Mechanizing Land Preparation for Maize Production in Kenya

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Abstract: This study evaluates alternative methods of land preparation for maize production on farms in western Kenya, the results of which may be applicable to regions of similar conditions. People, oxen, and tractors are the three sources of power. Maize production depends on rainfall, and the timeliness of operations is critical. To ensure optimum yields, farmers in the region need to prepare the available acreage for maize planting soon after the onset of the rains. An effective method of land preparation to improve labor productivity is desirable. Labor profiles indicated that those not using the hoe for land preparation used less labor for the task but subsequently used more labor to perform the other operations. Over a period of 5 years, ownership of oxen for ploughing increased. Higher yields and incomes were associated with oxen ownership. Public support for tractors should be diverted to alternative programmes, one of which should be the promotion of ox cultivation in suitable areas.

Introduction

Kenya's economy displays most of the characteristics of developing countries: heavy dependence on the agricultural sector, high population growth rate, and low levels of productivity and income. Agriculture contributes about 30 percent to GDP and 60 percent of the foreign exchange earnings. Over 50 percent of the total agricultural output is in the form of subsistence production, largely maize. Kenya's current population growth rate of 4 percent per year is the highest in the world—with consequent adjustment problems.

The aim of this paper is to evaluate alternative methods of land preparation for maize production on farms in Kenya and to determine a strategy for mechanization. Although the focus is on mechanization, it is only one element of a package of inputs that facilitate increased production. Others include the use of improved seeds, fertilizers, proper spacing, and crop protection measures. Provision of incentive prices by deliberate government policy is another way to encourage increased production.

Structure of the Agricultural Sector

The agricultural sector has a dual structure consisting of large and small farms. Arable land potential varies tremendously. Climate and altitude combine to produce areas of very high, medium, and very low agricultural potential. The dichotomy between small- and large-scale farms has its origins at the beginning of this century when about 20 percent of the usable land area was alienated for the European settlers (Heyer, 1976). The sizes of the large farms varied but were mostly over 1,000 acres. Since independence in 1963, population pressure has necessitated subdivision of some of the large farms into plots as small as 5 acres. The pattern of land use and development, with a few exceptions, has therefore tended towards smallholder agriculture. Another emerging feature is that, as relatively high potential land becomes more scarce and expensive, the population moves at an accelerating rate to more marginal lands. Such movements require that farmers should be aware of the appropriate cultivation methods in the new environment rather than continue with methods used elsewhere that may not be appropriate.

The Problem

Most of the agriculture depends on a bimodal rainfall regime. The major staple crop is maize. Ensuring that the land available for maize production is prepared for planting as soon as the rains begin is crucial if good yields are to be achieved. The problem is even more serious for farmers who rely on the hoe for land preparation. The drudgery involved in the work is evident. In addition, not all the land available for maize can be prepared on time due to labor bottlenecks. Land preparation overlaps other maize production activities, such as planting and weeding, that need to be performed at the same time. The use of owned or rented ox ploughs could be alternative methods of land preparation. Owning or hiring a tractor for the function are others.

Of the land currently cultivated in Kenya, 84 percent is done by hand, 12 percent by ox, and the rest by tractor (Oluoch-Kosura, 1983). Given such a structure, it is evident that enhancing development hinges on a good strategy for land preparation being developed for smallholder agriculture. A viable form of mechanization that achieves timeliness and reduces drudgery is
necessary to increase maize production.

The government of Kenya recognizes the problem of low labour productivity and spells out in the 1979-83 development plan that "low labour productivity, a major bottleneck in smallholder development, will be dealt with by appropriate mechanization to fully mobilize the ample labour capacities in rural areas." (Government of Kenya, 1979, p. 258)

The National Food Policy document also emphasizes the point about increased production, provision of basic needs, and alleviation of poverty (Government of Kenya, 1981). Wider use of more appropriate technology and reduction of imported capital-intensive equipment are needed. With the ongoing structural changes on farms, such a call is timely; but one needs to determine what levels of mechanization should be promoted.

Most of the hand tools and the animal-drawn equipment are currently manufactured in Kenya. The tractors in the country, estimated at about 6,000, are confined to larger scale farms, mainly owned by individuals, cooperatives, or the government. The fleet also includes about 200 tractors for the government-supported tractor hire service. Power tillers or small tractors of less than 26 hp have been tested and considered unsuitable for Kenyan conditions (Pollard, 1982).

Determining the Potential for Alternative Strategies

A study was undertaken in western Kenya where all the forms of mechanization of land preparation are familiar to the farmers and used to various extents (Oluoch-Kosura, 1983). The broad objective was to examine what potential exists for increasing the output of maize in the region through economically viable levels of mechanization. The region is located in a medium to high potential agricultural zone receiving more than 735 mm of rainfall per year. The area is contiguous with the large-scale farms. All farmers grow maize as a staple and sell it if a surplus is achieved. High valued cash crops such as tea or coffee are not grown. The proportion of fallow land averages 40 percent. The data set has a total of 202 observations. Out of these, 81 farmers had records for 1977 and 1981. Forty farmers had records for 1981 only. The various levels of factors of production used by farmers are also in the records. Farm sizes range from 5 acres to about 50 acres. Maize acreage ranges from less than 1 acre to 10 acres. A key variable is the number of days after rain to complete planting.

The sample farms were categorized according to the power source used in land preparation. The method of land preparation happened to be the major operation where farmers differed greatly. Subsequent operations were generally done manually. Four categories of farms were established: the hoe users, those using their own oxen, those hiring oxen, and those hiring either government tractors or privately-owned tractors. The sample had no tractor owners, although some farmers had relatively large holdings (more than 40 acres).

Labour utilization profiles were constructed. Production function and covariance analyses were performed to establish the sources of variation in maize yields. Finally, farm budgets were drawn to determine profitable plans and the consequences of changes in the plans.

Results

Typical labour profiles showed that those not using the hoe for land preparation employed more labour than average to perform all the other necessary operations on the prepared land. Staggered planting was practised by all the farmers in the sample, apparently to avoid the risk of losing all the crop should the rains fail after the onset. This led inevitably to some late planting and lower than average yields.

The proportion using owned oxen for ploughing increased from 25 percent in 1977 to 43 percent in 1981. Those hiring oxen decreased from 54 percent in 1977 to 25 percent in 1981, whilst the proportion relying on the hoe increased from 15 percent to 26 percent between the periods. No farmer in the sample used a hired tractor in 1977. In 1981, 6 percent used hired tractors. Farmers using the hoe expressed their desire to reduce the drudgery involved in hoeing if they could be assisted. The increase in the proportion using the hoe was explained by the failure of those who previously hired oxen to hire them during 1981 due to late availability of the oxen or due to cash constraints.

Production function and covariance analyses showed that those using their own oxen achieved higher yields of maize. Those using hoes had both the lowest yields and lowest labour productivity.
Ownership of oxen ensured timely land preparation and subsequent operations. A variable defined as “days after the onset of the rains to complete planting” was expected to capture the effects of timeliness on maize yields *per se*. A significant negative relationship existed between that variable and yields. Every day that planting was delayed reduced yield per acre by 11 kg. If planting were delayed 2 weeks, the farmers would lose about two bags per acre, a significant loss arising from lateness in planting alone. No other single factor, such as poor or late weeding, poor spacing, or poor or no use of fertilizer, would lower yields as much.

Net cash incomes per acre were highest for oxen owners and lowest for those hiring private tractors. Changes in farm plans towards using owned oxen for ploughing for holdings larger than 10 acres always proved profitable. This result confirms the hypothesis Adelheim and Schmidt (1975) posed when they undertook a study on the economics of farm mechanization in a region of relatively high potential with high value cash crops. The region they studied had low potential for ox cultivation because of the high opportunity cost of land. However, areas with larger farms but of relatively low agronomical potential could benefit economically by ox cultivation. The sample farms in the present study had an average of 40 percent fallow land and therefore some land could be used for grazing oxen. In addition, the oxen could be used in activities such as pulling the ox cart for transporting produce.

**Conclusions and Inferences for Policy**

The main conclusion of this study is that animal drawn equipment provides a viable way to increase crop acreage and improve timeliness, yields, and income in the specific region considered. Labour productivity is increased and the total labour required for maize production is maintained rather than displaced. For relatively small holdings (less than 10 acres), reliance on ox hiring is more profitable than using the hoe if oxen for hire are readily available. Such small farms could accommodate area expansion but not grazing their own oxen as well. Tractors are limited in number and use is therefore restricted. The logistics of obtaining the government tractor hire service confine its use to a few farmers.

The results of the study could be generalized to areas in Kenya with similar physical and socioeconomic characteristics. Farmers who are willing but unable to invest in improved animal-drawn equipment should receive government assistance. Public support for tractor hiring services should be diverted to alternative programmes. Tractor ownership should not be subsidized but left for the individuals to bear the full cost if they can economically justify ownership.

Alternative programmes that could benefit from funds diverted from the tractor subsidy include:
- Promotion of ox cultivation where applicable.
- Improvement of the time of delivery of farm inputs such as seeds and fertilizers.
- Provision of supplementary irrigation to enable discontinuation of staggered planting and therefore ensure high yields if other cultural practices are followed.
- Intensification of efforts in family planning education to check the population growth rate.

These alternatives need further evaluation to establish their cost effectiveness and therefore priorities. In the case of mechanization, greater availability of animal drawn equipment will improve timeliness of planting, yields, and rural labour productivity in suitable regions. Some of the proposals will enable self-sufficiency for an important staple crop to be achieved whilst providing more economic activity in the rural areas.
Note

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References


