Animal traction in Lower Casamance: technical aspects and socio-economic implications

by

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Abstract

Animal traction remains unequally developed in the different production zones of Lower Casamance. Its use rarely goes beyond land preparation. Farmers' reasons for using animal traction are mainly reduction of drudgery, better timeliness and extension of upland cultivation.

With decreases in annual rainfall and shortening of the rainy season in the region, animal traction may allow the timeliness required to secure production in the time available. However the impact of animal traction on labour productivity remains low, and this is associated with low use of existing equipment and only partial adoption of the technological options available.

From cash flow and cost-benefit analyses necessary conditions have been identified to ensure better utilization of the technology and make investments in this area profitable.

Introduction

The promotion of animal traction in Lower Casamance is part of an agricultural development strategy designed to intensify production and increase farmers' standard of living in the region. To implement this policy, the Programme Agricole (P.A.) and the Special Credit Program of PIDAC (The Casamance Integrated Agricultural Development Project) were established in the 1970's and in 1981 respectively, to facilitate the acquisition of farm equipment through credit.

This paper analyses the role played by animal traction in Lower Casamance. It draws heavily on several studies conducted by the Djibelor Farming Systems Research team (Fall, 1985; Sonko, 1985; Ndiamé, 1986). The first section describes Lower Casamance and the role of animal traction in farmers' strategies. The second section analyses the socio-economic effects of this technology in the region. The final section contains the conclusions and offers some recommendations for improving the efficiency of animal traction in the region.

Role of animal traction in farmers' strategies

Lower Casamance is located in the southwestern part of Senegal and corresponds to the administrative region of Ziguinchor. The region is very heterogeneous in terms of ethnic group, climatic conditions and soils. Several different types of production systems, characterized by differences in the division of labour and the organization of production, are found throughout the region.

The Djibelor Farming Systems Research (FSR) team began its programme in 1982. In order to identify technologies adapted to farmers' conditions and the needs of farmers in the region, the FSR team divided the area into five different zones (recommendation domains) with respect to three agro-socio-econ-

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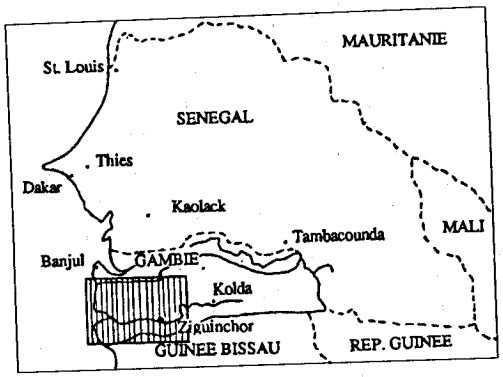
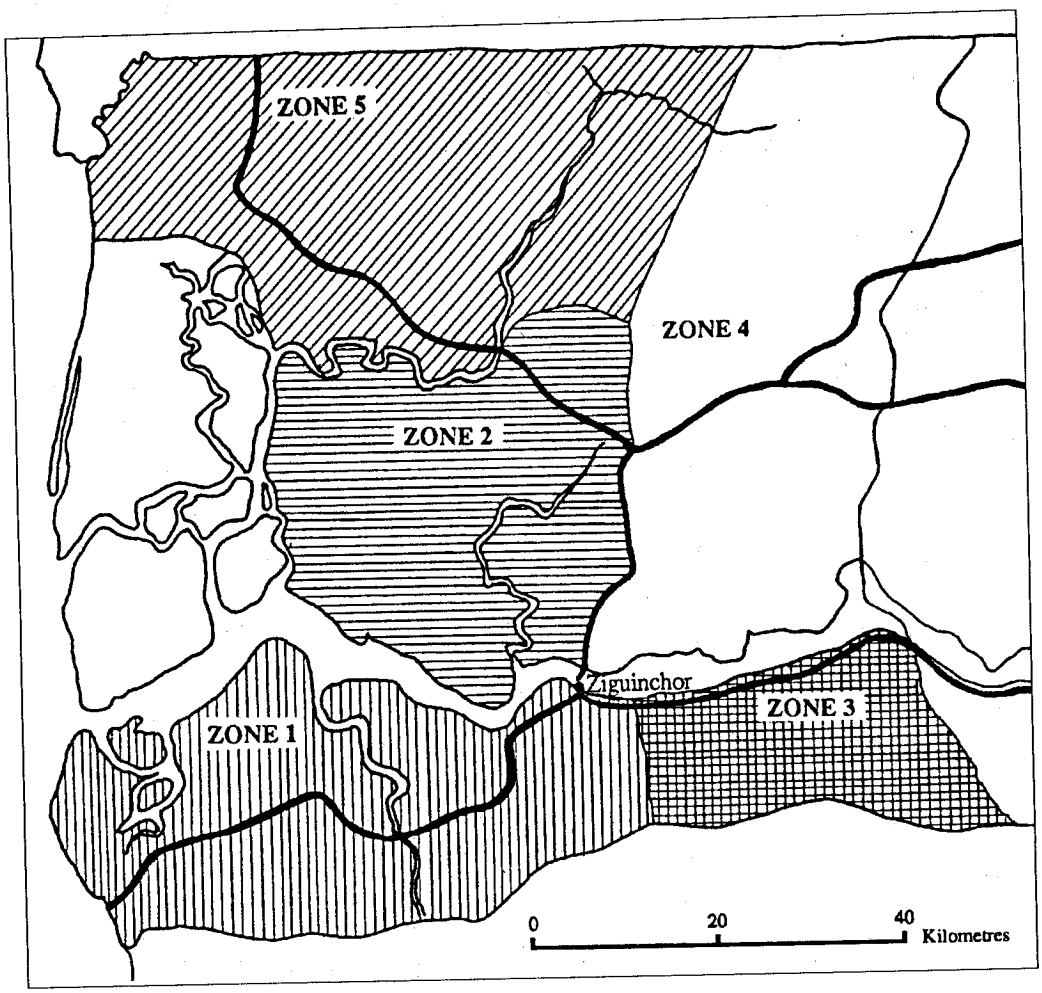
Map 1. Lower Casamance and its agricultural areas *(Source: Equipe SPT de Djibélor, 1985)*



Key to Zones

1. Diola social organization; farming systems based on transplanted swamp rice; no animal traction.
2. Diola social organization; farming systems based on transplanted swamp rice and direct seeding of other cereals; no animal traction.
3. Mainly Mandingo social organization; farming systems based on direct seeding of cereals; little animal traction.
4. Mandingo social organization; farming systems based on direct seeding of cereals; significant use of animal traction.
5. Mainly Diola social organization; farming systems based on transplanted swamp rice and direct seeding of other cereals; intermediate level of animal traction.



omic criteria: the irrigated/rainfed crop ratio, the sexual division of labour and the importance of animal traction (see Map 1). Animal traction is used mainly in the Sindian-Kalounayes (4th) and the Diouloulou (5th) zones. Upland crops dominate the area cultivated in both zones, and each differs notably with respect to the division of labour and the organization of farm production. A Mandingo-type of organization prevails in the 4th zone while the 5th zone is characterized by a Diola system (Equipe Systèmes, 1983, 1984). In the Mandingo systems, men work in uplands while women work the lowlands. Such a spatial division of labour implies a specialization of women in rice production while men specialize in the production of peanuts, millet and maize. In this system oxen cultivation is almost exclusively limited to uplands. In the Diola system on the other hand, men and women work together on both rainfed and irrigated crops with a complementary distribution of tasks: men plow the land, and women seed and transplant rice. Animal traction is widely used but is limited largely to land preparation.

Animal traction users

Recent surveys on a sample of 48 farms in the 4th and 5th zones reveal that the heads of residential units or chiefs of autonomous production units are the majority (79%) of animal owners in Lower Casamance. The users' status has important implications for the organization of production in the two systems. Among the Mandingoes, a residential unit coincides with a decision making unit concerning production activities and, specifically, the management of farm equipment. The family elder centralizes and manages family resources. Among the Diola, on the other hand, members of an extended-family group may live in the same residential area, but each nuclear family constitutes an autonomous production unit (Diouf, 1984). The average age of animal traction users is 53 years; the youngest is 24 and the oldest is 75. Experience with oxen cultivation varies widely from 0 to 25 years but averages 8 years (Ndiamé, 1986).

Reasons for animal traction use

A majority of farmers (79%) use animal traction for plowing because it is easier and faster than land preparation with hand tools. Only a minority of the farmers mention the opportunity to increase the area cultivated as the main reason for using animal traction. Ease and timeliness also motivated 42% of the farmers to use oxen-drawn seeders; (a similar percentage did not use seeders). Furthermore a high percentage (59%) of the farmers do not use weeding equipment, even though its use offers benefits. Finally, 59% of the farmers use carts for transporting equipment supplies and harvested crops (Ndiamé, 1986).

In summary, timeliness in production activities, and an effort to ease the workload constitute the most frequent reasons for the acquisition of animal traction equipment in Lower Casamance. Given the declining rainfall and the shorter rainy seasons in the region, a farmer's success for a cropping season depends on the speed of cultivation (plowing and seeding). In addition, previous studies undertaken on a larger sample have shown that Lower Casamance farmers increasingly seek to extend the area under upland cultivation and to shift from transplanting to direct seeding in lowlands (Posner *et al.*, 1985). Farm equipment plays a crucial role in these production strategies.

Farm equipment

The farm equipment used in the Lower Casamance consists principally of tools for land preparation (55%). These tools include:

Mouldboard Plows: the UCF or Arara types built by SISCOMA/SISMAR in Senegal comprise 28% of the equipment and are generally found in the 4th zone.

Ridgers: include the SISCOMA/SISMAR type plus the Emcot type from The Gambia. They comprise 27% of Lower Casamance farm equipment and are found principally in the 5th zone.

One-Row Seeders: represent 10% of the region's farm equipment. The SISCOMA-SISMAR seeders were widely distributed through different credit programmes. The use of ridges, which is frequent in the region, limits the more widespread use of seeders.

Weeding Equipment: especially the SISMAR-made Sine cultivator, is also limited by the use of ridges.

Transport Equipment: represents 34% of the total equipment used and is the most frequently used after mouldboard plows and ridgers.

The credit programmes (P.A. and PIDAC) have been the major sources for farm equipment acquisition in the region. Purchases of used equipment and inheritance are the other principal sources of acquisition. Because of the heavy use of equipment and frequent renting, 50% of the equipment has been found to be in very poor condition. Many implements are used to the point where they are beyond repair and local blacksmiths generally lack the appropriate training and tools to provide proper repair services. Nevertheless farm equipment is being used and the most utilized equipment (UCF mouldboard plows and Gambian ridgers) has a life expectancy ranging from 8 to 10 years (Fall, 1985).

Draft animals

Draft animals used in the Lower Casamance include trypanotolerant N'Dama cattle (87% of total livestock), donkeys (10%) and horses (3%). There are several modes of acquisition: purchases from other farmers; removal from extensive herds; exchanges against small ruminants; and gifts. Purchases are most common (49% of regional livestock), whereas only 29% of the draft animals come from the farmers' own herd. Most purchases are from other farmers (73% of the animals purchased) while 17% are purchased from traders.

The average starting age for a draft animal is 3 years 9 months (with the youngest recorded at 2 years and the oldest at 6 years). Donkeys and horses, however, are used for transport when they are 2 years old. Training takes place one month before the cropping season (June), if the animal has been acquired at the end of the dry season, or during the off-season (December, January) if the animal was obtained at the end of the rainy season. About 70% of draft animals surveyed in 1984 were found to have been working for more than 6 years (Sonko, 1985). The reasons for removing animals from service are diverse. Table 1 presents a relative ranking of reasons.

Table 1:
Reasons for removing animals from service

Reason (ranked)	Number	%
Sales	93	46.5
Death	52	26.0
Trade	14	7.0
Slaughter	13	6.5
Theft	8	4.0
Rented out	7	3.5
Out for training	4	2.0
Return to herd	4	2.0
Marital gift	2	1.0
Unknown	3	1.5
TOTAL	**200**	**100.0**

Source: Sonko, 1985

The management and use of farm implements and draft animals

Farm implements and draft animals are acquired by the head of the farm unit who deals directly with the representatives of the various credit programmes. The management of the

implements is controlled by the head of the production unit, but involves several other family members.

A guide, generally a 10- to 14-year-old child, is in charge of livestock feeding. A work leader deals with equipment maintenance and organizes the use of teams on different fields. This individual also organizes the work schedule according to labour and seed availability, rainfall pattern, etc. (Sonko, 1985; Fall, 1985).

Plowing and ridging with oxen, scarifying with donkeys and horses, seeding and to some extent weeding are the main tasks undertaken by animals in the Lower Casamance. The use of different animals for different tasks varies by the size and composition of a farm herd and the work to be done.

As Table 2 shows, in the case of a typical farm unit in the studied area, oxen are used mainly for land preparation and seeding (74% of oxen working time). The relative importance of work done under rental agreements and/or for exchange labour should also be noted. Donkeys are not in heavy demand during the cropping season and their role in transporting supplies, farm implements and drinking water to the field is relatively limited.

In summary, the use of animal traction in the Lower Casamance remains limited to land preparation and seeding. Such limited use of draft animals is due in part to the lack of equipment on farms in the region. In addition, previous studies have shown that an animal's experience plays an important role in its use. For horses and donkeys transport is their main activity until they acquire three years of experience; afterwards, they become more involved in seeding and weeding. For cattle, the youngest are used for plowing and seeding; after three years, ridging becomes their major activity.

Surveys conducted during the 1984 cropping season (Sonko, 1985) suggest that the strategy of farmers involves systematically using animals in maize and millet plots. Ridging and manual seeding are common and animals are paired according to their experience. In peanut fields, however, animals with unequal experience are harnessed for plowing and seeding.

In summary, the use of animal traction in the Lower Casamance varies widely by zone. The strategy for using animals is linked to everal factors including the cropping pattern, the type and size of draft animals available, equipment availability and experience with animal traction. In comparison to their potential, the use of draft animals is limited. The optimum use of animal is associated with several factors not the least of which is the type of equipment available to farmers.

Socio-economic aspects of animal traction

Changes induced by animal traction

This analysis is based on several hypotheses about the potential positive effects of animal traction: increases in area cultivated, higher yields, savings in time. The analysis, however, takes into account the need to assure the tech-

Table 2: Animal use (Working hours from June 3 to August 21, 1984)

Animal	No. of days	Total hours	Ridging (%)	Plowing (%)	Seeding (%)	Weeding (%)	Transport (%)	Renting (%)
Cattle	32	154	32	21	21			26
Horses & Donkeys	22	62			64	23	13	

Source: Sonko, 1985

nical coherence of the package, for example the use of complementary inputs and appropriate cultivation techniques. The farmers' specific contingencies and problems related to the production environment are also accounted for as background in the analysis. The results discussed here were obtained from surveys conducted in the region and specifically from a comparative analysis of two types of farms, those with and those without animal traction.

A survey was conducted by the author on a sample of 48 farm households in the Ziguinchor Region. This revealed that the majority of farmers in the sample have started using fertilizers, improved seeds and insecticides when they adopted animal traction. Moreover, the use of manure, plowing and seeding in line became more frequent. The majority of farmers also said they increased the area of upland crops under cultivation: 90% of the sample on peanuts, 65% on millet and maize. Furthermore 59% and 52% of the farmers feel that their peanut and maize yields have increased because of the more timely techniques practised with animal traction. Finally, almost all farmers gained time with the adoption of animal traction, which has been used principally by most farmers to rest, to weed or to help women in low lands (Ndiamé, 1986).

Although farmers have some clear perceptions about the effects of animal traction on their production system, it is commonly difficult for them to perceive certain aspects, such as yield effects, which can be assessed more accurately through cross-sectional analysis.

Results of a cross-sectional analysis

The following information is based on an analysis of data collected in 1983 by members of the Djibelor Production System team. Data collected in the Sindian-Kalounayes (4th zone) show a net income per person-workday of 761

Table 3: Cash-flow analysis on two groups of farm households

	GROUP 1 (Manual farmers)	GROUP 2 (Animal traction users)
	CFA	CFA
1. Value of sales [a]	112 393	176 457
2. Off farm incomes	41 596	5 694
3. Purchase of inputs	4 441	9 574
4. A.T. expenses	0	2 000
5. A.T. income[b]	0	15 000
6. Net income (1+2-3-4+5)	149 549	238 798
7. Food purchases[c]	76 555	72 296
8. Other expenses[d]	7 462	15 129
9. Cash balances (6-7-8)	65 533	151 371
10. Loans received	0	0
11. Reimbursements	0	55 868
12. Net cash-flow (9+10-11)	65 533	93 503

[a] *Peanut sales.*

[b] *Average income from renting out equipment.*

[c] *Each farm household is assumed to purchase imported rice to fill its production gap.*

[d] *Calculated on the basis of 1000 CFA francs per capita. A 500 CFA per capita tax is paid by each household; the remaining 500 CFA cover clothing and purchase of medicines.*

Source: Computed from data collected by the Djibelor Farming Systems Research Team, 1984

CFA for farmers using animal traction versus 551 CFA for those without animal traction. Similar results were found in the Diouloulou (5th zone) area: 774 CFA versus 634 CFA (Sall *et al.*, 1985).

Statistical analyses were carried out on several performance variables of farm households with different levels of animal traction adoption. These show that besides total cultivated area, peanut yields and seeding time, there was no significant difference between farm households with weeders and those limited to seeders. It is worth noting here that because of the additional expenses which arise from the acquisition and maintenance of animal traction implements, their use must generate additional revenues at least equal to the expenses incurred. Otherwise, the adoption of animal traction risks impoverishing farmers or, at the very least, jeopardizing the latter's capacity to repay the equipment loan.

Cash-flow analysis

Table 3 shows the results of the analysis of one group of farm households with animal traction and another group relying on manual cultivation. The two groups have positive cash balances amounting respectively to 93 500 CFA and 65 300 CFA. However, adopters would have serious cash flow problems because of the need to purchase a pair of oxen during the first year of adoption. Therefore, unless they obtain draft animals from their own herd or on credit, animal traction would be out of their reach.

The provision of credit, however, is justified only if the investment can be profitable in the medium term. In the Lower Casamance the relatively small economic contribution of oxen cultivation reflects the transitory situation of farmers who have only partially adopted the technical package. It is possible that larger benefits will flow as farmers gain more experience and adopt the complete package. Budget analysis over several years should allow the integration of the dynamic effects of animal traction.

The profitability of an investment in animal traction

The analysis in this section is based on simulations of actual and possible farmer situations in the region. An emphasis is given to elements that farmers and policy-makers can control so that quick and stable improvements can be made in the use of animal traction. A cost-benefit analysis was carried out using the method described by Gittinger (1982). The elements on which the analysis is based are presented in Appendix 3. Table 4 summarizes the results of the analysis. The first scenario assumes a learning period of 5 years. After this period a 5% annual increase in area cultivated is assumed for peanuts. The internal rate of return (IRR) is 8%, which is much smaller than the interest rate paid on credit, or what is considered as the opportunity cost of capital.

When some of the hypotheses are relaxed, different scenarios or possibilities can be examined. In scenario 6, (see Table 4) the IRR (14%) exceeds the interest rate (12%). This assumes that area cultivated in maize, millet and sorghum is increased by 10% per year, starting in the 6th year. In addition, a 10% increase in the area allocated to peanuts, and a 5% per year increase in peanut yields are assumed. The IRR increases to 18% in Scenario 7 when a larger rate of increase in area devoted to peanuts (20%) is assumed.

Scenarios 1, 2 and 4 were estimated with a shorter learning period (3 years instead of 5). In scenario 8, IRR changes from -8% (scenario 1) to 2%. From scenario 2 to scenario 9 the IRR increases by a factor of 14. Finally, the IRR increases by a factor of 2 from scenario 4 to scenario 10.

If we assume that resources are not diverted when farmers use animals owned by the farm

Table 4: Financial profitability of investment under several scenarios

Scenario	Year	Crops	Increases in area cultivated (%)	Yield increases (%)	Increases in off-farm income (CFA)	Credit for animal purchase	Use of farmer's own draft animal	Value of animal resale (CFA)	Internal rate of return (%)
1	6	Peanuts	5	2	0	No	No	0	8
2	6	Peanuts	10	2	0	No	No	0	1
3	6	Peanuts	5	2	0	No	No	0	
		Millet	5	0					
		Maize	5	0					
		Sorghum	5	0					-6
4	6	Peanuts	5	5	0	No	No	0	
		Millet	5	5					
		Maize	5	5					
		Sorghum	5	5					
		Rice	0	5					7
5	6	Peanuts	10	5	0	No	No	0	
		Millet	5	15					
		Maize	5	15					
		Sorghum	5	15					
		Rice	0	15					9
6	6	Peanuts	15	5	0	No	No	0	
		Millet	10	10					
		Maize	10	10					
		Sorghum	10	10					
		Rice	0	10					18
7	6	Peanuts	20	5	0	No	No	0	
		Millet	10	10					
		Maize	10	10					
		Sorghum	10	10					
		Rice	0	10					
8	4	Peanuts	5	2	0	No	No	0	2
9	4	Peanuts	10	2	0	No	No	0	14
10	4	Peanuts	5	5	0	No	No	0	
		Millet	5	5					
		Maize	5	5					
		Sorghum	5	5					
		Rice	0	5					14
11	1	Peanuts	5	2	0	No	Yes	0	-1
12	1	Peanuts	5	2	0	Yes	No	0	-9
13	1	Peanuts	5	2	0	No	No	80 000	
	1-5				+ 5 000				2
14	6	Peanuts	5	2	0	No	No	0	
	6-10				+ 10 000				

Source: Ndiamé, 1986

unit, the IRR is improved, in absolute value, by 7% (scenarios 1 and 11). However, when credit is provided to buy animals the IRR falls (-9% versus -8%). Finally, if after purchasing animals farmers can resell them, even for less than the acquisition price (80000 versus 100000 CFA francs), the IRR increases in absolute terms by 6% (scenarios 1 and 13).

It follows from the analysis that under the conditions of scenario 1, which reflect the current situation, most Lower Casamance farmers could not realistically adopt animal traction without a subsidy. Most of the farm implements owned in the region were distributed through the government-run equipment programme (Programme Agricole) and the debts

incurred by farmers in this programme were cancelled in 1980. It is unlikely that similar decisions will be taken in the future.

Moreover, even if in the next 10 years farmers could increase the area in peanuts by 100% and that of the major rainfed crops (millet, maize, and sorghum) by 25%, investment in animal traction will still be unprofitable. Only when increases in the area cultivated are matched with simultaneous increases in yields will the IRR exceed the interest rate. Thus, there is a need for a progressive intensification of farming systems in the Lower Casamance. In this respect, reducing the learning period with animal traction can play a major role. Better performances can be expected if farmers can combine a higher degree of technical mastery of equipment to a more complete adoption of the package: improved seeds, fertilizer and cultivation techniques. However, for most farmers in Lower Casamance, the level of initial investment and financial risk associated with these changes could jeopardize the adoption of the complete package. The achievement of rapid benefits can provide more incentives to make further investments. Appropriate institutional incentives can play a crucial role.

The resale of older animals could be an interesting possibility since the cattle market price increases as the animal gains weight. This option requires, however, certain cultural, technical, and institutional prerequisites that do not exist yet in the Lower Casamance, for example pasture availability, and outlets for the greater integration of livestock in farming. Moreover, research should not seek simply to improve the available technologies, but should also seek their progressive extension by accounting for the farmers' learning curve and their repayment capacity. Such an approach would involve an effort to coordinate the most important investments with the adoption of the first component of the package that increase agricultural productivity and provide farmers with higher net income.

Conclusions and perspectives

Animal traction constitutes a means by which decision-makers try to encourage intensification of agricultural production. It also plays a major role in new strategies adopted by farmers in the Lower Casamance in relation to decreases in the amount of rainfall and the shortening of the rainy season in the region.

The use of animal traction has induced changes in farmers' agricultural practices and it has positive effects on performances achieved by users: timeliness, reduced labour, and increases in area cultivated. However, the adoption of the technology generates, among other things, additional expenses that most Lower Casamance farmers could not meet. Furthermore, adoption in the region is only possible if animal traction induces in the medium run a greater intensification of agricultural production, higher yields and higher net income for farmers. For this, there is a need for important logistic institutional support, for example for inputs, equipment maintenance and extension advice.

The research programme conducted by the Production System Research team emphasizes the possibilities of intensifying production through animal traction. Trials are under way on type of equipment, land preparation, seeding and weeding techniques, manure and fertilizer applications. Research is also being carried out on meat and livestock marketing, and the role of blacksmiths in the farm implement maintenance. Other studies aimed at improving the nutritional and health status of livestock will be started very soon. Results from these studies could provide the basis for improving the technical and economic efficiency of animal traction in the region. From these studies, it is expected that the Production System team will be able to make useful recommendations to the Lower Casamance farmers and to decision-makers.

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