COMMUNAL APPROACH TO COST- EFFECTIVE AGRICULTURAL LAND DEVELOPMENT IN SIERRA LEONE

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ABSTRACT

In order to make agricultural production cost effective, there is need to make the cost of all the operations minimal relative to the value of the harvested produce (a condition which could only be achieved with appropriate mechanization). Generally, in developed countries of the world, success has been achieved in developing the technologies required for their economies. However, in the developing countries of the world and Nigeria in particular, various efforts that have been made in the past to introduce the modern high technologies of the developed countries into the development of agricultural mechanization have failed to achieve the desired results. This is mainly because these technologies seem not to be appropriate to the economic environment of the developing countries where majority of the farmers are peasants. This paper describes a method of solving this problem using a successful Inland Valley Swamp, rice- based production project among resource poor farmers in Sierra- Leone as a case study. In the project, farmers in the selected communities were encouraged to organize themselves into associations in order to benefit from the use of technologies that are more efficient than those currently in use by them. They were first given appropriate, simple management and technical training. The technical training included innovative grassroots surveying methods using simple locally -fabricated agricultural surveying instruments as well as land clearing methods using simple tools such as mechanical hand winch, PTO powered skidding winch and stump grinders. The result of the application of the acquired skills was quite remarkable as the project was able to exceed the set target of 25 hectares of fully developed swamp area in the two years of the project life by an additional ten hectares. In addition, the women's group in the farmers' association voluntarily participated in the tree felling exercise against their gender stereotypical roles, in view of the ease of tree felling which they observed in the use of the mechanical hand winch.

Keywords: Inland Valley Swamp, Agricultural development, Sierra Leone

INTRODUCTION

Agricultural land development in the West African Sub-region is laden with problems because it is a process which requires tremendous amount of power input. In the early days of agricultural practice; farmers in some parts of Nigeria voluntarily arranged themselves into groups with the ulterior motive of harnessing their human and material resources to carry out high energy demanding farm operations such as in land clearing on the individual farms of the members that constitute the groups. To effect this, a schedule is usually drawn up during the early part of the cropping season for carrying out group work on the farm site of each member without sacrificing timeliness. This arrangement prevents the dissipation of considerable amount of human energy that could be used efficiently for operations requiring low energy/power input such as crop planting, seedling transplanting, puddling, crop protection, etc. on high energy/power demanding operations like tree felling, brushing, stumping, clearing of felled trees and tillage- all of which constitute land clearing. It has been established by many researchers in the past that application of human muscle into land clearing operations is not only technically inefficient but also economically and medically inappropriate.

Energy input per unit area is usually very low when compared with those applied in low-energy-demanding operations. Most of the participating farmers often get exposed to serious health hazards such as hernia, lumbago, etc., when exposed to heavy duty field operations prevalent in land clearing. Apart from this, the land is usually not properly prepared due to low level of energy input. Unfortunately, the modern day farmers in Nigeria and the entire African sub-region

do not like to work with communal effort; they are often too individualistic in their agricultural land development and other activities. This attitude has resulted in keeping them at the manual level of agricultural production where tools of bye-gone ages such as hoes, machetes, axes, etc. are still very much in use.

However, some of the countries in the West African sub-region such as Nigeria, Ghana, Sierra Leone and some others have made frantic efforts to wriggle out of this situation by importing sophisticated modern high-technology tools and machines of the industrialized countries of the world for use in their agricultural production systems without any improvement in their agricultural production systems. This is these machines and tools were brought in and used without any modification to make them adaptable to their specific geographical and socio-economic environments.

A critical analysis of this situation in Nigeria, for example, reveals that a very important step has been omitted while the nation and others earlier mentioned were attempting to climb the ladder of technological advancement. This is sequel to the fact that technological development takes place in a step-wise, ladder like fashion (Ogbimi, 1991). This missing step is the use of a technology, which makes use of simple hand tools and machines whose level of sophistication falls somewhat between those of the modern high technology and the tools of the by-gone ages currently in use by the peasant farmers. This paper presents the result of partial mechanization of Agricultural land development in Inland Valley Swamp ecology in Sierra-Leone using a package of technology developed in a people participatory project.

AGRICULTURAL LAND DEVELOPMENT

Agricultural land development consists of two main operations-land clearing and tillage. Land clearing consists of four major operations namely: Brushing, Tree felling, Clearing of felled trees, and stumping: Tillage operations are of two types, namely: primary and secondary tillage. The only operation carried out in primary tillage is ploughing while secondary tillage consists of harrowing, ridging, first and second stage leveling, puddling, etc. With the exception of harrowing all the other operations in secondary tillage are optional because they depend on a specific situation and site.

The specific land development technique selected for a particular situation depends on such variables as socio-economic status of the producer, preference of the producer and government policies (Taiwo and Jekayinfa, 2005). No variable is entirely independent of the other, hence the seemingly endless variety of techniques such as the use of crawler tractors with chains and bulldozer attachments, the use of tools such as the mechanical hand winch, tractor-mounted skidding winch, stump cutters, power saws, etc.

The success of any project depends on the skill as well as the managerial ability of its leaders, but will only succeed if it attracts the active support of those who are supposed to be the beneficiaries provided it was properly formulated for effective execution and total participation by all the parties concerned. The Sierra Leone project in this case study was planned in such a way that everybody involved was carried along with its scheme, design and implementation from the management level, through the group promoters on to the benefiting group level.

Although he project was initially funded by the United Nations Development programme, a lot of the project budget was directed to training the benefiting groups so they could continue with the project on their own after the expiration of the project life.

LAND CLEARING IN FULLY MECHANIZED AGRICULTURAL LAND DEVELOPMENT

For a fully mechanized agricultural land development, there is the ever pressing need to bring more land under cultivation through the use of proven land clearing technologies. However, this should not be compromised with the need to protect agricultural lands from such deleterious effects of the use of heavy duty land clearing machineries such as excessive soil compaction and removal of the precious and plant nutrient-rich topsoil. According to Oni and Adeoti (1995), the clearing operation in which stumps are not

completely removed is better than one in which the top soil is much disturbed. While the former is an unfinished job, the latter is a spoilt job.

It has also been discovered that the prospects of farm mechanization in the savannah regions of Nigeria and perhaps the entire West-African sub-region are better than in the forest zones of the south because the vegetation density in the former is lower (Oni and Adeoti, 1995). Researches have shown that increased use of heavy duty agricultural machinery and equipment on fragile farmland can eventually lead to soil degradation cumulating in low infiltration rate, increased soil erosion, soil compaction and reduced crop yield. (Douglas *et al.,* 1980; Negi *et al;* 1980 Oni and Adeoti, 1986): Taiwo and Jekayinfa, 2005. Oni and Adeoti (1995) advocated that out of the different land clearing methods employed in Nigeria, the Mechanized Knock- Down method is the most cost effective. They also submitted that hand labour may not be every conducive to large scale mechanization but that small-and medium-sized land clearing machines with low capital investment are available and have proved to be superior to hand labour.

THE STRUCTURE AND ORGANIZATION OF THE SIERRA-LEONE PROJECT

The project was funded by the United Nations Development Programme (UNDP) and implemented by Food and Agriculture Organization of the United Nations (FAO). The Ministry of Agriculture, Rural Development and Forestry (MANR & F) of the Government of Sierra Leone worked with the former in a tripartite arrangement. The Government of Sierra Leone was represented in the project by a National Coordinator who doubles as the National counterpart of the project Chief Technical Adviser (CTA)/Project Manager who represented both the FAO and UNDP in the project management. At the project implementation level the project was structured along the line of Extension and Training headed by a National Extension and Training Expert, Irrigation and Drainage Engineering headed by an International Irrigation Engineer assisted by a National Irrigation Engineer. Also in the project structure is the Mechanization Unit headed by a United Nation Volunteer (UNV) Mechanical Engineer/Small Tools Specialist, Socio-Economic Unit headed by a UNV Socio-Economist and Fishery Unit headed by a UNV Fishery Expert.

The National Extension and Training Expert worked with the Land Development Instructors (LDI) who were seconded into the project by MANR & F of the government of Sierra-Leone and served as the Group Promoters (GP). These LDIs were trained by the project to identify the Beneficiaries who were usually encouraged to organize themselves into Farmers' Associations. To be qualified to work with the project these Farmers' Associations must have Inland Value Swamp site of their own i.e. Farmers' own plots. On a regular basis the LDIs were trained in the alternative techniques of land development broken down into component operations such as Agricultural Land Surveying, Brushing, Tree felling, Clearing of felled trees, Primary and Secondary Tillage etc. the training was usually inform of workshops, field trips and on-farm adaptive research work on regular basis. The theories gained are usually applied to the practical situations in the field during the Swamp Development Activities in a group of swamps designated as Demonstration Swamps. These are the swamps given intensive development and from where the data generated are replicated on other less developed swamp sites with the use of farmers trained in the demonstration swamps. This arrangement continues throughout the Moyamba District of Sierra Leone which is the project's area of jurisdiction during the pilot scale.

TRAINING ACTIVITIES IN THE PROJECT

Intensive training exercises were carried out on almost all the component operation in land development as developed by the project through the UNV Mechanical Engineer/Small Tool Specialist. Table 1 shows some of the results obtained using the alternative technique developed by the project. The Novelty in this project is that the use of heavy duty monkey winch in tree felling as shown in Figure 1 attracted the interest of the women's groups who were usually made to have a stereotype belief that land clearing is a job made only for the males in the farmers' associations. They volunteered to participate in tree felling operation carried out with the

use the monkey winch. These groups be came valuable human resources to the project because they were effectively utilized in training women and other willing groups in the use of monkey winch for partial mechanization of land clearing throughout the Moyamba District of Sierra Leone. Table 2 shows the summary of land development data obtained from the use of conventional technique of land development

Table 1: Summary of Land Development Data Using the Proposed Alternative Technique

Operation	Machine Tools Utilized	Labour Requirement		Average fuel Consumption		Mean Effective Field Capacity		Mean Lubricant Consumption	
		Man-hr/ha	Man-day/ha	Litres/ha	Litres/hr	ha/hr	hr/ha	Litres/ha	Litres/hr
Tree Felling	HD Monkey Winch	372.85	46.61	-	-	0.04	25	-	-
Clearing Felled Trees	MF 365 Tractor + Mounted Skidding Winch and MF 240 Tractor + Mounted Skidding Winch	149.60	18.70	37.20	2.10	0.06	16.7	4.00	0.24
Stumping	Mounted Stump Cutter	8.00	1.00	6.82	12.40	1.80	0.55	1.20	2.18
Primary Tillage (Ploughing)	MF 365 Tractor + HD 4 Furrow Disc Plough	70.90	8.90	32.60	2.94	0.09	11.10	1.00	0.09
Secondary Tillage (Harrowing)	MF 240 Tractor + Rotary Hoe + Cage Wheels	59.06	7.40	19.79	1.58	0.08	12.50	1.40	0.11
First Stage Levelling	MF 240 Tractor + Mounted Levelling Blade + Cage Wheels	113.58	14.20	28.47	1.14	0.04	25.00	1.70	0.07
Puddling	Daedong ND 130 Power Tiller + Rotary Attachment	39.40	4.90	14.20	0.57	0.04	25.00	1.06	0.04
GRAND TOTAL		813.39	100.71	139.08	20.73				

Source: Taiwo and Jekayinfa, (2005)

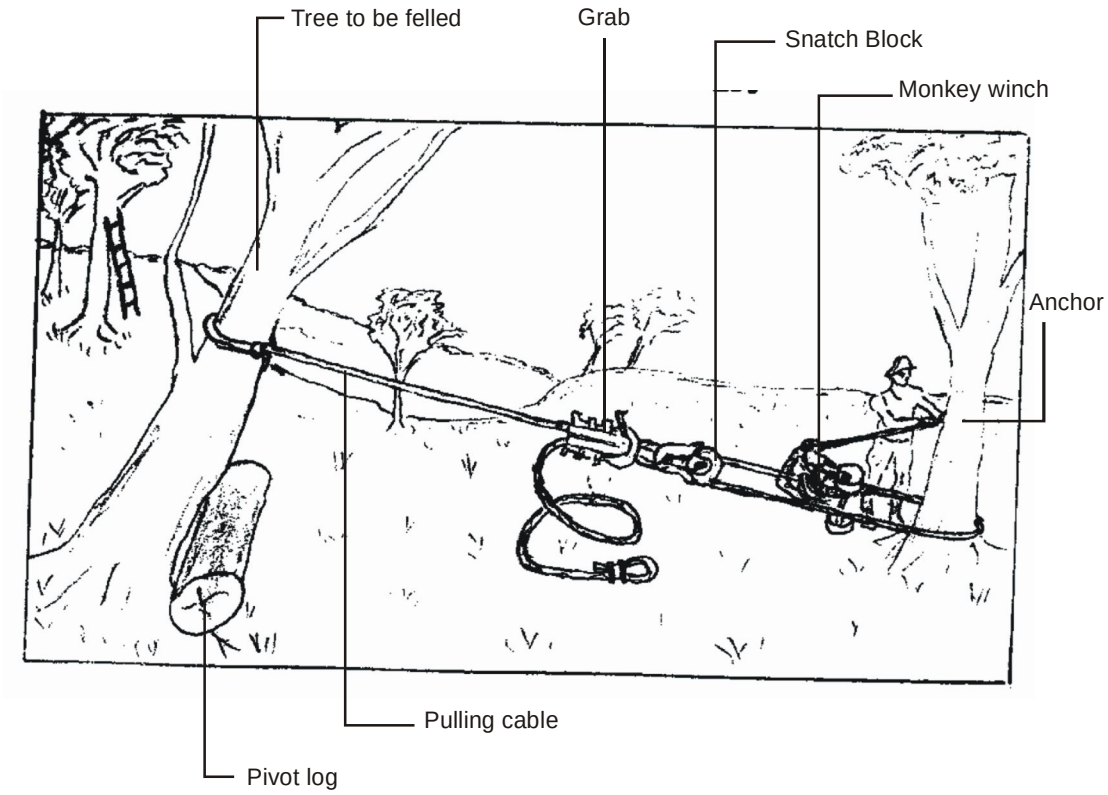

Figure. 1: Tree felling with the use of mechanical hand winch
Source: Taiwo, (1989)

Table 2: Summary of Land Development Data Using the Conventional Technique

Operation	Machine Tools Utilized	Labour Requirement		Average fuel Consumption		Mean Effective Field Capacity		Mean Lubricant Consumption	
		Man-hr/ha	Man-day/ha	Litres/ha	Litres/hr	ha/hr	hr/ha	Litres/ha	Litres/hr
Tree Felling	Bulldozer, Tree Pusher	65.5	8.19	85.50	21.40	0.25	4.00	10.00	2.50
Clearing Felled Trees	Root Rakes, Pay Loader, Bulldozer	48.5	6.06	48.50	24.25	0.50	2.00	3.50	1.75
Stumping	Bulldozer, Root Rakes, Subsoiler	2	0.25	6.22	20.20	3.25	0.31	2.80	9.03
Primary Tillage (Ploughing)	MF 365 Tractor + HD 4 Furrow Disc Plough	60.50	7.56	26.50	4.77	0.18	5.56	0.67	0.12
Secondary Tillage (Harrowing)	MF 240 Tractor + Rotary Hoe + Cage Wheels	58.05	7.26	19.70	1.58	0.08	12.50	1.40	0.11
First Stage Levelling	MF 240 Tractor + Mounted Levelling Blade + Cage Wheels	100.50	12.56	26.65	1.07	0.04	25.00	1.60	0.06
Puddling	Daedong ND 130 Power Tiller + Rotary Attachment .	39.40	4.90	14.20	0.57	0.04	25.00	1.06	0.04
GRAND TOTAL		374.45	46.78	227.27	73.84				

Source: Taiwo and Jekayinfa, (2005)

DISCUSSION

The proposed technique of land development was implemented in an inland valley swamp development project to evaluate its effectiveness and sustainability. A standard wheel type agricultural tractor was used for the exercise and the average trees population in the selected location was 50 trees per hectare.

Table 1 presents a summary of land development data obtained from the selected area using the project-developed technique. From the table, it can be seen that the labour requirement for tree felling using the mechanical hand winch is only about 46 mandays per hectare without any fuel consumption. Labour requirement for clearing felled trees from the area to be cultivated using the tractor – mounted skidding winch is 18.7man – days per hectare. Average diesel fuel consumption is 2.1 litres per hour. The labour requirement for using the mounted stump cutter for cutting residual stumps down to a depth of 36cm is 1 man – day per hectare.

The ease with which all subsequent operations were carried out depended on the effectiveness of the three component land clearing operations. For the case under review as contained in table 1, the labour requirement and average fuel consumption for primary tillage (Ploughing) is 8.9man – days per hectare (3.6man – days per acre) and 2.9 litres per hour respectively. For secondary tillage (harrowing), the values are 7.4 man – days/ha (2.99 man – day/acre) and 1.5 litres/hr. Similar values for first stage levelling and puddling are 14.2 man – days/ha (5.7man – days/acre), 1.25 litres/hr and 4.9 man-days/ha (1.98 man – days/acre); 0.5 litre/hr respectively.

Table 2 is a similar data set collected while using the conventional land development technique. The differences in the labour requirement and fuel consumption using the conventional method could be attributed to differences in (more sophisticated) machinery utilized. It could be seen from Tables 1 and 2 that although the effective field capacity is greater using the conventional technique than the project-developed technique, however the fuel consumption in the former is enormous which cannot be afforded by peasant farmers that constitute the beneficiary group in this project.

It is a generally accepted fact that the agricultural sector in the developing countries of the world is dominated by small scale farms, many of which are less than two hectares and consists of scattered fields or plots, with limited access (i.e. roads, lanes, entrances, etc). Any effective and sustainable development strategy must be firmly focused on

overcoming the constraints encountered these small-scale farmers constraints. With the firm belief that agricultural mechanization is a technology that is needed to solve these problems, there are two main considerations:

1. What levels and types of mechanization are appropriate; and
2. How can the advantages that mechanization provides be best made available to the small-scale farmers?

Whenever hand-tool technology is selected as the appropriate mechanization level, there are few problems in making it available to the small-scale farmer. The hand tools required will nearly always be owned by each farmer and used exclusively on his own farm. This is possible for most small-scale farmers especially if the tools are of the traditional design and local manufacture because the capital cost is usually within their means and operating costs are minimal. However, this is not always true if the tools are imported, of more sophisticated design, made of higher quality materials and therefore more expensive. In Nigeria, for example, many farmers have not been able to adopt the use of improved hand tools simply because the cost is beyond their means. Delivery of hand tools is normally handled through existing multi-commodity sales outlets such as village shops, and an elaborate sales and service network is not needed (Odigboh, 1999; Yohanna, 1998; Yohanna and Ifem, 2004). The greatest problems occur, however, in trying to provide mechanical power technology to small-scale farmers for exclusive use on a single farm unit. At one time, the partial answer, particularly for small-scale swamp farmers in the Far East, was power tillers and single-axle tractors with all their related implements. Of course, this answer is still applicable in those countries where this type of machinery is technically, economically and environmentally suitable and where increases in farm gate prices have kept pace with the increased costs of mechanization inputs.

In many developing countries, the present purchase price and operating costs of what has traditionally been the 'lowest price' mechanical power technology is beyond the means of many small-scale farmers. Reports from some distributors who have made several attempt to distribute power tillers in the past in Nigeria, for example, indicated a very sluggish market simply because the machines could not be imported and sold at prices that many small scale farmers could pay (Taiwo, 1990; Hebblethwaite, 1993).

With an objective of providing each small farm operator with mechanical power technology, which can be used exclusively on a single farm unit, many attempts have been made in the past to scale down the size of the conventional farm machinery. In some cases this has been successful but, in general, there is economy of scale in machinery manufacture and hence there is a cost involved in scaling it down. For example, the farm-gate price per kilowatt of farm tractors generally increases as kilowatts are reduced assuming equal levels of quality and sophistication.

The selection of appropriate mechanization hardware is a complex procedure and should always be given the utmost attention it deserves. Theoretically speaking, the selection of mechanization hardware starts with an assessment of the job to be done, e.g. land clearing, tillage, planting, weeding, harvesting, threshing, water lifting, milling, etc. The next step is to determine what tool, implement or equipment alternatives are available to do the job in the most effective and efficient manner and make a choice. The final step is to select the source of power of the tools, implement or equipment chosen.

In practice, the theory holds only if a farmer has access to all levels of farm power; human; animal and mechanical; and can, therefore, choose the best mix of power for the equipment chosen and the job to be done. For majority of the farmers in developing countries, including Sierra Leone, the listed theoretical steps are reversed. Their power sources are usually known and fixed; themselves and their family. Their access to tools may also be fixed and as a result, the scope to choose crops or the best hardware to do the job is limited. Millions of these farmers have access only to machetes and hoes of local design and fabrication. The improved or more sophisticated hand tools; e.g. knapsack sprayers, rotary injection planters (R. I. P), mechanical hand winch; may be relatively inexpensive but experience has shown that

cash or credit are often not available for their purchase.

Speedy development and intensive production, both of which are dependent on a time factor, need an appropriate degree of mechanization. The results of many studies conducted in the past have shown that while mechanization may displace labour on certain specific operations, the total of new jobs created is far greater than the number displaced. The extent to which labour can or should be employed depends on balancing at the local level such factors as costs, wage levels, degrees of mechanization appropriate to the local conditions and availability of labour.

Wage levels in Sierra Leone and many developing countries of the world at present favour labour intensive farming operations, but in the long run wages may rise to a level where labour intensive system may lose their advantage. These considerations need to be carefully appraised in the planning stage of any project especially now that there is continuous improvement in wages across the country. An alternative approach is system which ensures the proper mixture of labour and mechanical power in relation to the socio-economic circumstances of the farmers at a particular point in time.

CONCLUSION

The accepted procedure for the selection of mechanization hardware does not seem to be applicable in Sierra Leone and a large proportion of the developing countries of the world. The normal procedure of starting with an assessment of the job to be done, followed by the determination of what tool, implement or equipment are available to do the job in the most efficient and cost effective manner and the final step of selecting the power source for the chosen tools, implement or equipment chosen is often reversed in Nigeria and other developing countries. The power source(s) are often known and fixed right from the onset because they are usually those of the farmer's themselves as well as those of their families. Their access to tools may also be fixed culminating in limiting the scope to choose from or the best hardware to do the job because millions of them have access to only matches, axes, hand hoes of local design and fabrication and other tools of bye-gone ages. They hardly have access to improved or simple but more sophisticated tools such as knapsack sprayers, rotary injection planters (R. I. P), mechanical hand winch, etc all of which could allow not only intensive production but speedy development as well. It is this limited scope of equipment selection that this paper attempts to widen.

Another point worthy of note is the fact that current wage levels in Sierra Leone and many developing countries of the world like Sierra Leone favour labour intensive farming operations. However, there is the need for governments and policy makers in these countries to kick-start the development of alternative approach which ensures proper mixture of labour and mechanical power in relation to the socio-economic circumstances of the farmers at a particular point in time. This consideration is imperative in all project planning and appraisal at this point in the development of Nigeria when vivid efforts are being made by the government at the centre to improve wages across the country on a continuous basis. This approach is also elucidated in this paper to an appreciable extent.

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