-fed and irrigation agriculture, more adaptable new crop varieties, improved access to seeds and fertilizers, environmentally sustainable integrated pest management practices, reduction in post-harvest losses, and improvement of rural infrastructure, especially roads and communication infrastructure. These will need to be bolstered by bold pro-poor policies to help transform smallholder agriculture. More importantly, the following itemized points should be applied:

- Sustainable ecological engineering to improve environment of crops, trees and animals e.g “Sawah”.
- Creation of African “Satoyama” system.
- Appropriate farm equipment should be made available and affordable.
- Creation and emphasis on organized marketing institutions as well as production inputs, e.g co-operatives.
- Adequate and effective extension strategies should be put in place.
- Research institutions should be strengthened, researchers encouraged and exposed, while adequate funds be released for research activities and should be made farmers ‘oriented.
- Politics should be alienated from agricultural policies.
- Workable population control measure should be put in place as well as accelerated food productivity.
- Farmers insurance and guarantee should be established.
- Effective water management practices, fertilizers and high yielding varieties; the basic component of the green revolution and the first hypothesis of the Sawah eco-technology concept, should be applied, (Wakatsuki, 2009).

2.0 SUSTAINABLE RICE CULTIVATION THROUGH SAWAH ECO-TECHNOLOGY

Fukui (1987) pointed out that the history of rice growing in Asia has two aspects in its development processes: agronomic and engineering adaptation, though their importance differs according to rice farming ecology and the historical developmental stage of technology in each area.

The agronomic adaptation challenge has almost been completely tackled through breeding, fertilizing, weeding, disease prevention and pest control. The engineering adaptation are improvements in the environment of rice growing areas by constructing and improving weirs, small reservoirs, irrigation and drainage facilities and **Sawah** basins, (Hirose and Wakatsuki, 2002).

Thus, the term Sawah refers to man-made improvement (engineering and environmental adaptation) of rice fields with demarcated, leveled, bunded and puddled rice fields with water inlets and outlets which can be connected to various irrigation canals, ponds, springs or pumps, (Wakatsuki et al, 1998).

Total dependence on biotechnology from the standpoint that new varieties will solve rice production problems has led many people to believe that we may solve the problems by breeding, but it is also true that even the genetic characteristics of excellent species cannot show their potential fully unless fundamental environmental conditions are available. Unless biotechnology turns into alchemy or unless technology can go beyond the rule of mass balance, it will be impossible to keep the productivity of rice at a high level.

Another option is to lay emphasis on engineering technology for a better environment, such as irrigation and the creation of sawah fields. It is clear that this type of engineering technology, like the one of sawah based agriculture where various measures are taken to control and conserve water and land, is important in tropical Africa.

The last eco-technology strategy is to realize the importance of both agronomic and engineering adaptation technology to the development of rice growing in Nigeria in particular and Africa in general and to make sure that this technology is sustainable in rural communities as well as ecology in the region. We should understand the fact that sustainable efforts are needed to increase farming production while conserving soil and water resources n tropical Africa, where the total destruction of the agricultural environment is occurring. Therefore, sawah based agriculture may be recognized as important and may be accepted in the climate of tropical Africa.

The development of sawah based agriculture by farmer participation in inland valleys is the first step of such efforts. Mechanization options through the supplies of small machineries are another major mile stone, but all these are not with their challenges.

3.0 SAWAH DISSEMINATION AND LOWLAND MECHANIZATION IN NIGERIA

The dissemination of the concept of Sawah eco-technology in Nigeria is not without its challenges. These can be summarized as:

i. *Cultural Practices:* the existing cultural practices among practicing farmers of a particular area affect the rate at which new technology and agricultural innovations are adopted. For example, where the normal practice of the farmers who go into rice cultivation is transplanting, they will not have difficulty in adopting Sawah eco-technology. Table 1 below shows the ease of adoption of sawah technology based on the activeness and cultural practice of the states under consideration.

ii. *Language Barrier:* Nigeria being a multi-lingual nation has its inherent nature of language barrier. This is is the case of sawah adoption in SSA in which there is no appropriate word to describe sawah, (Wakatsuki, 2008). Also, in Nigeria, the multi-lingual nature makes it difficult for a researcher or expert form another part of the country to disseminate his technology.

iii. *Poverty:* the inherent poverty level of African farmers is another factor that inhibits or retards the ease of dissemination and acceptance of Sawah eco-technology. Most farmers always think that new technology must be accompanied with compensation or monetary benefits before they will be able to even test a technology or adopt it. This they always do in comparison with multinational firms or communication companies who pay certain amount for the use of their parcel of land.

iv. *Socio-economic factors:* Important socioeconomic characteristics that are of crucial concern in the introduction of power tiller to sawah adopting farmers are age, educational level, membership of farmer group, farm size, land tenure, practice sawah, location/distance of sawah plot and cost of power tiller use. The effect of each of these socio-economic characteristics and their interaction will determine the trend of continuous and future use of power tillers among the rice farmers. As the adoption of sawah rice production technology spreads among farmers in Nigeria, the consequent effect of socio-economic characteristics on the use of power - a major component of the technology should be given serious consideration, (Ademiluyi, et al, 2008)

S/N	Geo-political zone	States	Cultural practice	Sawah status
	South-South	Delta	Swamp rice, broadcasting	Semi-active
	South-West	Lagos, Ekiti, Ondo	Swamp rice, dibbling and broadcasting	Introductory stage
	South-East	Ebonyi, Enugu	Swamp rice, transplanting	Active
	North-West	Kebbi, Kaduna	Inland valley, dibbling	Active
	North-Central	Kwara, Niger, Benue	Inland valley, dibbling	Semi-active, Introductory
	North-East	Borno	Inland valley, dibbling	Non-active

Fig. 1: Classification of States by Sawah activity and ease of adoption

4.0 ISSUES ON AFRICAN AGRICULTURAL MECHANIZATION

According to Tokida (2011), the following are some of the perceived issues to African agricultural mechanization

i. No programs based on clear mechanization policy and strategy
ii. High local production cost due to imported materials
iii. Public led mechanization
iv. No scale merit due to too many brands with small volume (scattered customers and small market)
v. Unstable spare parts supply and post sales service
vi. Very limited human resources for mechanization promotion
vii. No international commitment to assist mechanization
viii. Private-Public Sector Model
ix. Balance of importation and domestic production
x. Support for farmers when purchasing machinery
xi. Custom hiring business model
xii. Risks:
xiii. Continuous economic growth?
xiv. Maintenance of crop price at higher level
xv. Political stability
xvi. Effect of climate change

5.0 LOWLAND MECHANIZATION AND SERIF DISSEMINATION IN NIGERIA AND SUB-SAHARA AFRICA

As multiple actors operate and interact in so-called systems of innovation – constituted by elements and relationships which interact in production, diffusion and use of new knowledge – one cannot ignore factors that are social, organizational, economic or perceptual, (Mele et al, 2006).

There is no single terminology that covers all the different dimensions of participatory technology development, participatory research, farmer education, knowledge and information systems, farmer platforms, institutions and policies. But the term "technology transfer" will be adopted for the sake of this paper and Sawah Eco-technology in general.

The failure of single blueprint method of technology transfer such as the Training and Visit (T&V) system of extension, previously promoted by the World Bank and part of the 'Transfer-of-Technology' or pipeline model of innovation which ignored that farmers are active agents and in many ways experts who have detailed knowledge of their environment (socio-economic, production circumstances, livelihood strategies) and have developed considerable knowledge concerning farming techniques, (Biggs, 1990; Leeuwis, 1999) led to a wave of participatory approaches and a new cycle of learning from failures and processes. This gave rise to multiple source of innovation model as described by Biggs, (1990).

5.1 ALTERNATIVES TO MECHANZATION

The following are the roadmaps to achieving agricultural mechanization in Nigeria and SSA:

I. Strategic Agricultural Mechanization Plan, Feasible SSA mechanization Model

II. Promotion of agricultural mechanization using imported machines

- Purchase promotion (Warranty, Low tariff, Credit, Purchase subsidy, O&M training service, etc)

- Promotion of service providers (Loan availability, Hiring entrepreneur support, Mechanic training, etc.)
- Dealer support (Warranty, Spare parts supply, Preventive maintenance, Loan availability, etc.)
- Elimination of poor quality machines

III. Promotion of locally produced machines

- Human resource development for research and development
- Promotion of local manufacturers (Loan availability, Government purchase, PPP, etc.)
- Sales promotion of locally produced machines (Purchase subsidy, O&M training service, etc.)
- Dealer support (Networking, Micro credit, etc.)
- Farmer support (Extension officer, Farmer group, Operator instruction, etc.)

IV. TRACTOR HIRING SERVICES

Many factors have been responsible for the availability of a model tractor hiring services in countries of SSA which include:

- Poor management
- Economic crises
- Poor maintenance
- Low efficiency
- Privatization of government hiring schemes

However, the importance of Tractor Hiring services to the achievement of agricultural mechanization cannot be overemphasized. Tokida (2011) proposed a mechanism to promote Hire Service for small holders as illustrated in the figure below.

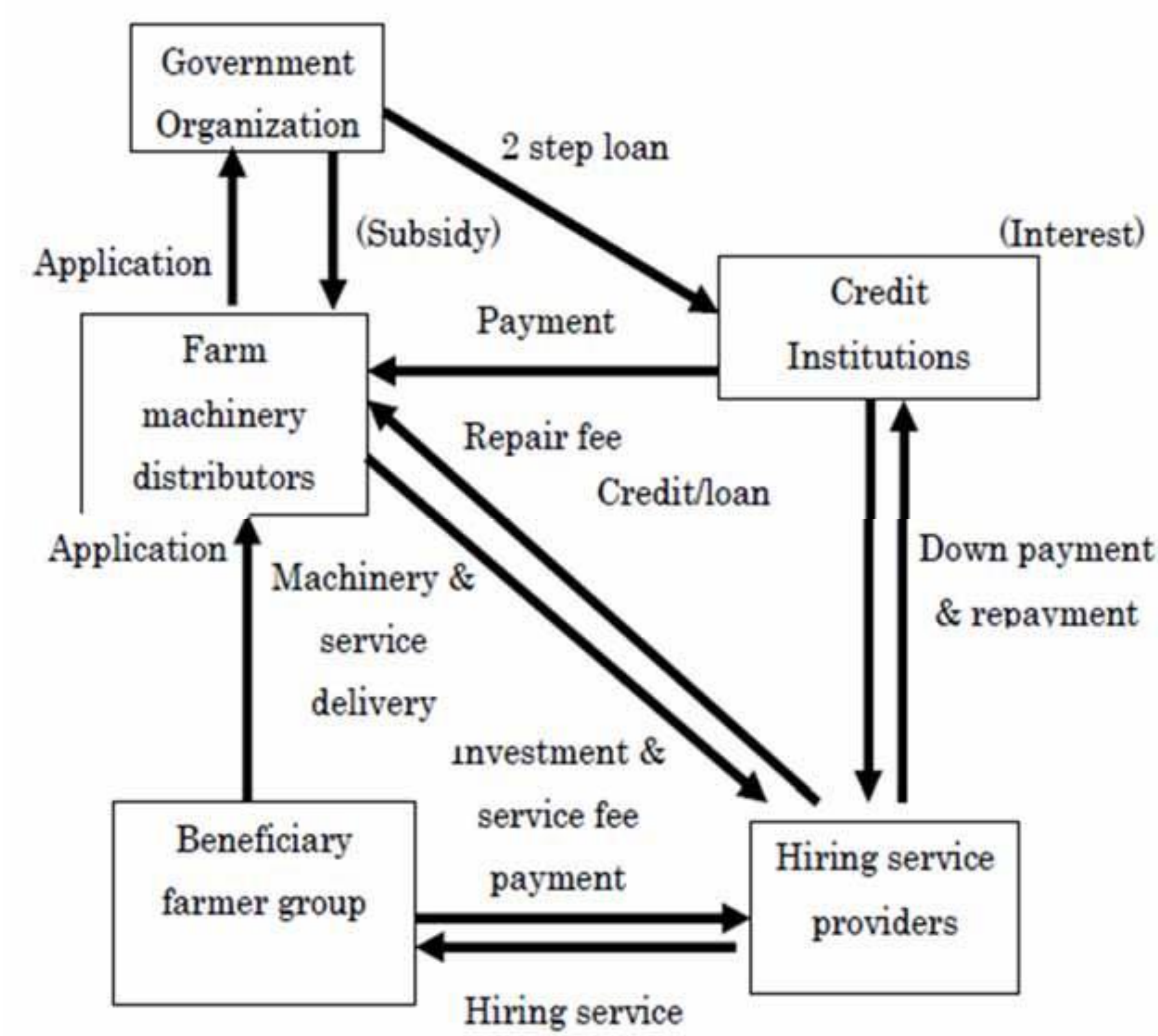

Fig. 2: Mechanism for promoting Tractor Hiring Services

5.2 Enabling Environment for Public-Private Partnership for Mechanization in SSA

Creation of enabling environment for agricultural mechanization to thrive involves:

a) Government commitment with clear mechanization policy and strategy with concerned ministries

b) Direct public investment that does not disturb private investment

c) Available human resources

d) Reduction of business risks

e) Business system for sustainable agricultural inputs

f) Protection of investors

g) Tariff reduction

h) Cost reduction through subsidies

i) Creation of mechanization demand

j) Protection of customers

k) Financial support and purchase subsidies

5.3 Promotion of Sawah Eco-Technology and Rice Farming (SERIF)

The Sawah technology for rice production as an action research system can be actively disseminated and replicated in the 36 states of Nigeria and SSA in general through:

i. Awareness seminars and workshop for all stakeholders in the agricultural sector.
ii. Active collaboration between various governmental and non-governmental organizations interested in the development of agriculture.
iii. Organization of Introductory Training of Trainers workshop.
iv. Demonstration of the technology to selected leading farmers in each state.
v. Active participation of farmers and farmer to farmer training.
vi. Periodic training and retraining on Sawah technology.
vii. Periodic monitoring and evaluation of the technology.
viii. Participatory Learning and Action Research (PLAR)

Currently, various mainstream agricultural research and development projects use new methods, such as Farmer Field Schools (FFS) and Local agricultural Research Committes (CIALs), for interacting with smallholder farmers to develop and spread appropriate technology (Bentley et al., 2006; Braun et al., 2000). These methods envision participatory learning and action research and rely on engaging people in experimentation, observation, measurement and other activities which allow people to draw their own conclusion.

PLAR equally aims to promote technological and organizational change through improving farmers' capacity to observe, to exchange knowledge, experiences and practices, and to make informed decisions.

ix. Participatory Varietal Selection (PVS)

Although participatory varietal selection (PVS) has been around for a number of years in other parts of the world (Sperling and Ntabomvura, 1994; Sperling and Ashby, 2000; Witcombe et al., 1996; Witcombe et al., 1999), the methodology can be modified and successfully applied to Sawah Eco-technology dissemination.

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