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CONFRONTING THE CHALLENGES OF AGRICULTURAL MECHANIZATION IN NIGERIA IN THE NEXT DECADE: SOME NOTES, SOME OPTIONS

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Invited paper

ABSTRACT

"The man with the hoe" still remains an apt description of the Nigerian farmer today. In spite of decades of immense expenditures and investments into agriculture, in terms of money men and materials, by national and international governments and agencies, the average Nigerian farmer remains an indigent serf, regarded by today's youths as a dreadful anachronism.

The Nigerian agricultural industry, populated as it is by aged and ageing peasants, has progressively developed into a world of drudgery for losers, shunned and despised by Nigerian youths. To change this ugly/unsavoury image of Nigerian agriculture, it has now become imperative to adopt an appropriate level of engine-power agricultural mechanization technology (EPAMT), necessary and sufficient to modernize, energize and revitalize the industry. This paper opines that the most viable option to achieve the objective is a mechanization strategy which can create the conducive environment for the emergence of small-to-medium-scale (SMS) market-orientated, youthful farmers, who will voluntarily choose to go into agriculture as a respectable and profitable business. This canvassed SMS farmer-oriented mechanization strategy is justified in this paper with objective analyses of information and data collected through surveys, interviews and a requisite review of relevant literature.

INTRODUCTORY NOTES

Nearly 37 years ago, Professor Gunkel (1963) proclaimed that the book, "The Man with the Hoe" by Edwin Markham, aptly described the average Nigerian farmer. Gunkel went further to list the problems facing the Nigerian farmer to include illiteracy, lack of technical know-why and know-how, low yielding crops, poor soil fertility, general poor health caused by hunger and lack of adequate diet, poor roads and relevant infrastructural facilities, inadequate storage techniques and structures, lack of venture capital and credit. In a recent forum, the same views were expressed differently as follows: "The poverty of the farmer is transferred to the land due to lack of funds to procure necessary inputs, hence the poor yield, leading to a vicious cycle that must be broken to permit meaningful economic development" (Golan, 1997).

Dramatizing the abhorrence with which many Nigerian farmers and their children regard farming, Odigboh (1976) stated that in Nigeria, Engineers tend to beget engineers, Doctors beget doctors, Lawyers, layers, but a Farmer who begets a farmer dies regretting his existence. And he asked why?

From a hard-hitting report titled "Food For the Future: Correcting Enduring Agricultural Errors for Achieving Future Food Security", published by Environment Liaison Centre International in Nairobi, Kenya, Wainaina (1990) culled this statement, "The son of the African farmer goes to school not to become a better farmer but to escape form the farmers' world which is considered a world of losers and drudgery".

From the time of the reputed oil boom back in the 1970's, the agricultural industry in Nigeria suffered a near-irreparable neglect and

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progressively lost its pride of place as it progressively promised only indigence and indignity to the peasant millions engaged in it. As a direct consequence, Nigerian youths began to shun agriculture like the plague. The net effect is that mostly aged and ageing peasants in their diminishing numbers are left to man this premier industry of the nation.

And so it is that nearly forty years after our political independence, a preponderant majority of Nigerians continue to be beset by serious and apparently incurable aliments of progressively deteriorating situation of poverty and destitution, severe food shortages leading to debilitating hunger, escalating delinquency and crimes and a general social environment characterized by a feeling of insecurity, fear of the present and a pervading doubt about the future (Odigboh, 1988 and 1990).

A panel of physicians in Nigeria has declared that one out of every four children under the age of three is suffering from stunted growth due to the escalating cost of food. UNICEF also reports that half of all Nigerian children of pre-school age are now malnourished and will never reach their full potential, if they survive at all. In the same article containing the above reports, it is said that Nigerian Ministry of Health has warned that if current high levels of malnutrition persist, not only does the present generation remain at risk, but the next generation of Nigerians will be intellectually deficient – decreasing Nigeria's chances for any long term development (Araka *et al.*, 1990). Well, God forbid, I say!

II. POTENTIALS OF NIGERIAN AGRICULTURAL INDUSTRY

But surely, the situation described above cannot be justified, given the bounteous natural endowment that Nigeria is blessed with. Nigeria has 71.2 million hectares (70% of the 98.3 million ha total land area) which are good cultivable lands spanning different ecological zones. As such, we can develop our agriculture to a plateau of excellence, and achieve a level of diversified agricultural productivity, which can prove a decisive weapon of economics and politics on the African continent and beyond. Our strategies for industrialization, if based on our agricultural produce, can readily lead to industries which can withstand international competition, since we can boast of products which the technologically advanced countries need but cannot produce – rubber, timber, cotton, groundnuts, coconuts, colanuts, palm produce, cocoa, various tropical fruits and vegetables, various tropical roots and tubers *etc etc*. And this is possible because only about 34 out of the available 71.2 million ha of cultivable land are under cultivation at present. That means that over 37 million ha of Nigeria's cultivable land area are not yet utilized. There is therefore, plenty of room for the modernization, expansion and intensification of Nigeria's agricultural industry, to dramatically enhance agricultural productivity, in order to, not only forestall the above cited forecasts of doom, but also raise the standard of living of the people and prepare a base for sustainable industrialization in the next decade (Odigboh, 1989).

III. PROMOTION OF APPROPRIATE MECHANIZATION TECHNOLOGY

However, to begin anew to tap the potentialities of the agricultural industry in the next century, after decades of neglect in the present, it is crucial to recognize and resolutely address the serious handicap of the industry created by the unenviable social status of the real Nigerian farmer (Odigboh, 1988). This time around, slogans alone will not do it; the conservative attitude and paradoxical inclination of Government and government officials to perpetuate pedestrianism and peasantry in agriculture will be counter productive and will be resisted, if indeed it does not attract violent dissention from the large number of unemployed but well qualified graduates from our institutions of higher education.

Advocation of hand-tool technology, or animal draught technology, for Nigerian agriculture in the next century will no longer be realistic and must not be encouraged because, it amounts to a deliberate condemnation of a large class of Nigerians to a virtual enslavement, perpetual serfdom and poverty (Odigboh, 1976, 1983(a, b), 1988). Hand-tool technology or

animal draught technology has absolutely no chance of inducing Nigerian youths into agriculture or of providing the food, feed and fibre needed to enhance industrial development in the Nigeria of the future (Odigboh, 1990, 1992, 1996b, 1997). In the face of soaring labour costs and the unfavourable position of agriculture as a competitor for labour among numerous dynamic and more lucrative modern sectors of the Nigerian economy, and faced with the understandable and ever increasing aversion of Nigerian youths to the drudgery, indigence and indignity of primitive muscle-power subsistence agriculture, mechanical power mechanization must be recognised as the missing input needed to accelerate agricultural production in Nigeria. The Nigerian Agricultural Engineers must stand ready to counter any views to the contrary, especially to remove the apparent bias and prejudice against mechanical power mechanization of African farms often sponsored by donor agencies.

Nigeria has certainly developed sufficient expertise not to allow external donor agents to pre-empt or preclude local initiatives and inputs in matters of agricultural mechanization policies. It is important that all concerned in Nigeria, should break away from the rote repetition of hackneyed prescriptions and generalizations of what is considered appropriate agricultural mechanization technology for developing counties, usually emanating form international donor agencies and their agents whose only qualification is that they provide some financial assistance to the developing countries (Odigboh, 1983b).

All real stakeholders know that, to match the demand for food and agro-industrial raw materials with their supply in the next decade, agriculture in Nigeria must be adequately mechanized. Peasant farming of the past and present decades cannot and should not be expected to catalyse Nigeria's economic recovery and growth in the next century. The war against hunger and scarcity of agro-industrial raw materials is too big, too complex and too sophisticated for the armament and arsenals of handhoes and matchets in the hands of the army of aged and ageing peasant farmers. The Nigerian Agricultural Engineers must assume their expected responsibility and resolutely undertake to evolve and promote appropriate indigenous mechanical-power agricultural mechanization technology, necessary and sufficient to rejuvenate the agricultural industry, and to extricate the farming population from the intricate webs of poverty begts poverty sort of vicious cycle mentioned in the introductory notes above.

It is therefore, necessary to now advocate an urgent change in policy, to appropriately de-emphasize hand-tool technology as a conceptual and psychological point to begin to change the undignified image of peasant farming and farmers, to hopefully make farming more attractive to the youths and thereby to foster some hope of a better future for the Nigerian agricultural industry of the next century.

Agriculture anywhere has always been mechanized, employing a combination of three main sources of power: human, animal or mechanical/engine, giving rise to three broad levels of agricultural mechanization technology classified as hand-tool technology (HTT), Draught-Animal Technology (DAT) and mechanical-power or engine-power technology (EPT).

Hand-Tool Technology

Hand-Tool Technology (HTT) is the most basic level of agricultural mechanization where a human being is the power source, utilizing simple tools and implements such as hoes, machetes, wooden diggers, sickles, etc. A farmer using only hand-tool technology can cultivate not much more than one hectare of land to produce what only barely suffices to feed his family. He cannot do more than that for some scientifically established facts.

Actual field rates for various tillage operations using hand-tools as determined by various investigators are presented in Table 1 (Odigboh, 1976; Anazodo 1976) These rates make it abundantly clear that power is the major limitation to increasing area cultivated by, and productivity of the hoe farmer. It should be noted that the problem is not with the tools used since past efforts at redesigning them had not led to any substantial improvements (Odigboh, 1991;

Makanjuola *et al.*, 1991). The peasant farmer and his cutlass and hoe are efficient companions in crop production; this is a vital fact to consider in proposing realistic solutions to the problem of mechanization at the level of the subsistence farmer. The toilage and drudgery as well as the power constraint on timely tillage operations which limits production and earning capacity are the inherent characteristics of the peasant farmer using HTT; change the technology and you change the status also.

Table 1. Some Field Operation Rates By Farmers Using Hand Tools

Operation	Manual Work rate (man days/ha) +	
Land clearing	20.1 – 47.8	(32.6)
Ridging for cassava	29.7 – 64.5	(43.8)
Mound making for yams	35 – 93	(57.8)
Cassava planting		(28.3)
Yam planting		(17.3)
Weeding root crops	22.3 – 77.6	(36.7)
Weeding general		(40)
Cassava harvesting		(28.5)
Yam harvesting		(32.0)

+ Average values in parentheses
Source: Anazodo (1976)

Draught-Animal Technology (DAT)

The second technology level involves the use of such animals as bulls, oxen, horses or even donkeys, singly, in pairs or in teams, to pull specially designed implements for light tillage operations. It is not used much, if at all, for other field operations like planting, weeding and harvesting. Animal draught power has been vigorously promoted in sub-Saharan African (SSA) countries, including Nigeria, since the 1920's in the belief that it is a power source suitable for the peasant farmers' operations and technical skills. But DAT has been the subject of increasing criticism, with a great deal of international and national debates on its merits and demerits from the opposing schools of thought (Allan, 1972; Musa, 1978; Munziager, 1982; FAO, 1988; Odigboh, 1981 and 1991; Mrema and Mrema 1993; Mrema and Odigboh, 1993; etc.). We do not wish to join the debate here, but it is a fact that, after millions of dollars spent by donor agencies like the World bank, as well as the huge expenditures by Federal and State Governments of Nigeria to popularise DAT over the past sixty years, less than 10% adoption rate has been recorded even in Northern Nigeria. It suffices here to say that, while DAT may still be a relevant technology for agricultural mechanization in some SSA countries, its long-term vision is not very bright anywhere, especially in Nigeria. The view of the informed is that DAT is not likely to play a significant role in the mechanisation of agriculture in Nigeria 5 – 10 years into the future particularly because DAT cannot lift the image and dignity of farming to a level that can attract young Nigerians into agriculture by free choice (Odigboh, 1991).

Engine power technology (EPT)

This involves the use of a very wide range of implements, machines and equipment powered by a similarly wide range of mobile or stationary power sources, engines and motors, using petroleum fuels, alcohol or electricity. The power sources and their associated implements are available in sizes, power ratings, levels of sophistication and technical complexity that vary tremendously. The most common and best known power source in agriculture today is the tractor which comes in a wide range of types, makes, sizes, power ratings and capabilities. With such a wide range of EPT systems to choose

Table 2. Sources of power for various primary land preparation operations in various countries

	Percentage of Total Land Cultivated		
Country	Human energy	Draught animal power	Mechanical power
Nigeria	86	4	10
Botswana	20	40	40
Zimbabwe	15	30	55
Tanzania	80	14	6
Kenya	84	12	4
Ethiopia	10	80	10
Zambia	55	15	30
Swaziland	15	35	50
Uganda	70	20	10
China	22	26	52
India	18	21	61

Source: Mrema and Mrema, (1993).

from, it is relatively easy for the expert to select and match a system that is appropriate to a specific situation. Considering all the relevant factors, engine-power technology is considered the most appropriate mechanization package for agricultural intensification programmes in Nigeria.

Status of Nigerian Agricultural Mechanization

All three levels of technology, HTT, DAT and EPT are applied to the mechanization of agriculture in Nigeria today, but unfortunately it is the hand-tool technology that predominates. About 86% of tillage and land preparation operations in Nigeria are performed using hand tools as shown in Table 2.

It is significant that Nigeria employs the highest percentage of HTT in primary land preparation operations of all the nine African countries listed in Table 2. Table 2 also shows that draught animals are employed on 4%, while mechanical power is used on 10% of the total land cultivated. For overall agricultural production in Nigeria, 90% of the power employed is human muscle power, 8% draught animal power and 2% engine power, as presented in Table 3.

When it is noted that in Europe and America, nearly 100% of the land is cultivated by mechanical means and that in Asia and Latin America it is about 40-70%, then it is easier to appreciate the implication of the dismally low figure of 2% in Nigeria. It is well established

Table 3. Sources of power for overall agricultural production in Nigeria, Africa and Latin America

Source of Power	Latin America	Africa	Nigeria
Human power	59	89	90
Animal power	19	10	8
Engine power	22	1	2

Source: Comsec (1990); Anazodo *et al.*, (1987).

that a power-use intensity of 0.4kw/ha is required nowadays for acceptable levels of agricultural production anywhere. As shown in Table 4, the power-use intensity is 0.786 kW/ha in USA, 0.201 kW/ha in Latin America, 0.37 kW/ha in Africa and only 0.018 kW/ha in Nigeria, making the Nigerian figure less than 50% of the African average and less than 5% of the globally recommended average of 0.4 kW/ha.

Table 4. Engine power available for agriculture in different countries and continents

Country/Continent	W/ha	(hp/acre)
USA	783	(0.430)
Europe	694	(0.340)
Latin America	201	(0.110)
China	142	(0.080)
Africa	37	(0.020)
Nigeria	18	(0.008)

Source: Adapted from Anazodo *et al.*, (1987)

It is thus quite evident that much higher levels of mechanical or engine power-use intensity are desirable for agricultural intensification programmes in Nigeria. Based on a recent regional survey (Onwualu and Odigboh 1995), the prevailing mechanization situation may be summarized as follows:

Peasant farmers account for 90% of farmers cultivating areass of less than 3 ha, with an average size of less than one hectare in most parts of Nigeria.

Medium scale farmers, defined as those with farm sizes of 20-100 ha, are virtually non-existent.

Large-scale farms greater than 100 ha in size are few and belong mostly to local governments or their agencies, companies operating the farms as a social service, and/or some wealthy Nigerians operating the farms as a status symbol, as their livelihood does not usually depend on them.

Machinery ownership patterns based on the survey of the Eastern and Benue States of Nigeria reflect the farm size patterns, as shown in Table 5.

Above 75% of the tractors in use in the zone are in the 38 - 60 kW (51-80 hp) power range. Small four-wheel tractors in the 30-37 kw (40-50 hp) power range account for only 9.5% of the total. The majority of the locally developed agricultural machine prototypes found in the Universities and research institutes are for post-harvest technology (cleaners, threshers, grinders, peelers, etc). A number of unique prototype machines for pre-harvest field operations have also been developed (Odigboh, 1997a & b). But, none of the

Table 5. Percentage of tractors and implements owned by governments and private farmers in the Eastern and Benue States of Nigeria.

State	Fed. Govt	State Govt.	Local Govt.	Private	Cooperative
Akwa Ibom	8.5	25.5	42.6	10.6	12.8
Anambra/Enugu	37.5	42.1	1.9	0.9	17.6
Benue	34.3	4.7	22.4	1.7	36.9
Cross River	20.1	40.0	4.5	6.2	29.2
Imo/Abia	16.1	43.5	3.2	3.2	33.9
Rivers	5.9	68.0	0.0	0.5	25
Overall (Mean)	20.4	37.3	12.4	3.9	26.0

machines is currently being manufactured which is a great pity indeed!

We therefore advocate strongly a strategy of engine-power agricultural mechanization technology, designed to encourage the emergence of small-to-medium scale commercial, market-oriented, youthful farmers who will go into agriculture as a business. By small-to-medium scale (SMS) farmers we mean youthful entrepreneurs who go into agriculture as a business and who can farm between 5 to 100 ha or more of arable crops. Those farming 5 to 20 ha are designated small-scale while those farming 20 to 100 ha are designated medium-scale. To appropriately explain our proposition, it must be stated at this point that focussing on the development of SMS farmers should not imply that our millions of peasant farmers should be ignored. On the contrary, by their very nature SMS farmers will set up and run sustainable growth inducing arrangements, through efficient agricultural input-supply and output-recovery systems (such as privately owned tractor hire services, THS) from which the peasant farmers can benefit more readily than form the erstwhile government institutions. But their functions in that regard is only secondary to their primary one of increased commercial agricultural production as demonstrated in India (Misra, 1991) and Pakistan (Byerlee and Husain, 1993). The big advantage of the SMS farmers is that they are the ones who can create and influence a functional market in the agricultural sector and play the role of ensuring its sustainable growth. The SMS farmers are also expected to become the rural entrepreneurs involved in agro-based industrial activities. Also, they are expected to function as contractors to the local governments for the provision, maintenance and repair of rural infrastructures (roads, water supply, etc) as well as other municipal and socio-economic services (transportation, agro-industries) which the governments cannot provide efficiently (Mrema and Odigboh, 1993). The SMS farming enterprises, involving market-oriented commercial farms will be capable of supporting modern agro-technological inputs economically, while providing the market for technical innovations and applied agricultural research results; they will create the desirable situation whereby agricultural extension services are not only government pushed but also farmer pulled (Odigboh, 1978). Furthermore, the SMS farming enterprises will play the very important role of changing the image of Nigerian agriculture from that of a "world of losers and drudgery" to one of "achievers and relative comfort".

We have belaboured and re-iterated this advocated re-orientation of policy away from peasant farming and peasant farmers towards commercial farmers and farming enterprises in full realization of the fact that engineering the policy change may prove more difficult than engineering the required technological inputs; ensure the former and the latter will follow with considerable ease. Against a background of chronic food shortages and rising food import bills, Nigeria's future food security may be literally at stake. Therefore, the nation should now boldly sponsor this advocated strategy of engine-power mechanization technology (EPMT) to instil a new sense of urgency into current efforts to confront the challenges of transforming, modernizing, rejuvenating and revitalizing Nigerian agriculture.

IV. EQUIPPING SMS FARMERS APPROPRIATELY

It has been sufficiently established (see Tables 1, 2 and 3) that labour and power are critically limiting resources in Nigerian agriculture, especially in tillage and other field operations. With only 0.018 kW/ha as against the globally recommended minimum of 0.4 kW/ha, the seriousness of the problem is obvious. Therefore, the crucial concern is how to address the problem of appropriate power for small-to-medium-scale (SMS) farmers, using engine power technology, especially for land preparation and pre-harvest field operations. The natural linkages between pre-harvest field operations for production agriculture with post-harvest processing and agro-industrial enterprises is self evident; the scale of success in the former predetermines the scale of success in the latter. The critical issues involved have been discussed extensively elsewhere (Odigboh, 1996, 1997; Makanjuola *et al.*, 1976; FAO 1988).

Appropriate Power Level of Four-Wheel Tractors for SMS Farmers

As earlier indicated, tractors exist in almost all power categories from 1 kW, 20-50kW, 50-100kW and above 100 kW, each with distinct characteristics. The tractors in the 20-50 kW power range are referred to as medium-size tractors, usually with diesel engines, having three or four cylinders and water cooling systems, operating at about 2,500 rpm. As earlier stated, the regional survey we conducted showed that tractors in the 30-37 kW (40-50 hp) power range account for 9.5%, and those in 38-45 kW (51-60 hp) range account for about 14% of the total number of tractors in Nigeria. Thus, tractors in the power range of 30-45 kW (40-60 hp) account for less than 24% of the total, while the large tractors of 46-60 kW (61-80 hp) are an overwhelming majority, accounting for about 62% of the total. Another important statistic from the regional survey is that of all the tractors in Nigeria, less than 4% are owned by private individuals some of whom are non farmers.

Medium-sized tractors and their associated implements are normally the most efficient form of farm tillage power, provided that the amount and conditions of use can be economically related to cost and capability. For economic efficiency in this regard, the farm sizes should be between 5 and 100 ha or more, available on individual farms or through multi-farm use systems. Multi-farm use systems in the private sector may take the form of (a) pooling of individually owned machinery by formal groups, (b) joint ownership (cooperatives), (c) commercial enterprises operated full time by machinery service contractors or part-time by farmer contractors and (d) by hiring, renting or leasing schemes offered by machinery dealers or cooperatives (FAO, 1988).

The form given in (c) is really the well known tractor hire service (THS) by private operators, which is one of the functions we ascribe to medium scale farmers. Therefore, taking into consideration all the facts given above, we duly recommend four-wheel tractors and their related equipment in the 30-45 kW (40-60 hp) power range as the most appropriate engine power mechanization technology for the SMS farms and farmers.

Sources of the Needed Agricultural Machinery

In recommending medium-sized tractors and their related equipment, it is intended to take advantage of the fact that there are many tractor and equipment manufacturers world-wide that produce them routinely. Curiously enough, the tractor assembly companies in Nigeria preferentially produce tractors it the large and very large power ranges. It should be possible to make them produce tractors in the desired power range, if adequate governmental encouragement is applied. In the process, they should be obliged or encouraged to produce and supply basic tractors, without embellishments or unnecessarily sophisticated features in order to bring the prices down. Another viable alternative is to encourage some tractor/equipment manufacturers, preferably from Brazil, China, India and/or suitable Far-East countries, to supply the tractors and related equipment. The supply may commence by importation of identified tractor and implement systems certified to have desirable features. But from the start, arrangements for local assembly and subsequent manufacture should be made a condition and an integral part of the supply agreement.

V. LOCAL MANUFACTURE OF AGRICULTURAL MECHINERY/EQUIPMENT

There is sufficient evidence to demonstrate that local manufacture of agricultural machinery is both technically and economically feasible in Nigeria. Potential advantages of local manufacture are usually cited to include the provision of machines and equipment more closely geared to local needs and farming systems, facilitation of fast and ready spare parts supply, considerable savings in scarce foreign exchange, promotion of ancillary industries, potential for substantial employment generation, build-up of national self reliance and the psychological restoration of our national pride and esteem. Surely no eloquence is needed to preach the potential advantages of local

manufacture of agricultural machinery. However, due attention must be paid to the existence of very many severe constraints arising form ineffective and apparently inimical national policies which must be recognized and addressed. Local constraints notwithstanding, local manufacture of agricultural and rural industrial machines and equipment must be accorded the status and urgency of a national imperative in Nigeria (Odigboh, 1990). Although agricultural mechanization in Nigeria will continue to borrow substantially from developments overseas, acquisition of mechanization hardware by importation must become more selective and subjected to local adaptation studies and modifications. More importantly, it is now generally appreciated that, to succeed, mechanization of agriculture in Nigeria must be based more and more on indigenous design, development and manufacture of most of the needed machines and equipment, to ensure their suitability to the crops as well as to the farmers' technical and financial capabilities. While Government should be prepared to promote and support local manufacture of agricultural machinery, the actual setting up of the manufacturing firms must be left to private-sector initiative, fuelled by the profit motive. The local manufacture of needed implements may follow the modus operandi used for tractor assembly/manufacture. In fact, we advocate that both tractors and the full-range of related land preparation and tillage implements should be manufactured under the same management. As in the case of tractors, local manufacture of the implements should start with local assembly of the more difficult parts together with local manufacture of simple components and progressively change to full-fledged local manufacture. Local manufacture of implements is much easier to achieve quickly than local manufacture of tractors because, for most implements the percentage of high-grade steels and complicated parts is much smaller compared to tractors. In many cases, most of the parts of the implements can be easily fabricated locally through welding and easy-to-achieve casting.

Production of Locally Developed Agricultural Machines

There are a number of locally developed pre-harvest production machines, including planters, weeders, harvesters etc. Some of the prototype machines, especially those for root crop production, are quite unique. But, they are not being manufactured for supply to the farmers. One reason advanced for this is that the few firms that may be interested in manufacturing the machines unfortunately lack the necessary resources and technical capability to develop the commercial models from the existing shop prototypes. We recommend urgent action necessary to bridge the technical gap between the existing shop prototypes and their field/ commercial models in order to facilitate their local manufacture. Through the agency of identified firms/organizations, the developers should be sponsored to achieve the following specific objectives:

- To optimise the design of selected shop prototype machines for the fabrication of their field/commercial models.
- To fabricate enough units of the commercial models for intensive/extensive testing under usual-use conditions (used/ abused by the farmers themselves) thereby to determine their suitability/acceptability.
- To induce suitable local manufacturers to undertake the manufacture of the machines, if possible by helping them to identify/remove their operational constraints.

VI CONCLUSION

This paper has discussed some of the viable options and strategies needed to confront the challenges of effective mechanization of Nigerian agriculture. We strongly believe that peasant farming is no longer sustainable and that peasant farmers in Nigeria are an endangered species. The most effective way to sustain

Nigerian agriculture in the next century is to make farming attractive enough to encourage the emergence of small-to-medium-scale commercial farmers who can go into farming as a business. We maintain that the most effective strategy to achieve that objective is to urgently develop an appropriate level of engine-power agricultural mechanization technology (EPAMT) through the establishment of local manufacture of most, if not all, the needed machines and equipment. It is not likely that sustainable food security for Nigeria can be achieved otherwise.

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