Animal traction technology in northern Nigeria: a survey of constraints and a model of prospects

by

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Abstract

In order to forecast the long-term relative preferences of farmers for manual, tractor and animal traction ridging techniques, a survey was carried out on 84 farmers representative of the farming population of northern Nigeria. Against a socio-economic background of youth migration to urban areas, growing importance of hired labour, predominance of hand tools over tractors (despite government incentives) and present restricted use of animal traction, the forecast showed that animal traction use is expected to increase in northern Nigeria. The forecast produced the following figures: farmers using hand tools, 23%; tractors, 29%; animal traction, 49%. The constraints to this potential development were sorted by order of importance and weighted according to their importance to the farmers' situation. The most important constraints led to a set of recommendations in favour of improving: veterinary services, local manufacturing of traction implements, credit facilities, and support for research in draft animal breeding.

Introduction

The aim of this study is to investigate the alternative ridging techniques in northern Nigeria and to forecast the long-term relative preferences of farmers for those techniques. Such a forecast should provide valuable information on the potential level of acceptance of animal traction technology as a source of farm power in the study area. We will first give some background information regarding the historic coexistence of hand tools, tractors and animal traction (AT). Then, we will outline the procedure used for this study. The findings of this study are presented with the general characteristics of the respondents, the prospects for, and constraints to the adoption of AT in northern Nigeria. The conclusion includes a set of recommendations for the expansion of AT in northern Nigeria.

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Background

Since the boom in the Nigerian oil sector in the early 1970s, new factors have influenced the socio-economic farming environment in northern Nigeria. The expansion of the service sector, the increase in urban income opportunities, indirectly reinforced by the free primary education introduced towards the end of the same decade, have led to a migration of rural youth to urban areas. Recent studies (Oyejide, 1986) have shown that hired labour is now an important component in the cost structure of Nigerian farm families, also partly due to hand tools (mostly hoes and cutlasses) predominating over other techniques (tractors and AT) in the preparation of cultivated land.

Since the early 1980s, one of the key interventions of the Nigerian Government has been to make tractor services available to farmers. At federal level, tax relief incentives have been granted on most classes of imported farm machinery. At state level, tractor hiring units have been created for the purpose of acquiring, maintaining and hiring out tractors to farmers at subsidized hourly prices (Phillip and Ezeh, 1988). In recent years, the high costs of

Table 1: Distribution of farmers by actual and intended methods of ridging in year 1988 (t_2)

	Hand tools (S_1)	Tractor (S_2)	AT (S_3)	Row total
Hand tools (S_1)	36	2	6	44
Tractor (S_2)	22	8	4	14
Animal traction (S_3)	0	6	20	26
Total	**58**	**16**	**30**	**84**

importing farm tractors and spare parts, the down turn of the oil prices, and the strong disappointments from unattained tractorization goals have led to a rethinking of the approach to land preparation in Nigeria.

The awareness at both research and farm levels of the use of AT for ridging is increasing, especially in northern Nigeria. Several studies have investigated the potential and actual land cultivation gains generated by the adoption of AT. The parameters measured include total cultivated area, total output and financial returns. While the superiority of AT over hoe technology has been positively demonstrated (Panin, 1987) it appears that less than 15% of the total cultivated areas in sub-Saharan Africa is prepared with AT (ILCA, 1987).

Procedure

This study was based on a sample of 84 farmers, all located in the semi-arid farming environment of the Kadawa area (11°39'N, 8°27'W) in northern Nigeria. Information was gathered from research among farmers regarding the various techniques used for ridging and post-ridging operations, as well as key socio-economic characteristics which might influence the farmers' choice of techniques. We therefore obtained a complete picture of the various techniques employed for ridging in 1986 and 1987 and the intended methods for 1988.

For the purpose of this forecast, we assumed that the current land preparation methods will continue to coexist in the long term in the studied area. In this context, the observed relative preference of farmers for hoes, AT and tractors were treated as conforming to a discrete-finite Markov process. The theoretical model obtained can be used for policy decision making (a detailed explanation of this model is presented in the appendix).

For the purpose of investigating the constraints to the adoption of AT in northern Nigeria, farmers were classified in two groups: the "adopters" and the "non-adopters" of AT for ridging purposes in 1987. Thus, farmers using hoes or hired tractors in 1987 belong to the latter group.

A total of 20 potential constraints to the adoption of AT were listed by the researchers. Farmers were then asked to sort them into three categories: "not important", "important", "very important". These categories were assigned a respective score of 1, 2 and 3. These scores were then weighted according to their importance to the farmers' situation, to produce an index representing the mean importance of each constraint (Table 6). The farmers were also asked to indicate their intended method of ridging for the next 1988 season (Table 1).

Results

Characteristics of the respondents

The sample was mostly composed of experienced farmers, with 76 of them (91%) in farming for 10 or more years. The average household consisted of 11.5 persons, with 4.7 adult males and 3.2 adult females. The average farm size was 1.15 hectares. The dominant rainfed crops included sorghum, millet, maize, cowpea and groundnuts. Dry-season (irrigated) crops included wheat, maize and vegetables, especially tomatoes. While

Table 2: Transition probability matrix P based on the actual (1987) and intended (1988) ridging methods

		Year 1988 (t_2)		
		Hand tools	Tractor	Animal traction
Year 1987 (t_1)	S_1 Hand tools	0.818	0.045	0.137
	S_2 Tractor	0.143	0.571	0.286
	S_3 Animal traction	0.000	0.231	0.769

crops like millet and sorghum were frequently grown in combination, others, like wheat, were mainly grown on their own.

Human labour came from both family and independent sources. Twenty farmers (24%) relied strictly on family labour, while 11 (13%) relied solely on hired labour. The remaining 53 farmers (63%) employed both family and hired labour during the survey year 1987.

Forty-five farmers (54%) only owned donkeys, 13 others (16%) only owned oxen, 16 (19%) had both donkeys and oxen, while the remaining 10 farmers (11%) had no traction animal of any kind.

Table 3: Forecast of future relative farmer preference for alternative methods of ridging

Year (t_k)	Hand tools[a]	Tractor	Animal traction
1989	0.3970	0.2119	0.3911
1990	0.3550	0.2293	0.4157
1991	0.3232	0.2429	0.4339
1992	0.2991	0.2535	0.4474
1993	0.2809	0.2616	0.4575
1994	0.2672	0.2677	0.4651
1995	0.2569	0.2723	0.4708
1996	0.2491	0.2758	0.4751
1997	0.2432	0.2784	0.4784
1998	0.2387	0.2804	0.4809
1999	0.2354	0.2819	0.4827
2000	0.2329	0.2831	0.4840
Steady state or long term	0.2252	0.2866	0.4882

Notes:a) refers mainly to hoes.
The predictions for each year are shown in the form of relative frequencies. To find the corresponding number of respondents the relative frequency in a given year needs to be multiplied by the sample size (of 84). See Table 4 for an example.

Prospects for animal traction

In the 1986 planting season, 46 farmers used hand tools for ridging, 10 relied on tractors, and 28 employed AT implements. In 1987, these figures changed to 44, 14 and 26 respectively (the information about the 1986 season was collected merely as a check on the 1987 figures). Referring to Table 1, we note that 36 of the 44 farmers using hand tools in 1987 intend to continue to do so in 1988, while 2 of the same 44 will change to hired tractors, and 6 farmers plan to employ AT in 1988. From Table 1, the row totals translate readily into a transition probability matrix P, as shown in Table 2.

The respective column totals in Table 1 form the computing basis of the initial state probability vector $\emptyset_{(1)}$. Table 3 presents the predicted future relative preference of farmers in the Kadawa area for the three ridging techniques.

The long-term forecast, or steady state, which is more relevant to policy decision making, is further presented in Table 4, in the form of a frequency distribution (note that the last column in Table 4 is the same as the last row in Table 3). From Table 4, we can forecast that in the long term, 23%, 29% and 49% of the far-

Table 4: Steady state (long term) frequency distribution of respondents by ridging methods

Cultivation method	Number of farmers	Percentage %
Hand tools	19	22.5
Tractor	24	28.7
Animal traction	41	48.8
Total	**84**	**100**

Table 5: List of potential constraints to animal traction in northern Nigeria

Code	Description
01	Cannot afford to buy draft animals
02	Cannot easily find draft animals to buy
03	Cannot easily find draft animals to hire
04	Cannot afford to hire draft animals
05	Cannot afford to buy traction implements
06	Cannot easily find traction implements to buy
07	Cannot afford to hire traction implements
08	Cannot easily find traction implements to hire
09	Farm size is incompatible with animal traction
10	Cropping pattern is incompatible with AT
11	Inadequate literacy level
12	Cannot afford to maintain draft animals
13	Cannot afford to maintain traction implements
14	Inadequate supporting facilities for AT (e.g. veterinary centres)
15	Spare parts for implements not readily available
16	Personal beliefs and values incompatible with AT
17	Have never seen or heard of AT
18	Animal(s) owned are unsuitable for traction
19	Available AT unsuitable for post-ridging operations
20	Have enough household members to replace the need for AT

mers respectively will use hand tools, tractors and AT for ridging.

The prediction shows that there is a prospect of increase in the use of AT for ridging in northern Nigeria. However, the trends predicted here are underlined by a set of constraints.

Constraints to AT

The list of constraints sorted by order of importance by the farmers is presented in Table 5. Distribution of farmers for each constraint, along with the weighted importance index is presented in Table 6. Table 7 shows the relevance or importance of each constraint to farmers' situation.

In the same Table 7, we see that the purchase, hiring, maintenance and even availability of traction implements are among the important constraints hindering the development of AT.

Table 6: Distribution of farmers by the ranking of each constraint

Code[a]	Number of farmers scoring constraints as: Not important	Important	Very important	I[b]
01	41	29	14	1.68
02	57	18	9	1.43
03	55	21	8	1.44
04	45	28	11	1.60
05	2	32	50	2.57
06	10	29	45	2.42
07	44	37	3	1.51
08	5	31	48	2.51
09	60	19	5	1.35
10	57	20	7	1.41
11	69	11	4	1.23
12	63	11	10	1.37
13	8	19	57	2.58
14	24	32	28	2.05
15	9	17	58	2.58
16	79	5	0	1.05
17	84	0	0	1.00
18	68	11	5	1.25
19	7	11	66	2.83
20	63	13	8	1.35

a) See Table 5 for the actual description of constraints

b) Weighted "index of importance" calculated as

$$I = \frac{(n_1.1 + n_2.2 + n_3.3)}{(n_1 + n_2 + n_3)}$$

where n_1 n_2 and n_3 are the numbers of farmers scoring a constraint as "not important"; "important"; and "very important" respectively.

The availability and maintenance of draft animals were not generally judged as "very important" constraints. This may suggest that the traction implements, which are mostly imported, constrain the adoption of AT more than draft animals do.

It is significant that farmers did not see the existing cropping patterns (mostly mixed), their low literacy level, their traditional beliefs and value systems, their small farm size, as either "important" or "very important" constraints to the adoption of AT. However, farmers expressed concern that most of the post-

Table 7: Final classification of constraints by the indicated extent of importance in the study area

Code[a]	I[b]	Final Classification[c]
01	2	important
02	1	not important
03	1	not important
04	2	important
05	3	very important
06	2	important
07	2	important
08	3	very important
09	1	not important
10	1	not important
11	1	not important
12	1	not important
13	3	very important
14	2	important
15	3	very important
16	1	not important
17	1	not important
18	1	not important
19	3	very important
20	1	not important

a) See Table 5 for the description of the actual constraints.
b) The results in Table 6 have been rounded-off to the nearest whole numbers.
c) Based on the responses at survey time only. Classification may change with time.

ridging operations must still be done by hand rather than AT.

Conclusion and recommendations

The resulting forecast presented in Table 4 gives a measure of the prospects of AT in northern Nigeria. If this sample was sufficiently randomly drawn, the forecast holds, at least approximately, for the larger farming population in northern Nigeria.

While this forecast suggests a possibility of relative expansion of AT use in the long term in this area, there are non-trivial constraints to be addressed. The most important ones relate to the availability of traction implements, their costs and maintenance. Also, most post-ridging operations are still not adaptable to the use of AT, and are still done by hand. In such a context, governments have an important role to play, especially for the provision of:

- readily accessible veterinary services for draft animals;
- incentives for local manufacturing of traction implements and spare parts (for both ridging and post-ridging operations), hopefully to be available at affordable prices;
- credit facilities for individual farmers or farmer groups for the purchase and maintenance of draft animals and traction implements;
- financial support for research into the development of better breeds of work animals.

Appendix: Markov process model used

Let S_1, S_2, S_3 represent the states of using hoe, tractor and AT for ridging, respectively. Also, let P_{ij} (i,j = 1,2, ..., n) represent the proportion of farmers in state S_i in year t_1, who moves (or intend to move) into state S_j in the following year t_2. The P_{ij} may be assembled into a transition probability matrix P, which in this study, is of dimension 3 x 3.

If the farmer behaviour pattern embodied in P is expected to continue, this model can be used for predicting the relative preference of farmers, over time, among the three states (or ridging methods) indicated. To achieve this, let $\emptyset_{j(k)}$ be the probability that a randomly selected farmer is in state S_j after k years, and $\emptyset_{(k)}$, the vector of probabilities that the farmer is in states S_1, S_2, or S_3 in any year t_k. In general, under these assumptions, it has been shown that $\emptyset_{(k)} = \emptyset_{(1)} P^k$, where $\emptyset_{(1)}$ is the relevant state probability vector, corresponding in this case to the year t_1. If P is a regular stochastic matrix, then for a large k, P^k approaches some steady state matrix, and the corresponding steady state vector probability vector $\emptyset_{(k)}$ has important implications for policy.

Résumé

Cette enquête effectuée auprès de 84 fermiers sert de base à la prévision à longue échéance de l'utilisation des techniques de buttage (techniques manuelles, tracteurs et traction animale) dans la région nord du Nigéria. Dans un

contexte socio-économique d'exode rural, de croissance de la main-d'oeuvre salariée, de prédominance des techniques manuelles sur l'utilisation de tracteurs (malgré les facilités offertes par le gouvernement) et de la traction animale (utilisée sur 15% du total des terres subsahariennes cultivées), l'étude prévoit qu'à long terme la traction animale se développera dans le Nord Nigéria dans les proportions suivantes: fermiers utilisant les techniques manuelles: 23%, des tracteurs: 29%, la traction animale: 49%. Les contraintes locales font l'objet d'une classification ajustée en fonction des caractéristiques spécifiques des fermiers. Au vu des contraintes les plus importantes, l'étude offre une liste de recommandations pour l'amélioration des services vétérinaires, de la fabrication du matériel de culture attelée au niveau local, des sources de crédits, et du financement de la recherche pour le développement de l'élevage du bétail.

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