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Comparative analysis of farm labour cost, animal traction and tractor hiring rates on land cultivation in Northern Nigeria

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Abstract

This paper compares the cost of three labour sources namely, farm labour, animal traction and tractor hiring. The comparison is predicated on the policy issue that may affect labour usage in agricultural production. Data were obtained from secondary sources and comparisons were made across the states and the labour sources. The result of the study shows that Adamawa State has the highest cost of farm labour, Katsina for animal traction and Bauchi for tractor hiring. Significant differences were recorded for the cost of farm labour animal traction and tractor hiring. $F = 25.2$ $p < 0.05$. Similarly significant differences occur in the cost of farm labour ($F = 2.92$ P $p < 0.05$) and animal traction ($F = 3.49$ $p < 0.05$) but not tractor hiring ($F = 1.99$; $p > 0.05$) among the states. The paper concludes on the policy implications of homogenous technology for heterogeneous clients.

Key words: Animal, land, economy, equipment, labour.

Introduction

Labour shortages constitute a major constraint to agricultural production in Nigeria; labour shortages of varying degrees occur in different regions due to the unequal population distribution in the country and cultural preferences. Moreover, the perceived better economic opportunities in the urban centres have tended to fuel rural-urban migration, contributing to the problem of scarce labour on the farms. Most agricultural operations are time-sensitive and crop yields suffer if they are not completed with due timeliness. Timeliness depends upon good management backed up by suitable equipment and adequate levels of power. A mechanized farming operation is one, which is carried out with the help of a machine. The machine may be a hand-tool such as a hoe, and implement such as animal-drawn plough, or a complex machine such as a combine harvester. The machine, of whatever type, requires a power input to make it produce a specified output effect such as cultivation, seed planting, or weeding. The power input defines the rate at which energy is supplied and so controls the rate at which the output effect is achieved. Human labour is characterized by limited power output compensated by versatility, dexterity and judgment. Thus human labour has superior capability for operations requiring these skills, such as transplanting seedlings, weeding and selective harvesting of fruit, vegetables and some fibre crops. It is less competitive for operations demanding brute power rather than skill, such as water lifting and heavy soil cultivation. CTA[1] noted that from the point of view of power production, human being is in essence a heat engine with built-in regulators against overload. An input of chemical energy in the form of food is converted into energy outputs in useful forms, including work, together with by-products and waste products such as excess heat and food waste with reduced energy content. The sustainable rate at which the body can use up energy in this way is about 300 W for a reasonably fit person in temperate conditions. In hotter climates heat stress may reduce this value, perhaps to about 250 W. Animal power is of enormous importance throughout Asia and in South America. Its use in Africa, particularly south of the Sahara, is limited but the potential is correspondingly greater. The main limitation in this region is that many farmers have restricted access to animal power. Restrictions arise because: farmers may not own cattle because mixed farming is not traditional in many areas; trypanosomiasis is endemic in many regions; and government agencies often lack interest in, and commitment to, encouraging the use of animal power [2]. For field operations such as cultivation, planting and harvesting, the power source must be mobile. The need for in-field mobility limits the choice to: humans; animals and engines - usually a diesel or petrol engine installed in a tractor with its own self-contained fuel supply. More power becomes available after the progression is made from human labour to animal power an then to engine power. The fundamental question arises of how to use the extra power to best advantage. Power cannot substitute fully for the skill, judgment and experience, which people can bring to delicate operations such as transplanting seedlings. Relatively sophisticated machines are needed to undertake such operations, but not much power. On the other hand, routine operations such as water lifting consumes much power but little intelligence once the system has been installed [1]. Binswanger [3] calls operations of the former type 'control-intensive' and of the latter type 'power-intensive'. In between these extremes are many operations requiring various mixes of control and power. Binswanger [3] observed that, historically, when new sources of power are introduced (first animal power, then engine power) they are used initially for power-intensive operations such as transport, water lifting and primary cultivation. When the owners of new sources of power have satisfied their own needs in basic power-intensive operations, they have usually found it advantageous to sell surplus capacity to non-owners, often neighbours or tenants, and buy in the skills needed for their more control-intensive work. Thus new power sources tend to be used for operations in which they have the greatest comparative advantage[3]. The factors influencing the selection of power source varies with the type of power source to be used . Many governments use subsidies in an attempt to increase food production. Farming subsidies are of two main kinds. Input

subsidies encourage the farmer to use particular inputs such as fertilizer, improved seed, or tractor services by providing guaranteed high purchase prices as an incentive to produce particular crops. Subsidies distort the market with the intention of producing fully considered. Input subsides influence the farmers' freedom of choice. For instance, if subsidized fertilizer is available in a free market other inputs might be more cost-effective and desirable on a sustainable basis. Mechanization inputs are often subsidized by low prices for tractors and machinery or by providing tractor hire services at less than their true cost. In many countries animal power and equipment are not getting similar support and encouragement. The smallholder farmer, and the national economy, may be disadvantaged in consequence. Another point of consideration is the cost of the labour supply. It is difficult to assess the costs of power in near-subsistence farming where human labour and, in some areas, draught animal power are likely to be the dominating power sources. Consequently it is not possible to make a convincing exact comparison of costs for alternative farming systems under varying degrees of mechanization and with a variety of power sources. Smallholder farmers react mainly to costs paid in cash and cash-equivalent costs involving payments in kind. Government and its various agencies will probably be more interpreted in economic costs, often involving subtle variations in definition. The availability of cash, and cash flow, are major problems which limit the farmers' ability to use more power to expand or intensify their production system. For most smallholder farmers, personal and family labour is the most readily available, reliable and cheap source of power. The cost of such labour is not readily identifiable unless there is alternative employment which would bring in a cash income. It will usually be regarded as free.*I*n the selection of animal power a distinction must be made between areas where mixed farming is customary and areas where livestock raising is a special activity limited mainly to a particular, often nomadic, group of people. Where mixed farming is customary it is likely that at least some farmers will already use their animals on draught work, possibly for transport or irrigation water lifting. Other will have experience of livestock husbandry and will generally accept draught animal power as a user-friendly technology. The cost of using these already-owned power sources will be that of extra feed, additional health care and the purchase of harnesses and implements. Individual ownership of a tractor is not a viable option for most smallholder farmers. The total cost of tractorized operations is very high such that with good yields and selling prices, a power intensity of 0.5 kW/ha is the maximum, which is likely to be economically viable. On this basis about 40 ha of well-cropped arable land will be needed to support the costs of a 20 kW tractor-the minimum power at which a tractor is considered technically feasible. It will be necessary for a number of smallholder farmers to participate in the use of such a tractor, a concept usually referred to as 'multi-farm use of agricultural machinery' [5]. An individual smallholder farmer may have access to tractor power through a variety of 'multi-farm use' arrangements by individual ownership and supply of contract services to neighboring farmers. The owner becomes a farmer contractor; buying in services from a neighbouring farmer-contractor; buying in services from the landlord; group ownership of a tractor through a cooperative or syndicate; buying in services from a commercial contractor; and making use of a government-sponsored tractor-hire service.

Statement of Problem

Advocates of draught animal power in the country often based their arguments on the expected benefits such as increased timeliness of sowing, better soil structure, water infiltration, rooting and maintenance of soil fertility with manure without empirical evidence to substantiate such benefits and other effects. It is true that animal traction is being widely advocated in the semi-arid areas of Africa on account of the realization of these benefits in Asia and elsewhere [6,7,8]. However, the enthusiasm and policy thrust have been difficult to sustain. In Francophone West Africa for instance, Stroud [9] estimated that there have been at least 125 agricultural development projects since the 1930s which emphasize animal traction technology. Despite the emphasis, poor adoption and high abandonment rates were major features of many projects throughout the region[10]. Emphasis on animal traction technology in Nigeria is desirable not only on account of the aforementioned stylized facts but also in view of the current economic situation which makes other alternatives such as manual cultivation and tractorization inadvisable and/or unaffordable. Manual labour is becoming scarce and increasingly expensive; and many farmers are already tired of the drudgery of muscle power. The use of tractor has little prospects both on technical and economic grounds. Tractors are largely ill-suited for the soil and environmental conditions prevailing in the semi-arid zone. They break down frequently and stay out of operations for a long period due to limited know how for repair and maintenance as well as scarcity of spare parts. Other factors militating against effective use of tractors include the current macroeconomic policies which make importation of tractors very expensive, desensitization of tractor hiring services and decline in the number of tractor hiring units nationwide due to lack of spare parts and inadequate funds for the acquisition of new tractors. Doubts have been expressed by some analysts concerning the impact of tractorization on crop yield and profitability in several parts of Africa[4]. On the other hand, the resources required for animal traction can be obtained locally. Local blacksmiths and manufacturing companies can easily fabricate the necessary equipment. Also, local breeds of draught animals are easily available in the tsetse free areas of Northern Nigeria. It is expected that if framers are fully aware of the positive effects of animal traction it would be possible for them to take advantage of the existing resource endowment to improve their performance. Indeed, the substantiation of the productivity improvements derivable from animal traction as intended in this study is crucial to the dissemination of the technology across the relevant ecological zones in the country. This fact has not received due consideration by analysts as evidenced by the few existing studies [11, 12] on animal traction in Nigeria. Such studies have tended to focus attention on the management of work oxen an the assessment of the feasibility of introducing and intensifying animal traction within a sole cropping system. By estimating the relative gains and explaining the comparison with other labour sources, this study will attempt to add to the existing knowledge on animal traction and thus assist in the articulation of an enduring animal traction technology policy and the realization of the wide range of potential benefits associated with the technology.

Methodology

The study was carried out in the savannah of the northern Nigeria where the use of animal traction is prominent apart from farm labour

and tractor. The comparison is based on the land cultivation alone because of the limitation in the use of animal traction for ploughing and ridging as well as the fact that land preparation is common to all crop production, which takes place at almost the same time for all the farmers because of the limiting effects of the climate. Data on the cost of land cultivation using the three alternative labour sources were obtained for a period of seven years (1995 – 2001). The data were then subjected to analysis using means, and one-way analysis of variance for comparison between sources of labour and states.

Results and Discussion

Table 1 shows the average cost of land cultivation using the three different sources of labour for each state that were covered in the study. The average cost of farm labour is highest in Adamawa State ₦3857.14/ha while Yobe State has ₦1771.00/ha. A plausible reason for this may be the degree of rural-urban migration and the proportion of people in agriculture. With respect to the cost of Animal traction Katsina State has the highest cost of N 2000.00/ha while Jigawa has the lowest (₦778.00/ha). The rate and level of animal traction technology may be responsible for this cost variation among the states. The mean cost of tractor hiring is highest in Bauchi State (₦1942.00), while it is lowest in Katsina State (₦907.00). The overall mean cost for all states pooled together shows that the mean cost of animal traction is the lowest among the three sources of labour. Farm labour cost is ₦ 3012 and tractor hiring is ₦1380.00. Significant difference in the cost of three sources labour was tested for when the cost for all the states were pooled (Table 2). The result shows that significant cost differences exist between farm labour, animal traction and tractor hiring ($F = 25.21$, $p < 0.05$). The cost of farm labour is significantly different from that of animal traction and tractor hiring as indicated by the letters of the Duncan post-hoc analysis. However, the cost of animal traction and tractor hiring are not significantly different. Table 3(a,b) shows the significant difference in the cost of farm labour for a period of seven years. ($F = 2.92$, $p < 0.05$) Adamawa, Bauchi and Borno State are significantly different from others in the Duncan ratings. A similar trend was observed for the differences in the cost of animal traction ($F = 3.49$ $p < 0.05$) with Adamawa, Plateau, Bauchi, Yobe and Borno States differing from other States. Conversely, no significant difference was recorded for the tractor hiring in the seven states ($F = 1.99$ $p > 0.05$).

Conclusions

The comparison has clearly shown the trend of the adoption of these three sources of labour among farmers in Northern Nigeria. This has also put forth the issue of homogenous technologies for heterogeneous clients. Even within the ambit of similar ecological terrain, the cost among other variables varies as the intensity of the adoption of these technologies. Means were obtained for each labour source over seven years and also for each state as well as for all the states before comparison between labour sources and states were made.

Table 1a. Cost of land cultivation with different sources of labour (₦/ha).

States/Year	1995	1996	1997	1998	1999	2000	2001
Adamawa							
FL	**1500**	**2000**	**3500**	**8000**	**7500**	**2000**	**2500**
AT	1000	1200	2500	1000	1000	3000	3500
TH	1000	1200	2000	1800	2000	2200	2000
Bauchi							
FL	**1500**	**2000**	**2750**	**2100**	**2500**	**1500**	**2000**
AT	400	1000	1500	750	1000	2000	2500
TH	1000	1000	2200	2300	2300	2400	2400
Borno							
FL	**2000**	**2500**	**3000**	**3500**	**4000**	**3500**	**3000**
AT	2500	2500	2500	2500	3000	2700	3000
TH	800	800	800	1000	1000	1000	1000
Jigawa							
FL	**2000**	**3000**	**1200**	**3100**	**2950**	**5000**	**5000**
AT	500	900	1000	400	500	950	1200
TH	1000	1000	1000	1200	1200	1500	1500
Katsina							
FL	**1000**	**1300**	**1450**	**2100**	**2150**	**5000**	**5000**
AT	800	800	750	800	850	5000	5000
TH	1000	1000	750	800	800	1000	1000
Plateau							
FL	**2000**	**2700**	**4500**	**4950**	**6550**	**5700**	**5700**
AT	900	1200	1200	900	900	1400	1800
TH	1000	1000	1000	1000	1000	1000	1500
Yobe							
FL	**500**	**500**	**1200**	**3600**	**4600**	**1000**	**1000**
AT	500	600	800	1200	1200	1400	1600
TH	1000	1000	2000	2200	2200	2400	2400

FL – Farm labour, AT – Animal traction, TH – Tractor hiring; Source: NAERLS, 1995 – 2001: Cropping season performance appraisal
₦=Naira (the currency of Nigeria)

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Table 1b. Mean Cost of Land Cultivation in (₦/ha).

States	Farmlabour	Animal Traction	Tractor Hiring
Adamawa	3857.14	1885.7	1742
Bauchi	2050	1378	1942*
Borno	3071	2671	914
Jigawa	3178	778'	1200
Katsina	2571'	2000*	907'
Plateau	4585*	1105	1071
Yobe	1771	1042	1885
Over all Mean	3012	1563	1380

·Highest, 'Lowest

Table 2. One Way Analysis of Variance for Differences in Cost of labour sources.

	Sum of Squares	Df.	Mean Square	F	P
Between Group	7.8E + 07	2	3.9E + 07	2528	0.000
Within Group	2.2E + 08	144	1552886		
Total	3.0E + 08	146			

Duncan ratings

Means:1 Farm labour=3012.24[a]; 2 Tractor Hiring=1380.61[b]; 3 Animal Traction =1563.27[B];

Means with the same superscript are not significantly different.

Table 3a. Analysis of variance to differentiate the cost of farm labour, animal traction and tractor hiring rates among seven states.

Farm labour	Sum of Squares	df.	Mean Square	F	p
Between Group	4.5E + 07	6	7480323	2.92	0.02
Within Group	1.1E + 08	42	256062		
Total	1.5E + 08	48			
Animal traction	Sum of Squares	df.	Mean Square	F	p
Between Group	1.8E + 07	6	3082313	3.49	0.007
Within Group	3.7E + 07	42	881904.8		
Total	5.6E + 07	48			
Tractor hiring	Sum of Squares	df.	Mean Square	F	p
Between Group	3477653	6	579608.5	1.99	0.08
Within Group	1.2E + 07	42	289915.0		
Total	1.6E + 07	48			

Table 3b. The Duncan ratings of the states for farm labour, animal traction and tractor hiring are as stated below.

Farm labour		**Animal Traction**		**Tractor Hiring**	
States	Mean	States	Mean	States	Mean
Adamawa	1500.00[a]	Adamawa	1014.28a	Adamawa	971.42[a]
Bauchi	2000.00[a]	Plateau	1078.57a	Bauchi	1000.00[a]
Borno	2514.28[a]	Bauchi	1171.43a	Borno	1392.86[a]
Jigawa	338571[b]	Yobe	1207.14a	Plateau	1471.42[a]
Katsina	3457.14[b]	Borno	1464.28a	Yobe	1500.00
Plateau	39.14[b]	Jigawa	2350.00b	Jigawa	1642.85[b]
Yobe	4321.42[c]	Katsina	2657.14c	Katsina	1685.71[c]