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Animal traction in Mauritania: situation and prospects

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by

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Plowing in Hodh Chargui, Mauritania

Photo: Paul Starkey ©

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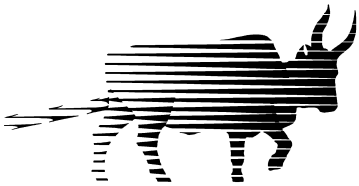

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Acronyms and abbreviations

ADRAO	Association pour le Développement de la Riziculture en Afrique de l'Ouest
AGETA	Association Générale d'Etudes Techniques Agricoles
ARPON	Amélioration de la riziculture paysanne à l'Office du Niger, Mali
ATNESA	Animal Traction Network for Eastern and Southern Africa
CFA	Franc d'Afrique ouest et centrale (la monnaie du Sénégal et d'autres pays)
CFOOOP	Charrue de SISCOMA/SISMAR
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement, France
CNRADA	Centre National de Recherche Agronomique et de Développement Agricole, BP 22, Kaedi
CTA	Technical Centre for Agriculture and Rural Cooperation, The Netherlands
DGIS	Directorate General for Development Cooperation, Ministry of Foreign Affairs, Netherlands
DRAP	Direction Développement des Ressources Agro-pastorales, MDRE
DRFV	Direction Recherche-Formation-Vulgarisation, MDRE
DRSPR	Division de Recherches sur les Systèmes de Production Rurale, Institut d'Economie Rurale, Mali
ENFVA	Ecole Nationale de Formation et de Vulgarisation Agricole, Kaedi
FAO	Food and Agriculture Organization of the United Nations
FED	Fonds Européen de Développement (European Development Fund), Belgique
GRDR	Groupe de recherche et de réalisations pour le développement rural dans le tiers monde, France
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit GmbH, Germany
IER	Institut d'Economie Rurale, Mali
IMAG-DLO	Instituut voor Mechanisatie, Arbeid en Gebouwen, Wageningen. The Netherlands
ISRA	Institut Sénégalais de Recherches Agricoles, Senegal
MDRE	Ministère du Développement Rural et de l'Environnement
NGO	Non-governmental organization
ONG	Organisation non-gouvernementale
PSSA	Programme Spécial de Sécurité Alimentaire (FAO/MDRE)
SAED	Societé nationale d'aménagement et d'exploitation des terres du Delta du Fleuve, Sénégal
SISCOMA	Société Industrielle Sénégalaise de Constructions Mécaniques et de Matériels Agricoles, Senegal
SISMAR	Société Industrielle Sahélienne de Mécaniques, de Matériels Agricoles et de Représentations, Senegal
SONADER	Société Nationale pour le Développement Rural
UM	Ouguiya, monnaie de Mauritanie. 1$E-U = 135 UM (juillet 1996)
UK	United Kingdom (of Great Britain and Northern Ireland)
WARDA	West Africa Rice Development Association

Summary

The report relates to a consultancy mission of Professor Paul Starkey to Mauritania from 25 June to 17 July 1996 for the FAO Special Programme for Food Security (PSSA). The consultant was expected to review the use of motorised and animal power mechanisation for rice cultivation and to provide advice relating to the possible enhanced use of animal power in the country.

The great majority of the land area of Mauritania lies in the Saharan and Sahelian agroclimatic zones where crop production is minimal. Most crop production takes place in the south-east zone (close to Mali) and in the southern zone, bordering the Senegal River. Several irrigated rice production schemes have been established in the southern zone. The use of mechanical power on which they are based has yet to prove to be economically viable and technically sustainable.

Mauritania has had a very long tradition of using animals for riding and pack transport. In the past twenty years there has been a rapid increase in the use of donkey carts. It is estimated that there are now about 75,000 donkey carts in the country. This represents an investment of about US$15 million by transporters, farmers and households, which has been achieved with little or no credit provision or government support. Donkey carts now play an extremely important role in the urban and rural economies of Mauritania. There are a much smaller number of horse carts, found mainly in the south of the country. Horses are faster and more powerful than donkeys, but they are much more expensive to buy and to feed.

The use of work oxen for plowing spread into south-eastern Mauritania from Mali in the late 1950s. It was boosted by Operation charrue in 1966. This led to a rapid expansion in the use of work oxen in Hodh Chargui, with resulting increases in areas cultivated and total crop production. The use of oxen also spread from Mali into the east of Guidimaka. Several thousand pairs of work oxen are currently used in Hodh Chargui and Guidimaka. Most plows have been purchased in Mali, but are maintained by local blacksmiths.

Along the Senegal River, many farmers use donkeys or horses for the cultivation of sorghum and millet. However, the hand seeding and weeding of these crops remains dominant. The animal traction technology and associated equipment has spread by farmer-to-farmer contacts with Senegal. Animal traction is not commonly used for rice cultivation.

The irrigation schemes for rice production have been established with the assumption that tractors and combine harvesters can be profitably used. Many people contacted felt that such mechanisation was unsustainable. Based on figures obtained during the mission, tables are presented that suggest that at present hire costs and productivity levels, motorised systems are not genuinely viable and sustainable. However, while services are declining, they have not yet collapsed completely and farmers still rely on such mechanisation. Profitability is restricted by low yields (two tonnes per hectare is common) and one crop per year.

In the short-term, human and animal power cannot completely replace tractor power, but in the longer term, sustainable human and animal systems can be developed. These will probably involve transplanted rice.

In the first instance, farmers may be most interested in using work oxen for levelling rice fields (a manual operation at present). It is anticipated that plowing and puddling small areas will follow, and that animal traction will become a part of rice farming systems. It will be easier to introduce work oxen to rice systems in Gorgol, where motorised systems are less available. Animal feed will be a constraint to increased use of work oxen. It is recommended that the potential should be assessed for a forage crop (single or dual purpose) that can be grown in rotation with rice. These could be considered cash crops since a market for animal feed exists.

The use of donkeys or horses for sorghum and millet production is likely to spread in the south. Its introduction into new areas where water-harvesting is practised is quite realistic. The combination of loaned equipment for testing and farmer-to-farmer technology

transfer should provide a useful context for on-farm assessment of the options.

Mauritania should build on existing regional experiences in rice production and rainfed tillage systems. It is recommended that a study tour be undertaken involving PSSA, farmers, MDRE and research staff. These should visit Projet Arpon based at Segou, Mali, which has much experience of irrigated rice production using animal traction and various motorised systems. Rice production projects in Senegal and The Gambia should also be visited.

The PSSA coordinator should also contact the relevant research organisations in Mali and Senegal (DRSPR and ISRA) to learn of recent developments in donkey tillage systems. Participation in a planned workshop in Ethiopia in which donkey tillages systems are to be demonstrated and discussed would also be valuable.

Following the study tour(s), PSSA (in collaboration with existing extension and research structures) should initiate and fund a simple programme of on-farm assessment of animal traction technologies. These should involve rice production systems and rainfed cultivation.

In-service training of extension agents will be required in the long-term. This can be implemented after some national expertise has been developed through the proposed farming systems programme of adaptive research relating to animal power.

It is recommended that a regional workshop be initiated (possibly in Senegal or Mali) so that regional experiences in rice production using animal power be shared. This might be arranged in conjunction with WARDA and the West Africa Animal Traction Network. Since the Dutch organisation IMAG-DLO has much technical experience in this field, the aid programme of The Netherlands might be usefully contacted in connection with such proposals for information exchange.

There is little information available in Mauritania on animal traction that can be used for extension or training. It is recommended that PSSA/FAO assist in the provision of suitable materials. The FAO modular manual on animal power is only available in English and a French-language edition should be prepared. Modules relating to animal power for rice production should be produced.

Introduction

Mission context and objectives

The FAO Special Programme for Food Security has recently been established by FAO and is beginning to develop strategic programmes in a number of countries. In Mauritania the Programme Special Securité Alimentaire (PSSA) is implemented by the Direction du Développement des Ressources Agro-pastorales (DRAP) of the Ministère du Développement Rural et de l'Environnement (MDRE) with support from FAO.

The DRAP-FAO PSSA is working with farmers in the south of Mauritania in a rain-fed area (H'Neikatt, Gorgol) and in some irrigated schemes in the south-west (Trarza). The farmers in these areas do not at present use animal power for soil tillage. The PSSA programme is aware that there are serious constraints to the large-scale use of tractor power in Mauritania, and that animal traction could play an increasingly important role in agricultural systems. However, at present the MDRE has little expertise relating to animal power.

FAO invited the present consultant to briefly review the use of motorised agricultural mechanisation and the potential for animal power in the country. He was expected to compare and contrast the use of animal power and motorised power for rice cultivation. The consultant was also asked to provide advice relating to the possible enhanced use of animal power in the country, commenting on appropriate animal species, operations, harnessing, implements, management systems and extension messages. The full terms of reference can be found in the report annexes.

The consultant, Professor Paul Starkey, worked from 25 June to 17 July 1996, and implemented the mission in conjunction with the PSSA Coordinator, Abou Yéro Kide. Together they held discussions with senior staff of the MDRE in Nouakchott, Kaédi, Rosso and Néma. They also visited farmers and a range of state-funded and private organisations, notably in Gorgol, Trarza and Hodh Chargui. They travelled over 4000 km by road and track and contacted over 80 relevant persons including officials, farmers and private sector service providers. The full mission itinerary and a list of persons contacted can be found in the report annexes.

Acknowledgements

The consultant would like to express his appreciation to the Director of DRAP-MDRE, Dr Ely Ould Ahmédou for his personal support, and that of his staff, in the planning and implementation of the mission. Particular thanks are due to Abou Yéro Kide, who gave up a great deal of his professional and free time to work very closely and effectively with the consultant. M Kide can be considered as a co-author of this report since he worked as the counterpart of the consultant and all issues were discussed together (although the consultant was responsible for the actual writing and any errors).

Grateful acknowledgement is also due to the FAO Representative in Mauritania, Nourredine Kadra and to his office staff. FAO Headquarters support for the planning of the mission was provided by the desk officer Julien Amegandjin and by the technical officer Juan-Carlos Chirgwin. Appreciation is also due to all the persons contacted (Ministry officials, business people and farmers) who provided the information on which this report is based. Additional valuable technical information was provided by Aalbert Wanders of Instituut voor Mechanisatie, Arbeid en Gebouwen (IMAG-DLO), The Netherlands and by Brian Sims of Silsoe Research Institute, UK. Assistance with the French edition of this report was provided by Sophie Fall (FAO Office, Mauritania) and Abou Kide (PSSA). To all these people who assisted the mission, a warm thank you.

Paul Starkey
Reading, July 1996

Terms of Reference

Conformément aux termes de la mission d'identification technique et sous la supervision directe des unités techniques et administratives de la FAO à Rome, le spécialiste doit:

Evaluer globalement d'une façon chiffrée et brève les besoins, les contraintes et l'impact pratique de la mécanisation motorisée ainsi que l'emploi des animaux de travail dans une optique d'utilisation multiple de l'élevage.

Décrire et compter les activités productives recommandées pour la production du riz pour deux modèles:

a) un faisant recours à la mécanisation motorisée;

b) l'autre basée sur l'utilisation des animaux à fin multiples, bien intégrés dans toutes les opérations de la culture du riz et d'autres travaux (transport, propulsion, etc)

Préciser les besoins en formation pour la revitalisation des animaux de travail (traction, bât, transport, propulsion) concernant la conduite et le dressage des animaux, la manufacture artisanale des harnais, la fabrication et réparation des équipements, presse, ramasseur des résidus de récolte, faucheuses d'herbe, etc).

Identifier les espèces animales et le type d'animaux pour chaque activité, et recommander ces harnachements et équipements. Etablir un calendrier à respecter concernant: l'alimentation quotidienne, le travail à fournir et le suivi des réalisations y inclus d'état des animaux. Elaborer un programme pratique pour l'utilisation rationnelle des animaux tout le long de l'année.

Elaborer un schéma de formation et recommander des "messages techniques" de base proposer du matériel de formation (utiliser le manuel modulaire FAO pour la vulgarisation de cette technologie).

Rédiger et présenter en français un rapport technique de la mission suivant la structure requise par la FAO (1. Sommaire, 2. Résumé, 3. Introduction, 4. Réalisations et Conclusions, 5. Recommandations, 6. Annexes). Une disquette contenant ce rapport en WP 5.1 doit être remise aux services techniques de la FAO.

The Mauritanian context

General

The Islamic Republic of Mauritania is a large (one million square kilometres), arid state located to the south-west of the Sahara desert. The Sahara dominates the country, but there is also an Atlantic coast and the Senegal River along the southern border. The population is about two million people, of whom about 20% live in the capital Nouakchott, 20% engage in settled agriculture (mainly in the south) and 10% are nomadic. The population is noted for its geographical and professional mobility, within and outside the country, and external remittances are important. Two main industries are mining (iron and some copper) and fishing. The country is not self-sufficient in food, and it imports about 70% of its cereals.

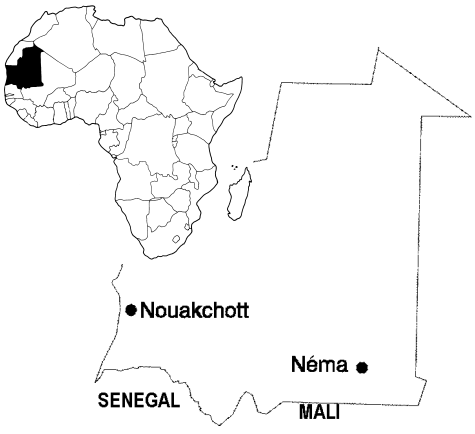
Agricultural zones

There are four broad agricultural zones. The largest zone, comprising the northern half of the country is the very arid Saharan zone. Rainfall is unreliable, and generally less than 100 mm. Agriculture is restricted to oases, where date palms grow and there is some cultivation of vegetables, fruits, and cereals such as wheat and barley.

In the south and central parts of the country, there is the second largest zone where sahelian agro-sylvo-pastoralism is practised. Here nomadic and semi-nomadic livestock keeping is important, with herds of camels, cattle, sheep and goats. The very variable annual rainfall is 100-300 mm and the cattle herds are found mainly in the south of the zone, in the higher rainfall areas. Some cropping is practised, using natural or artificial water harvesting methods. Sorghum and millet are grown in low-lying areas and behind water-conserving bunds. Some vegetables are also grown in the wetter areas and around watering points.

The third much smaller agricultural zone is in the south-east of the country, close to the border with Mali. This area used to receive 300-500 mm of rain, allowing settled habitation and the cultivation of rain-fed sorghum and millet. However, in the past twenty years the average rainfall has been less than 300 mm.

Map 1. Africa, Mauritania, Nouakchott and Néma



Map 2. Mauritania administrative regions
T = Trarza; B = Brakna; A = Assaba
Go = Gorgol; Gu = Guidimaka
HG = Hodh Gharbi; HC = Hodh Chargui

Map 3. Mauritania
Rainfall isohytes in millemetres

Livestock rearing (cattle, sheep and goats) is also important.

The southern zone comprises Mauritania's portion of the Senegal River valley. Here, rainfall of 200-500 mm (up to 600 mm prior to the droughts of the 1970s) allows some cultivation of rain-fed sorghum, millet and groundnuts. However it is the proximity of the river (with its tributaries and derivatives) that is crucial to agriculture as this allows cultivation of rice and other cereals using flood water or irrigation. This is the main crop-producing region of the country and several large-scale irrigation schemes (totalling 14,000 ha) have been established in recent years, with the aim of greatly increasing rice production.

Livestock

The majority of domestic animals are sheep and goats (9 million). Cattle (1.1 million) and camels (1.1 million) are herded and used for milk and meat. A small proportion of the camels are used for riding and pack transport. Donkeys are ubiquitous and used throughout the country (including Nouakchott) for pulling carts, pack transport and some riding. Accurate statistics are not available, but it is estimated by the consultant that there are about 250,000 donkeys in use. A small number of horses (perhaps 25,000) are used for pulling carts and some riding, notably in the towns and villages in the south.

Observations and conclusions

Animal traction in Mauritania

For centuries, animals have been used in Mauritania for riding, pack transport and for raising water from deep wells. The main work animals have been camels and donkeys. There has also been some use of horses for riding and some pastoralists have used cattle for pack transport. With the increasing settlement of nomads, and the advent of heavy trucks for long-distance trans-Saharan trade, the importance of camels has been gradually declining. However camels still play an important transport role for nomads and pastoralists in the Saharan and Sahelian zones.

Animal-drawn carts

Animal-drawn carts were introduced on a small-scale during the colonial period. Since independence in 1960, when there were probably fewer than 1000 carts in use, there have been huge increases in the use of donkey carts and horse carts. One report (Bianquis, 1979) mentioned a figure of just 27 donkey and horse carts, an estimate that was possibly based on formal importations from Senegal in the 1960s and 1970s. It is now estimated by the author that there are over 75,000 donkey carts in use today (a figure based on the estimated donkey population and field observations of donkey cart frequency in urban and rural areas). Some carts are privately imported from Senegal but many others are manufactured in small, local workshops. They are almost all based (more or less) on the Senegalese SISCOMA/SISMAR design, using a metal chassis, flat wooden platform, tapered roller bearings and pneumatic tyres.

The continuing very rapid increase in the use of donkey and horse carts is remarkable and has been largely the result of entrepreneurial activity, and not government intervention. Donkey carts today cost about UM 25,000 - 35,000. Thus it is estimated that at present values, some UM 2000 million (or about US$15 million) has been invested in donkey carts in the past 20 years. The great majority of these carts would have been purchased for cash, since credit facilities for carts have been minimal. This is a huge investment by rural families and urban transporters, and illustrates the capacity of such people to invest in technologies seen to be profitable.

The carts have greatly increased the capacity of donkeys to transport water, forage, agricultural produce, building materials, traded goods, people and urban waste. Donkeys (and to a lesser extent horses) now play extremely important roles in the urban and rural economies of Mauritania, and the present trends suggest a further increase in the ownership and use of donkey carts.

Animal power for crop production

It is generally believed that there was little or no use of animal power for plowing and cultivation in Mauritania prior to the 1960s. However, there were some limited introductions in the late 1950s. For example, farmers in Djiguéni, Hodh Chargui, reported animal power was introduced by the [colonial] authorities in 1958. Also, from the late 1950s onwards, the use of animal power appears to have spread ‘spontaneously’ into the south-east of the country by farmer-to-farmer contact with neighbouring Mali. It was reported that there were 214 Malian plows in use in Hodh Chargui in 1961 (Bianquis, 1979).

Hodh Chargui and Operation charrue

The ‘spontaneous’ adoption was boosted in 1965/66 by ‘Operation charrue’ based at Néma (Hodh Chargui) in the south-east agricultural region. The project was funded by the national development bank. The success of this project, soon after national independence, appears to be well known in Mauritania, and was frequently mentioned by MDRE staff during the present mission.

‘Operation charrue’ was not a typical national project, because the area was greatly influenced by its close links with the population in neighbouring Mali. The people on both sides of the border are very closely related, and at one time in the colonial past, the area had been administered from Bamako. Moreover, the government, aware of the movement of people in the border area, specifically wanted to encourage people to settle on the Mauritanian side.

Although the consultant is unaware of any published report concerning Operation charrue, there appears to be much information available through personal recollections and in MDRE files (which would allow an interesting case history to be produced).

Farmers were provided with credit over a three year period to purchase oxen and plows. Plows came from SISCOMA (Senegal) and Ebra (France). There are also references to Balac, Fonder and Huard plows. In 1965, six hundred CFOOOP plows from Senegal were distributed. In 1966, one hundred and seventy CFOOOP plows, five hundred Ebra plows and one hundred Super Eco seeders were distributed. Spare parts were also stocked for sale, and some assistance was given to blacksmiths to help maintain implements. The support to blacksmiths was apparently abandoned for logistical reasons (Bianquis, 1979).

There were also on-farm trials carried out relating to manure production (parcs fumier), groundnut production, construction of water-retaining dams and the use of seeders and Houe Sine 7 cultivators. Such trials continued into the 1970s.

It is widely acknowledged by MDRE staff and by farmers, that Operation charrue did encourage farmers to settle within Mauritania and did lead to significantly greater food crop production in the target area. Farmers using animal power increased their area under cultivation, producing greater overall quantities of crops. In the short-term this led to some problems, as the local marketing system had not adapted to the larger surpluses.

The initial euphoria that followed the success of Operation charrue died away in the subsequent years of drought. Even after the most serious droughts had passed, the rainfall appears never to have recovered to its previous levels. MDRE figures for the past 20 years suggest an average of less than 300 mm in the south-east (see Map 3), which inevitably restricts the agricultural potential of the area.

Although interest in animal power was maintained by both the farmers and MDRE officials in Hodh Chargui, official support services became minimal. Farmers increasingly relied on Mali for the supply of implements and spares. Nevertheless, the draft animal technology proved highly persistent, and it is now estimated by MDRE staff that the target area (eg, around Djiguéni), the great majority of crop producing farmers use animal power. If they do not own work animals themselves, they borrow or hire them from a neighbour or relative. Estimates of the numbers of oxen employed are not available, but approximately 2000 plows are now in use in Hodh Chargui.

Farmers reported that they train animals at about three years, and work them for up to eight years. Oxen are the main work animals, but bulls are sometimes used (they may be castrated at a later stage). Some farmers use cows. Horses, donkeys and camels have all been used for work in the area, but oxen remain most popular.

Local artisans repair plows and make yokes and plow shares. They can make plows, but are limited by lack of raw materials. Thus farmers generally purchase plows made by blacksmiths in Mali.

Farmers are aware of a range of animal traction implements including cultivators and seeders, but the mouldboard plow is still the main cultivating implement and it remains popular. Farmers sometimes use plows for weeding crops that have been planted using a hand hoe. While farmers would be prepared to evaluate alternative implements (including tines designed to reduce wind erosion), they feel their main problem is obtaining spare parts for existing equipment.

Guidimaka

Guidimaka borders Mali (to the south-east) and the Senegal River (to the south-west). In some respects the south-east of Guidimaka is similar to the south of Hodh Chargui in that rainfall is sufficient for sorghum and millet production and the influence of neighbouring Mali is very strong.

In the late 1970s and early 1980s, there was a programme funded by the British NGO War on Want to introduce animal traction into Guidimaka. About 70 implements (mainly Houes Occidental and 20 Mali-type plows) were sold on credit between 1979 and 1982 (Dufumier, 1983). However, early use of the equipment was disappointing, as farmers preferred to retain traditional direct planting following the early rains. They used tillage only for later plantings. The potential for animal power for weeding and earthing-up (sarclo-binage) of traditionally-planted crops seemed encouraging (Dufumier, 1983).

Despite the equivocal results of the War on Want programme, animal traction appears to have spread in Guidimaka. According to MDRE sources, the part of Guidimaka close to the Mali border (an area which the consultant was unable to visit) is now said to have the highest concentration of animal power in the country. Farmers use work oxen and plows purchased in Mali to cultivate sorghum and millet. There is also some use of horses and donkeys for cultivation. The technology seems to have spread mainly by farmer-to-farmer contacts and visits to Mali. Unlike Hodh Chargui, there do not appear to have been formal animal traction promotion or support programmes provided by MDRE.

Gorgol, Brakna and Trarza

All along the Senegal river, from the east (Gouray) to the west (Rosso and beyond), it is now common for families to own donkeys or horses for transport. As noted, there has been a significant expansion in the ownership of animal-drawn carts in the past twenty years. Increasingly, the transport animals are also being used to pull the implements through the light, sandy soils for the production of rainfed sorghum, millet and some groundnuts.

Horses are stronger and quicker, but much more expensive. Donkeys are more available and affordable. Farmers without access to animals or implements may hire them from neighbours.

The main implement is the Houe occidental, purchased from Senegal and this may be used for primary tillage and/or weeding. Some Super Eco seeders are used for planting, although manual seeding is more common. Some implements in use are built and/or maintained by local blacksmiths.

The use of animal power for crop cultivation along the river is relatively recent (the past 20 years), and seems to have spread mainly through farmer-to-farmer contacts and visits to Senegal. The adoption appears to have been accelerated by the relative shortage of labour in the villages, as young men look for work in towns.

It is difficult to estimate the extent of the use of animals for upland tillage, but it is certainly widespread. For example, in the village of Niabina (near Kaédi, Gorgol) ‘most people’ are now said to weed their millet using horses or donkeys to pull a broad, v-shaped tine. However, in this and other villages, traditional manual seeding is still common.

Rice production systems

Mechanised systems

Along the Senegal river a series of large-scale irrigation schemes totalling about 14,000 ha have been established by SONADER including those at Kaédi, Bogue and Rosso. The largest schemes are found at Rosso. The schemes have the following characteristics in common.

Large-scale initial levelling involves heavy earth-moving equipment (graders). Water is pumped from the Senegal River (or associated water courses) into irrigation canals. Initial land preparation of levelled plots is performed on dry or pre-wetted soil using tractors and disc plows. Secondary cultivation involves tractor-drawn offset disc harrows. Final levelling is performed using hand tools after flooding. Seeding and fertiliser application are by hand in Rosso. Some transplantation of rice takes place around Kaédi (transplanted rice generally has fewer weed problems and higher yields). Herbicides are generally used to aid weed control in fields where rice is seeded. Harvesting is by large-scale combine harvesters, where these are available, and by hand in the absence of combines.

SONADER was involved in the infrastructural development, but now the infrastructure is controlled by the users (cooperatives and large-scale farmers).

The rice schemes have not been as successful as envisaged for a variety of reasons. The very high yields theoretically possible during the long days of the summer/rainy season have not been achieved by the farmers. Farmers contacted suggested their initial yields of up to five tonnes per ha had dropped to nearer two tonnes, due to multiple factors such as weed competition, changing soil conditions, bird losses, irrigation and drainage problems, poor timeliness (waiting for machinery), inappropriate fertiliser use and deteriorating seed quality.

Most farmers only grow one crop per year, as dry season rice crops suffer intense bird damage. This has huge economic effects on the

effective costs of using the land, pumps, tractors and combines as their capital costs have to be recouped over a small amount of time each year.

Problems of mechanisation

Reliable, effective and affordable maintenance facilities for large-scale machinery (tractors and combines) have yet to be firmly established. Initially, SONADER and donor agencies supplied machines and parts direct, effectively by-passing local agents. The market was fragmented by the introduction of many different makes of tractors and combines. While this might have led to healthy competition in a large market, in the small size of the Mauritanian market, it adds considerably to the total capital cost of stocking spare parts.

According to farmers and to AGETA, lack of spare parts is a major problem. Apparently a similar problem now exists in neighbouring Senegal, where the profitability of mechanised rice production was badly affected by the devaluation of the CFA Franc.

The local supply agents claim there is not a problem of spares, arguing they have good stocks and can obtain special spares within one week. They blame tractor and combine owners for failure to undertake routine maintenance, for not tackling problems in good time and for preferring cheap artisanal solutions instead of correct maintenance procedures. While these may be contributing factors, the consultant concludes there clearly is a general problem of spares, but the problem differs with the various types of machine and the various agents.

It appears (from the inevitably superficial investigation possible in this short assignment) that those suppliers most motivated and able to service machines are those agents who themselves have a main farming enterprise that actually produces and hires out services using the machines in question. These have a vested interest in maintaining their own machines, and keeping essential stocks in place. However, no clear consensus has emerged as to the most reliable machines and best parts provision.

There seems little evidence to suggest that private farmers, cooperatives or donor-supported programmes choose new machines on the basis of their local reputations for maintenance and reliability. Cost, availability and other factors seem more important at the time of purchase. Thus the competitive pressures on local agents to perform well seem to be under-developed, to the detriment of all.

While the problem of spares and maintenance is clearly genuine, the consultant is of the opinion that this is mainly a symptom of the more fundamental problem of the lack of profitability of the machinery use. In the same region, long-distance trucks and taxis operate effectively. Their engineering complexity is comparable to that of agricultural machines, but the returns from transport are much greater. Thus transport operators, and their mechanics and supply agents, rapidly overcome the problems of parts and maintenance. It is not simply a question of critical mass (although that is important) for old and unusual vehicles are often kept operating on the road.

The main problem with the large-scale mechanisation appears to be the lack of economic justification. If two crops per year, each of six tonnes per hectare, could be grown, rice might be very profitable and support services could be afforded. In such a case local entrepreneurs would almost certainly ensure that the machinery was available and working.

Costs of large-scale mechanisation

No one contacted by the mission made available reports relating to the economics of rice mechanisation in Mauritania. However, it is understood that an economist from WARDA recently visited Mauritania, as part of a regional study on rice production in irrigation schemes. Thus WARDA might be contacted for further information. Economic studies have also been carried out by ISRA, Senegal and by Projet Arpon, Mali.

In the time available, it was not possible to obtain detailed economic costings of rice production, based on actual or average uses. Tables 1 and 2 are presented to give order of magnitude estimates of the costs involved, based on information supplied, and various usage scenarios. Naturally all the assumptions can be questioned, but the important issue is the overall picture not the specific assumptions.

The capital costs are based on duty-free importation of some current models in use (bigger and smaller options would be available). Work rates are based on reasonable expectation figures quoted by farmers (two hours per hectare for plowing, 30 minutes for harrowing, one hour for harvesting). The harvesting figure may be optimistic, people

Table 1. Illustrative calculations on costs of operating a tractor in Mauritania				
Initial assumptions based on 5-year useful tractor life				
Total tractor life (hours of work)	1250	2500	5000	10000
Effective hours work per year	250	500	1000	2000
Hectares plowed/disked per year	100	200	400	800
Fuel consumed per effective hour (litres)	7	7	7	7
Hours per hectare plowing	2	2	2	2
Hours per hectare harrowing	0.5	0.5	0.5	0.5
New tractor cost (UM)	8000000	8000000	8000000	8000000
Annual cost calculations	*UM '000s*	*UM '000s*	*UM '000s*	*UM '000s*
Annual depreciation				
20% cost per year	1600	1600	1600	1600
Interest				
12% interest on 50% capital	400	400	400	400
Repairs/Maintenance				
25% of initial cost per year	2000	2000	2000	2000
Insurance and security				
3% capital cost per year	240	240	240	240
Fuel				
60 per litre	105	210	420	840
Lubricants				
2% of fuel costs	2	4	8	17
Driver/labour				
150000 per year	150	150	150	150
Total annual cost	**4497**	**4604**	**4818**	**5247**
Effective cost per hectare plowed	*45*	*23*	*12*	*7*

Table 2. Illustrative calculations on costs of operating a combine harvester in Mauritania				
Initial assumptions based on 5-year useful combine life				
Total combine life (hours of work)	500	1000	2000	4000
Effective hours work per year	100	200	400	800
Hectares harvested per year	100	200	400	800
Fuel consumed per effective hour (litres)	12	12	12	12
Effective hours per hectare harvesting	1	1	1	1
New combine cost (UM)	11000000	11000000	11000000	11000000
Annual cost calculations	*UM '000s*	*UM '000s*	*UM '000s*	*UM '000s*
Annual depreciation				
20% cost per year	2200	2200	2200	2200
Interest				
12% interest on 50% capital	660	660	660	660
Repairs/Maintenance				
25% of initial cost per year	2750	2750	2750	2750
Insurance and security				
3% capital cost per year	330	330	330	330
Fuel				
60 per litre	42	84	168	336
Lubricants				
2% of fuel costs	1	2	3	7
Driver/labour				
180000 per year	180	180	180	180
Total annual cost	**6163**	**6206**	**6291**	**6463**
Effective cost per hectare harvested	*62*	*31*	*16*	*8*

suggested five hours a day was a reasonable expectation if nothing went wrong. Fuel consumption figures are nearer international standards than the figures quoted by farmers, which included 20 litres a hectare for plowing, 15 litres a hectare for harrowing and 13 for harvesting. Transport and travel operations, although important, are ignored for the purposes of the calculations. Standard estimates are used for interest, depreciation and maintenance calculations. The interest rate is a favourable agricultural rate. The five year average working life and the 25% of purchase price annually for repairs and maintenance are considered reasonable given the harsh operating conditions and weak supporting infrastructure. While some machines will last longer, others will be non-operational in less time.

Based on the models presented, the existing prices (exclusive of fuel) of UM 4000 for plowing, UM 2500 for harrowing and UM12,000 for harvesting only make sense if the highest machine productivity estimates are used (800 hectares a year each of plowing and harrowing and about 600 hectares of harvesting). These productivity figures do not appear to be met by anyone at present.

For example, the Mpourié farm considers 200-300 hectares per tractor per year to be reasonable and 250 hectares a year for a combine (last year four combines harvested 900 hectares). Other figures confirm about 150-300 hectares is reasonable for a combine, provided it does not have a major breakdown. However major breakdowns appear to be common. The Breun cooperative has one tractor (purchased 1991) and one combine (1992) on 160 hectares. The tractor is not hired out, but the combine is, if it is working. Last year it was not hired out. The high costs and low actual productivity partly explain why reliable contracting services are not available and why farms, cooperatives and commercial enterprises are not renewing their machinery. At present, it appears that the hiring out of large machinery leads to capital depletion rather than capital accumulation. Several local businessmen agreed with this.

Low profitability of tractors and combines

It appears that the real costs of mechanisation are greater than the prices quoted by contractors. This apparent anomaly can be explained by the fact that there are few, if any, specialised contractors whose income depends solely on contracting. Those businesses that are contracting are mainly enterprises who have equipment to ensure the timeliness of their own production: the hiring out is simply a means of obtaining some income (or social prestige) once their own work has finished. One ‘exception that proves the rule’ was an entrepreneur in Kaédi. He had been assisted with credit to buy several tractors for hiring out. Even without allowing for depreciation, he found to his disgust that his gross income was not sufficient to meet his interest payments. He therefore simply defaulted on his loans (with a clear conscience). This is not a particularly surprising or unusual story.

The fact that mechanisation costs are high, does not necessarily mean that mechanisation is unprofitable, particularly if the initial capital costs are ignored. The Breun cooperative farmed 160 hectares last year, with total costs (including loan repayments) of UM 52,000 per hectare. The rice yield was about 2.6 tonnes per hectare, bringing a gross income of about UM 104,000 per hectare. Member farmers therefore made about UM 50,000 a hectare income. This example should be treated with some caution as credit repayments appear quite favourable (UM 1.7 million per annum for their 1992 combine) and the cooperative is very vulnerable to mechanical breakdowns and a range of external factors over which they have little control.

The profitability of rice production is being greatly influenced by low yields. Some people interviewed reported yields down to 1.5–2.0 tonnes per hectare due to lack of (or high cost of) herbicides and declining soil fertility. One businessman investing in farming for the first time reported huge cash losses due to high costs and low income.

The effective availability of large-scale mechanisation is greatest at Rosso, where costs are lowest. This is because Rosso has the best supply routes and infrastructure. Real costs get higher towards the east, and availability decreases. At present there are no working combines based at Kaédi. In theory, these could be supplied for the season from Rosso, travelling via Nouakchott. In practice, as long as there exists an unfulfilled demand in the Rosso area, the economic incentive to send combines to Kaédi will be small. Thus, in the absence of locational subsidies, farmers in Kaédi must expect to pay higher rates for mechanisation services.

Other regional experiences

Most West African countries have some experience of using four-wheel tractors for rice production. There are few (if any) examples of sustained and profitable tractor mechanisation.

The closest example is on the other side of the Senegal River, around Matam, Podor and the Delta. Here tractors have been used for several years, in production systems similar to those employed at Rosso. However recent reports suggest that the Senegalese tractor fleet is not thriving, having been hit by the devaluation of the CFA Franc, declining rice yields and the lack of multiple harvests. Anecdotal evidence for the problems of Senegal may be suggested by the reported lack of tractor spare parts in Senegal.

Tractors have been introduced for rice production in The Gambia and Mali. In neither case is there clear evidence that farmers or entrepreneurs can replace existing tractors from the profits obtained from using tractors for smallholder rice production.

Many rice schemes in West Africa have imported large-scale combine harvesters but there seems little (or no) evidence of their economic sustainability. This is in marked contrast to the case of Vortex threshers that seem to be successful in several countries, notably Mali. Most rice in West Africa is harvested by hand.

Intermediate motorised systems

The tractor and combine systems used in southern Mauritania are all relatively large-scale machines. There exist in the world intermediate systems, including less powerful four-wheel tractors, two-wheel tractors/power tillers and small-scale combine systems. Most originate in south-east Asia, but some smaller machines are produced in Europe and the Americas (these are mainly for peri-urban producers and the golf-course/leisure market).

The use of two-wheel tractors for rice production is spreading in several countries in Asia. Most West African countries have been provided with or have obtained examples of such machines for evaluation. However, as far as the consultant is aware, they have not yet proved adequate or cost-effective under African conditions. The Projet Arpon in Mali has been evaluating some 2-wheel tractors from Thailand, but it is too early to say whether these will prove economically viable.

It appears that under existing technological and economic conditions in African rice production systems, if mechanisation is required and is economically justified, then medium- or large-scale tractors can be technically appropriate. In the circumstances, it is not recommended that Mauritania experiments with intermediate motorised systems at present. However, it should closely monitor progress in other countries in the region (notably Mali), so that it can benefit from any developments in this field. Suggestions are made elsewhere of how relevant information can be gathered through study tours and networking arrangements.

Animal traction for rice production

The case for animal power

According to people contacted during the mission, there are no farmers using animals in rice production schemes around Rosso. There has been no tradition of using oxen in the area. It was generally believed that soils were too hard and areas were too large for animal cultivation. Suitable animals and equipment were not available and animal feed resources in the region were minimal. Moreover, people had been introduced to motorised power for rice farming and would not wish to abandon this in favour of animal power.

The consultant accepts some of these points, and agrees that there is not at present an over-riding case for any large-scale introduction of animal power for rice production. Nevertheless, the subject does warrant investigation.

The use of large-scale mechanisation for rice production by smallholder farmers in Mauritania has yet to be proven sustainable and profitable in the long-term. Many MDRE staff and private entrepreneurs have serious doubts about the long-term viability of motorised systems. However, motorised power sources are still widely used and have not yet been seen to fail conclusively.

For animal traction to appear attractive, the costs of motorisation will have to rise and its availability will have to decrease. This seems inevitable if market forces prevail. When faced with the choice of unavailable or unaffordable tractors and hand cultivation, farmers may well consider animal traction as a preferable option. This has happened in some irrigation schemes in The Gambia, Mali and elsewhere.

Animal power can be used to cultivate rice over very large areas, provided sufficient animals and people are available. However, animal power is most suited to small-scale, family farms of 1-10 ha. If there is an economic imperative, it would not be impossible in the medium term for large-scale farms to switch from tractor production to the use of work animals. (For example, in Cuba, a country with a large number of tractors, the number of work oxen has doubled in the past three years due to changing economic circumstances). However, such economic conditions are not yet apparent in Mauritania, and emphasis in the following sections will be placed on small-scale production systems.

Operations and equipment

There are no fundamental technical problems relating to animal-powered rice cultivation that cannot be overcome by matching the available power sources (animal type and number) with suitable implements and water management systems. The most suitable combination can be found following the local testing of those systems already found effective under comparable conditions elsewhere in the region.

Animal power can be most effectively used for primary tillage (with a mouldboard plow), secondary tillage (harrowing), levelling, bund preparation and transport. These technologies have all been well-proven in West Africa, and their transfer to Mauritania should be straightforward using the methodology proposed.

Animal-drawn multi-row seeders and fertiliser distributors have also been used in Mali (Projet Arpon) but were not adopted in large numbers. It would seem more appropriate to concentrate on transplantation systems of rice production.

Manual and animal-drawn transplanters are available in Asia, but they are generally quite complicated. Some have been evaluated in West Africa, but none has been adopted on a large scale. Before there is any attempt to introduce transplanters into Mauritania, the experiences of other countries should be carefully assessed (see recommendations for study tour).

Unfortunately for Mauritania, animal-drawn rice harvesting equipment is not yet used in West Africa. The power requirement for wheel-driven mowers and threshers is high. Some animal-drawn, motor-powered implements have been developed, but they have yet to prove viable in West Africa. The possibilities of using animal power for harvesting can be further investigated using the methodology proposed, but at this stage no recommendations can be made for the introduction of such technology into Mauritania.

It appears that diesel powered Votex rice threshers have proved successful, and they are being locally assembled in Mali. The implication is that hand harvesting and mechanical threshing may well prove to be viable in Mauritania, and these options should be investigated in collaboration with colleagues in Mali and Senegal.

Animals

Oxen of the local breed are likely to be the most suitable animals in the first instance. Some farmers are already using donkeys for upland cultivation, but donkeys are unlikely to prove strong enough for rice cultivation. Horses are used for pulling carts and might possibly be used (some horses are used for rice production in Indonesia and in The Gambia) but generally bovines are preferred for work in wet conditions.

Cows (females) might well be used by smallholder rice producers in the long term. Under conditions where feed resources are in high demand, maintaining oxen the whole year for a few weeks of work may not be justified and under such circumstances, well-fed cows are highly profitable, producing milk, calves and a modest amount of work. Most animals involved in rice production in Indonesia and Egypt are females. Cows are increasingly used for rice production in Bangladesh. Cows are also used for work by small-scale farmers in Morocco and in parts of Senegal. However, the use of cows is generally a refinement that comes after farmers have been using oxen for work.

In the majority of situations, the most appropriate breed to be used as work oxen are those that most readily available and affordable. The use of local ‘Fulani’ cattle has proved effective elsewhere in the region. At present, local male animals are sold quite young (2-3 years) for meat. These same animals could be sold four years later for double the price (twice the weight of meat) having served as work animals. Farmers might prefer to keep the animals for longer (up to eight years). This reduces the need for re-training of new animals,

but also reduces the potential number of profitable sales of mature work animals.

A major problem for (additional) work animals would be shortage of feed. Food resources for all animals are in short supply, particularly in the dry season. A market already exists for dried forage, including rice straw. This is marketed locally for milk cows, equids and sheep and goats, and is also exported from the region (to Nouakchott and probably to Senegal too).

The infrastructure for rice-production (including land, machines and pumps) is not used during the dry season due (mainly) to the high losses from birds. These resources might be profitably employed for the production of bird-resistant forage crops, that could be marketed through existing channels, to offset the costs of production. Some of the forage could be retained for local animals. Once forage was more readily available, the possibilities for using draft animals (oxen, equids or dual-purpose cows) within the rice production systems would be much greater. High returns might come from dual-purpose food-fodder crops such as groundnuts or cowpeas or other legumes should these prove appropriate to the local conditions.

In the Rosso area, where tractor power is still available and resources to feed animals are in great demand, a major campaign to use animal power is unlikely to be popular. However introducing work oxen for levelling flooded rice fields might prove to be of interest as the operation presently involves manual labour. Oxen are efficient at levelling, the equipment is simple and the basic operation does not require a very high degree of animal training.

Economics of animal power

It is much more difficult to estimate reliably the cost of animal power, than the cost of tractor power. With tractors, most of the costs are external (cost of machinery, spares and fuel) and relatively fixed. Only a small proportion of the costs is local (labour for operations and repairs) and this is generally performed by staff on known wages. With animal power very few costs are external and fixed (the cost of the plow).

In theory, many of the costs relating to animals relate to local labour for operating the equipment and looking after the animals. Such labour is rarely performed by full-time staff on set wages. Most work involves members of the farming families (sometimes children) or labour hired through informal village arrangements. Animals (unlike tractors) have to be maintained every day of the year, but farmers seldom hire labour throughout the year to maintain working animals. Sometimes unpaid family labour is used and sometimes the oxen are grazed with other animals as part of communal herding arrangements.

The feed cost for animals varies enormously. In most countries in Africa, oxen obtain most of their food from rough grazing, which may have a supervision labour cost but not actually a feed cost. It is unusual for oxen to be fed purchased feeds. However, in a rice scheme, with minimal grazing options, it would be expected that some feeds and residues would be fed, and even if they were to come from the farm itself, these would have an opportunity cost (the sale value on the open market). Urban and peri-urban working horses and donkeys do tend to be fed daily rations, and these can be taken as estimates of reasonable daily feed costs for rural animals during their working periods.

The relatively low capital costs relating to animals can be estimated accurately, but oxen these tend to be negative over a four year period (oxen generally appreciate in value in their first four years of work, and can be sold for a profit). Horses and donkeys depreciate, over a working life of about 8-10 years (in Mauritania). However, the main role of horses and donkeys is for year-round transport, and their use for cultivation would almost certainly be a secondary activity. In such circumstances, it is unrealistic to charge full annual capital and maintenance costs to the cultivation. It would be more appropriate to use the marginal costs or a proportion of the annual costs.

As a result of all the local variables, any budget estimates relating to the use of animals tend to be functions of the estimated cost and amount of human labour used. Animal power can appear expensive if year-round paid labour at industrial rates is assumed, and if all the annual costs are charged to the cropping operations. Animal traction appears cheap if family labour with a low opportunity cost is assumed, using animals maintained mainly for transport.

Some illustrative budgets are provided (Table 3), but these should be treated with great caution.

Table 3. Some illustrative calculations on costs of owning and cultivating with animals in Mauritania

Principal crop	Rice	Rice	Sorghum/Millet	Sorghum/Millet	Sorghum/Millet
Farm size (ha)	4	10	3	6	5
Work animals	2 oxen	2 oxen	1 donkey	2 donkeys	1 horse
Initial assumptions					
Purchase cost per animal (UM)	35000	35000	7000	7000	35000
Sale price per animal (UM)	70000	70000	0	0	10000
Animal working years	4	4	7	7	8
Cultivation days per year (own farm)	27	67	15	20	10
Area prepared per day primarly cultivation (ha)	0.3	0.3	0.2	0.3	0.5
Area prepared per day puddling/levelling (ha)	0.3	0.3			
Hectares pepared per year (own farm)	4	10	3	6	5
New plow/cultivator cost (UM)	8000	8000	8000	8000	8000
New harness cost (UM)	1000	1000	2000	4000	2000
Annual equipment cost calculations					
Annual equipment depreciation					
15% cost per year	1200	1200	1200	1200	1200
Annual harness depreciation					
20% cost per year	200	200	400	800	400
Interest on implements and harness					
12% interest on 50% capital	540	540	600	720	600
Repairs/maintenance					
20% of initial cost per year	1800	1800	2000	2400	2000
Annual animal cost calculations					
Animal capital costs					
Oxen appreciated over four years	-17500	-17500			
Donkey/horse: depreciated over seven years			1000	2000	7143
Animal interest costs					
12% interest on 50% capital	4200	4200	840	840	2100
Insurance (risk) and housing					
5% capital cost per year	3500	3500	350	700	1750
Management/veterinary					
UM 4000 per ox/horse	8000	8000	1000	2000	4000
UM 1000 per donkey					
Total annual cost (excluding labour)	1940	1940	7390	10660	19193
Effective cost per hectare plowed	485	194	2463	1777	3839
Labour and animal supplementation costs					
Annual supervision costs					
Equivalent 30 days full-time labour @ UM 500	15000	15000	15000	15000	15000
Labour for plowing					
UM 500 per working day	13333	33333	7500	10000	5000
Feed supplementation/management costs					
UM 50, 75, 200 per work day for ox, donkey, horse	1333	3333	1125	1500	2000
Total annual cost (including paid labour)	31607	53607	31015	37160	41193
Effective cost per hectare plowed	7902	5361	10338	6193	8239
Cost per hectare if same labour at UM 250	4360	2944	6588	4110	6239

Notes

Prices for animals and equipment are based on figures obtained during the mission.

No allowances have been made for the costs and income associated with hiring out of animals

No allowances have been made for the costs and benefits of animal-drawn transport

Foreign exchange issues

Most tractor costs are foreign exchange costs (tractors and fuel), while most animal traction costs are local costs (labour and feed). For every UM 1000 spent on tractor use or hire, almost all is exported from Mauritania. For every UM 1000 spent on the ownership or hire of draft animals, almost all remains within the country and the rural community. Thus even if the financial costs were the same, the sustainability and economic benefits of animal power are likely to be greater.

Hand cultivation systems

Hand cultivation is the default option for rice production, in the absence of animal-powered or motorised systems. Primary land preparation, levelling, planting/transplanting, weeding and harvesting can all be performed by hand. Many systems in West Africa and in Asia depend almost entirely on human energy. Large areas can be prepared in this way, provided adequate labour is available. Hand cultivation can be productive, timely and efficient in terms of land and capital, although efficiency in terms of human labour is lower than animal-powered or motorised systems.

In southern Mauritania, labour availability can be a crucial limiting factor. Land preparation and harvesting are particular labour bottlenecks with rice production. In Mauritania at present, harvesting is the crucial labour constraint for technological reasons (tractors are more available than combines) and economic ones (harvesting, unlike land preparation, follows significant seasonal financial outlay). Several farmers and businesses reported problems with effective harvesting and some have resorted to hiring labour from Senegal for the rice harvest. Farmers hiring labour for rice harvesting, claim it proves expensive as numerous work days (with wage, food and tea) are required for the multiple operations of cutting, transport and threshing.

The present labour problem seems to result largely from the speed and the scale of the recent infrastructural developments. The labour markets, local populations and settlement patterns have not yet had an opportunity to adjust to the labour demands (and rewards) of the large irrigation schemes. If rice production is intrinsically profitable in southern Mauritania, market forces will gradually equilibrate labour supply and demand, with seasonal labour migration being a future possibility.

As noted previously, the introduction of motorised threshers (proved effective elsewhere in the region), might make it easier for farmers to accept the human labour alternative to combine harvesters.

Rainfed and water-catchment farming systems

In the south of the country, by the borders with Senegal and Mali, farmers are generally aware of the potential for using animals for the cultivation of rainfed crops, such as sorghum and millet.

Near the border with Mali, in Hodh Chargui and Guidimaka, work oxen are used to pull plows, often purchased from Mali. The implements are used for plowing and also for weeding. The oxen are often purchased specifically for work. After several years they are sold for a profit.

Near the border with Senegal, in Gorgol, Brakna and Trarza, the use of oxen is rare, or non-existent, but some farmers use horses or donkeys for cultivation. Horses are faster and stronger, and are preferred by those who can afford them. Donkeys are cheaper and more readily available. Houe Occidental cultivators purchased from Senegal are the main implements, but Houe Sine toolbars, V-shares and seeders are used. Horses and donkeys are mainly transport animals, and their use for cultivation is secondary.

Manual seeding using a traditional hoe is still the most common form of crop establishment in the south of Mauritania. It is considered cheap (only a hoe and labour are required) and very flexible (planting can start in any particular field as soon as soil conditions are suitable). In the areas where ox plows are used, some crops are planted behind the plow, while others are seeded direct.

Animal traction technology is currently spreading by farmer-to-farmer contact, and it is likely to continue to do so. Although many farmers have never used work animals for cultivation, few have never heard of it.

There appear to be no major technical reasons why animal traction cannot be used throughout

the south of Mauritania in rainfed farming systems. The constraints are mainly lack of familiarity and lack of readily available implements.

Feed supply

Lack of animal feed could become an economic constraint if animals were used for a great deal of work. It would be economic rather technical because farmers in the region are generally already aware of how to supplement animals used for transport. A market for animal feed for transport animals already exists in the region, involving natural hay, crop residues and grains.

The feeding of transport animals is generally perceived as profitable, even in the short-term. However, the advantages of feeding animals for agricultural operations are generally less clear. Feeding strategies will depend on the perceived benefits of time saved or production increases relative to manual alternatives. If use of animals is considered only marginally beneficial (as appears likely from the relatively slow uptake to date), farmers may be reluctant to invest feed resources on such operations.

For these reasons, no specific recommendations will be made relating to improved work animal feeding at this stage. In any case, any method for improving the nutrition of working animals would not be specific to agricultural operations. Any good and affordable means of improving animal nutrition that becomes known or available is likely to be rapidly adopted throughout the region by transporters and other livestock owners.

Introduction of animal traction

In some areas (such as H'Neikatt and Boudhirwa in Gorgol), animal power might be introduced for cultivation in water-catchment farming systems. Donkeys are likely to be the animals of choice in most circumstances, since they are widely available. The use of oxen might be assessed in villages where cattle are owned. Oxen might be particularly useful for making bunds, although teams of several donkeys could be used for this.

Farmers in H'Neikatt thought their soils might be too hard or stony for cultivation by animals, but such problems could be resolved by an appropriate combination of animals and implements.

The most suitable method for identifying the most appropriate combination of implements and animals is likely to be allowing farmers to test a range of options. It is recommended that the PSSA Coordinator discuss some of the possibilities with ISRA and SISMAR (Senegal) and DRSPR/IER (Mali). The most likely options are Houe Occidental or single tine for one or two donkeys, or one horse. For making bunds a mouldboard plow pulled by two or four donkeys, one horse or two oxen is recommended.

Farmers in Hodh Chargui expressed interest in evaluating ridgers. However, the experience of DRSPR (Mali) and ISRA (Senegal) should be reviewed prior to purchasing ridgers for testing.

As far as possible, the systems used in areas of introduction should be those already employed by farmers in the region. These have already proved to be acceptable to farmers. For the work of single donkeys or horses, simple breast band harnesses can be used (see annex). For two donkeys, an evener system should be used. If four donkeys are used, it is probably best to harness them as two pairs in tandem. For oxen, the yoking system employed in Hodh Chargui appears appropriate.

Technical problems, extension, training and research

Harnessing

There is no evidence that the existing designs of harnessing systems (breast bands for equids, withers yoke for oxen) represent a constraint to the use of animal power in Mauritania. Such systems are widely used elsewhere in the region and the world. While it is arguable that some better systems are available (notably collars for equids which tend to be efficient but expensive), switching to these is not a priority.

Although the general systems appear effective, some individual samples were seen to be inefficient or even cruel due to poor fabrication, maintenance or fitting. It is possible that greater overall benefits could come from ensuring that existing systems are in good condition and fit well (a gradual programme of education), than changing the systems.

In particular, a number of donkey carts cause unnecessary suffering to the animals. The position of the saddle and the way it is fixed to the shafts means that the cart sometimes touches the back of the donkey, causing wounds. Without altering the length of the shafts, this could be prevented by moving the saddle further back on the animal or by adjusting the position of the shaft attachments. This is primarily a topic of education and the donkey-users interviewed had not recognised the problem, or were unaware of a solution.

Extension and training

At present there is no national institution training extension workers. The Ecole Nationale de Formation et de Vulgarisation Agricole (ENFVA) in Kaédi is carrying out a survey of present training needs and priorities, and will develop its new programme based on the planning exercise.

The extension workers contacted all felt that additional knowledge relating to animal traction would be useful. This should include knowledge of different animal traction options (obtained through books and study tours). It should also build on the indigenous knowledge already existing in the country (eg, knowledge in Hodh Chargui and Guidimaka).

It is probably too early to arrange special in-service training relating to animal power at present. However documents and manuals can be obtained and distributed to raise awareness.

It is envisaged that for at least one year, a small number of extensionists will be involved with on-farm testing of rice production implements and rain-fed tillage implements. The proposed study tour will provide these people with direct (for the participants) and indirect (for non-participants) training opportunities. Further knowledge will come from working with the farmers.

Following at least one season of testing, the knowledge obtained from the investigations could be shared through a small workshop. At this stage, options for more widespread extension and training can be discussed. By that stage the small team of extensionists working with draft animals will be experienced and confident and able to share their knowledge with others.

Training manuals

When extension workers were trained, animal traction was included as a minor topic. Work animals (oxen, horses and donkeys) were not normally maintained at ENFVA, and any practical lessons were restricted to identification of implements and their adjustment. Neither text books nor training manuals relating to animal power were available to the students. Dictated lessons notes have been based on the CEEMAT manuals (1971, 1974). Staff of ENFVA were generally unaware that several French-language publications relating to animal traction are available. A list of some of these is provided in the annexes.

The useful FAO modular training manual on animal traction is not yet known in Mauritania (the consultant left one English-language copy with the PSSA coordinator). This manual was prepared in English and neither French nor Arabic editions have yet been produced.

To make the manual more appropriate to the needs of Mauritania (and other countries in West Africa) modules relating to the use of animal power for rice production could usefully be included.

Research

At present there is no research being carried out relating to animal power in Mauritania. However, it is clear that there are important questions to be answered concerning the

present and future roles of work animals for rice production, soil tillage and transport.

There appears no immediate need for fundamental or on-station research in this area. What is required is a farming systems approach to animal traction, with diagnostic discussions with farmers, followed (if indicated) by adaptive, on-farm testing of various options. Such a methodology, combined with international networking has been proposed here.

The existing research organisations (CNRADA and DRFV) were contacted during the mission. They expressed interest in the subject but acknowledged they did not have specific expertise in this field at present. Nevertheless it is assumed these organisations will be actively involved in the planning and implementation of the proposed investigations relating to animal traction in Mauritania. Further possible research studies are likely to arise from the initial diagnostic surveys and on-farm trials.

Recommendations

Rice production systems

Assessment of regional experiences

Mauritania does not have the human or economic resources to justify a major programme of research relating to the role of work animals (or mechanised rice production). Rather Mauritania should build on the experiences of neighbouring countries, adapting well-proven technologies to local conditions. This will require greater knowledge of experiences in nearby countries, obtained through a 'networking' approach.

Probably the quickest and most efficient means of obtaining information would be through rapid (1-3 week) study tours to neighbouring countries. These would involve visits to relevant organisations (governmental and non-governmental) concerned with extension, research and training, as well as to farmers using the technologies in question.

Study tour: rice production systems

It is recommended that a rapid study tour be undertaken to rice-production schemes and on-farm research organisations in the region. The main ones would be those in Mali (Projet Arpon, Segou and IER/DRSPR), Senegal (ISRA, SAED and Projects at Matam, Ile à Morphil, Podor) and The Gambia (Jahaly Pacharr).

Projet Arpon appears to be the most interesting, with much experience relating to both animal power (many thousand work oxen) and motorised operations. Appropriate contacts can be made through the appropriate government channels and/or FAO. Some additional contacts relating to The Netherland's technical assistance are provided in the Annex. A two- or three-week schedule for the study tour would be realistic.

The small group of persons (5-6 people willing to travel in one vehicle) should be selected. This should include the PSSA Coordinator and one or more suitable interested and influential farmers from the rice-production cooperatives supported by PSSA. In addition, (space permitting) there should be people from MDRE and/or SONADER who would be directly involved in planning and implementing a suitable follow-up programme. If possible, one of the farmers selected for the tour should be actually interested in using work oxen for levelling (and/or plowing) and who would be willing to grow forage crops.

If it is practicable, it would also be desirable if people who might be involved in follow-up research (on-farm testing) and training could be included. These might be relevant staff of CNRADA, DRFV and ENFVA.

The study group should try to acquire (or order) examples of the most interesting technologies seen. These could then be evaluated in Mauritania.

Regional workshop

It is recommended that FAO Rome and FAO Mauritania explore the options for a West African regional workshop to exchange information about and to critically review the use of animal power in rice production systems. It is not suggested that Mauritania host such a workshop, but that it expresses interest in participating in, and possibly partly co-funding, such a workshop. Such a workshop would probably be held in Senegal or Mali.

Participants would be drawn from many countries in the region including (in descending order of importance to Mauritania) Mauritania, Senegal, Mali, The Gambia, Niger, Guinea, Guinea Bissau, Sierra Leone and Côte d'Ivoire.

The rice production workshop might be organised in collaboration with the West Africa Animal Traction Network and WARDA. Workshop planners might consider the option of a multi-site workshop and/or an over-land study tour.

Technical and/or financial inputs for such a workshop could be solicited from a number of national, regional and international agencies. It is recommended that among those that should be contacted at an early stage should be the aid programme of The Netherlands (DGIS), in order to request technical inputs from IMAG-DLO. IMAG-DLO has much valuable experience relating to animal power and mechanisation in West Africa and it is likely to be able to provide useful advice to PSSA. It is understood that the DGIS adviser concerned

with Mauritania is based in the Royal Netherlands Embassy in Senegal and is very familiar with Projet Arpon (Mali) that has received technical advice from IMAG-DLO. Some contact names and addresses are provided in the annexes.

Large-scale mechanisation

It is not recommended that the PSSA becomes involved in large-scale mechanisation in Mauritania. If mechanisation is to work, the greatest need is for a sustainable, private-sector support system for the machinery. Further short-term measures to supply equipment and/or spares by direct importations are likely to be counter-productive in the long-term. They will simply compound the present problem of unsustainable development of mechanised agriculture.

Thus any interventions relating to mechanised agriculture that are planned by MDRE (and associated donor agencies) should be implemented by established, local private sector businesses, following competitive tendering procedures. This is particularly important with regard to any importations of equipment and spares and the associated maintenance contracts.

Use of animal power for rice cultivation

It is recommended that a simple farmer-based programme be started to investigate the potential for using work animals for rice production. This could be implemented within the context of the PSSA, in cooperation with interested bodies (eg, DRFV, CNRADA, SONADER).

In the first instance, selected interested farmers might be asked to try the use of oxen for levelling flooded rice fields. If it is required, nearby expertise in such programmes exists just across the river in Senegal, where Projet FED, based in Podor, investigated various systems for using oxen and trained numerous oxen around 1990.

The project should assist with training and supply of a suitable harrow or leveller, but if possible the animals and the labour should be supplied by the farmers. Examples of possible harrows and levellers are provided in the annexes, but the final decision should be made after the proposed study tour to Projet Arpon in Mali.

Once work oxen are trained and in use, the project could suggest farmer-trials using a mouldboard plow for primary land preparation following irrigation. The land management system to be adopted should be determined following the proposed visits to rice schemes in neighbouring countries (notably Projet FED and Projet Arpon). It is likely that emphasis will be placed on using animals for the cultivation of transplanted rice.

Forage production

At present, the low levels of feed resources during the dry season would constitute a limiting factor to the widespread use of animals for rice production in southern Mauritania. This problem is also faced in neighbouring countries.

The PSSA, in collaboration with other interested bodies (eg, DRFV, SONADER, CNRADA) should initiate investigations into the potential for forage crops to be grown in rotation with rice. This could be as a ‘catch crop’ (using residual moisture), such as *Macroptilium atropurpureum* (Afrique Agriculture, 1995). Alternatively it could be an irrigated dual purpose food-forage crop (eg, cowpeas, or groundnuts). Given that a proven market already exists for forage, a single-purpose irrigated forage crop might be possible.

The first activity would be to review the experiences in Senegal, The Gambia and Mali during the proposed study tour. If this suggests dry-season forage production is likely to be feasible, simple farmer-managed on-farm trials of various options should be initiated.

Assessment of tillage systems

Horses and donkeys are already used to a certain extent in Mauritania for tillage for rainfed crops. The use of both types of animals is likely to increase in the coming years. In such circumstances there are two main approaches that might allow the technology to evolve and spread: farmer evaluation of technologies and farmer-to-farmer technology transfer.

Following discussions with interested farmers, selected farmers should be invited to test different implements that have proven popular in other countries. Such implements should not be actively promoted, but offered as alternative options. Small quantities of implements could be obtained to be lent to farmers. Following a monitored season of use, the farmers would be expected to release the equipment. At this stage

it will be extremely obvious how useful the implements are perceived to be, and farmers may well try to purchase favoured implements.

In areas of Gorgol (such as H'Neikatt and Boudhirwa) where farmers do not currently use animals for tillage, transfer of knowledge can be encouraged through farmer-to-farmer visits. Farmers can be taken to nearby areas to see animals in use. If considered necessary a farmer from the village visited could then go to assist in the initial trials. The process would be organised and monitored by the extension service. This farmer-to-farmer approach is likely to be more effective than a formal training-and-visit extension system.

These processes may well lead to the identification of suitable implements and techniques. In such circumstances, assistance may be needed to help establish reliable and sustainable supplies of implements. This should involve local traders/businesses and/or local artisans.

During the proposed regional study tour of rice production systems, the PSSA Coordinator should endeavour to obtain relevant information concerning rainfed tillage systems. Discussions should be held with ISRA and SISMAR (Senegal) and DRSPR/IER in Mali. Where practicable, examples of suitable implements should be acquired or ordered for evaluation in Mauritania. Implements to be assessed are likely to include the Houe occidental and Houe Sine from Senegal and the locally produced toolbar with tines from Mali.

Donkey workshop

The PSSA Coordinator, or a suitable colleague, should consider participating in a workshop on donkey utilisation due to be held in Ethiopia in early May 1997. At this workshop, several donkey-drawn tillage implements will be demonstrated and discussed, including plows, tillage tines and weeders. These are likely to include donkey-drawn implements developed in Zimbabwe, Niger and Burkina Faso. There will be much opportunity to discuss the potential suitability of such implements for Mauritania. The most appropriate implements can be acquired following this workshop, in time for the 1997 rains. The workshop will be held under the auspices of the Animal Traction Network for Eastern and Southern Africa and further information will be provided by the consultant.

Extension and training manuals

It is recommended that PSSA and/or FAO Mauritania obtain copies of some of the French language extension and training manuals listed in the annex. If possible copies should be available in the libraries of ENFVA, CNRADA, MDRE and FAO.

It is recommended to FAO Rome that a French language edition of the modular FAO 'Draught animal power manual' be produced. If resources allow, Arabic versions of some modules could also be produced.

It is recommended to FAO Rome that modules be prepared for the FAO 'Draught animal power manual' that cover the use of animal power for rice production. This would be valuable to many countries, including Mauritania and most of West Africa. The proposed West African regional workshop on the use of animal power for rice production could provide a useful forum for clearly defining the contents of such modules and/or for critically reviewing prepared draft modules.

Annexes

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Mission itinerary

Mardi 25 juin 1996

Voyage Reading-London-Amsterdam -Casablanca-Nouakchott

Mercredi 26 juin 1996

Rencontres Nouakchott (FAO, PSSA, DRAP-MDRE)

Jeudi 27 juin 1996

Rencontres Nouakchott (DRFV-MDRE, DRAP-MDRE)

Vendredi 28 juin 1996

Observations de traction asine, Nouakchott
Revue des documents, Nouakchott

Samedi 29 juin 1996

Voyage Nouakchott - Kaedi

Dimanche 30 juin 1996

Rencontres Kaedi (Délégation MDRE, SONADER, ENFVA)
Voyage Kaedi - H'Neikat
Réunions avec agriculteurs

Lundi 1er juillet

Visites de terrain, H'Neikat
Voyage H'Neikat- Kaedi
Rencontres Kaedi (CNRADA)
Voyage Kaedi - Rosso

Mardi 2 juillet 1996

Rencontres Rosso (SONADER, AGETA, fournisseurs)
Visites de terrain et discussions avec agriculteurs, Trarza

Mercredi 3 juillet 1996

Visites de terrain, Trarza
Rencontres Rosso (MDRE)
Voyage Rosso - Nouakchott

Jeudi 4 juillet 1996

Nouakchott: travail PSSA/FAO

Vendredi 5 juillet 1996

Nouakchott: travail PSSA/FAO

Samedi 6 juillet 1996

Nouakchott: travail PSSA/FAO

Dimanche 7 juillet 1996

Nouakchott: travail PSSA/FAO

Lundi 8 juillet 1996

Voyage Nouakchott - Timbédra

Mardi 9 juillet 1996

Voyage Timbédra - Néma
Rencontres Néma (MDRE)
Voyage Néma - Djiguéni
Visites de terrain
Voyage Néma - Timbédra

Mercredi 10 juillet 1996

Voyage Timbédra - Néma
Rencontres Néma (MDRE)
Voyage Néma - Kiffa

Jeudi 11 juillet 1996

Rencontres Kiffa: Projet Assaba
Voyage Kiffa - Nouakchott

Vendredi 12 juillet 1996

Nouakchott: travail PSSA/FAO

Samedi 13 juillet 1996

Nouakchott: travail PSSA/FAO

Dimanche 14 juillet 1996

Voyage Nouakchott - Rome

Lundi 15 juillet 1996

Réunions FAO Rome

Mardi 16 juillet 1996

Réunions FAO Rome

References and bibliography

Afrique Agriculture, 1995. Quel avenir pour les rizicultures au sud du Sahara. Afrique Agriculture: 229: 41-52

Arrif A and Pascon P, 1985. Exhaure à traction animale: essai de transfert technologique approprié en Mauritanie. Direction du Développement, Institut Agronomique et Vétérinaire Hassan II, Rabat, Morocco. 68p.

Ashburner J and Starkey P, 1994. Draught animal power manual. Food and Agriculture Organization, Rome, Italy. 240p.

Bianquis A, 1979. La culture attelée. Ecole Nationale de Formation et de Vulgarisation Agricole, Kaedi, Mauritania. 40p.

Dufumier M, 1983. La culture attelée dans le Guidimaka. War on Want, London, UK.12p.

Mallet M, Dufumier M et Reynaud C, 1983. Compte-rendu de l'expose de MM Dufumier et Reynaud sur le War on Want dans le Guidimakha, Mautitanien, Groupe de recherche et de réalisations pour le développement rural dans le tiers monde (GRDR), Aubervilliers, France. 14p.

Lemine M M O M, 1996. Fiche technique: Culture attelée. Departement de l'Elevage, Delegation Regional du Hodh Chargui, Ministère du Développement Rural et de l'Environnement, Mauritania. 8p.

Some French-language animal traction manuals

CARDER-Borgou, 1984. Mémento de culture attelée. CARDER-Borgou, Parakou, Bénin. 108p.

CEEMAT, 1971. Manuel de la culture avec traction animale: techniques rurales en Afrique. Centre d'Etudes et d'Expérimentation du Machinisme Agricole Tropical (CEEMAT) et Ministère de la Coopération, Paris, France. 336p.

CEEMAT, 1974. Aide-mémoire du moniteur de culture attelée. Centre d'Etudes et d'Expérimentation du Machinisme Agricole Tropical (CEEMAT) et Ministère de la Coopération, Paris, France. 147p. (texte) and 50p. (schémas).

CMDT, 1990. Mémento techniques culturales à l'usage des agents d'encadrement agricole. Division de Recherches sur les Systèmes de Production Rurale (DRSPR) et Compagnie Malienne pour le Développement des Textiles (CMDT), Ministère de l'Agriculture, Bamako, Mali. 125p.

Dineur B, Morières G et Canard P, 1976. Guide pratique de la culture attelée au Bénin. Projet BEN 72.015, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. 84p.

Duchenne T, 1984. Le point sur les harnais pour la traction animale. Dossier No. 5. Groupe de recherches et d'échanges technologiques (GRET), Paris, France. 132p.

FAO, undated (c. 1982). Les bovines utilisés en Haute-Volta pour la traction animale: présentation des bovines de trait; le choix des bovines de trait; le dressage des boeufs. Projet FAO/UPV/17. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. 40p.

FAO, undated (c. 1982). Les bovins de trait: logement et alimentation; hygiène, soins et maladies. Projet FAO/UPV/17. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. 48p.

FAO, 1983. Le matériel aratoire: la charrue et son entretien; la houe et son entretien; le butteur et son entretien; le travail du forgeron. (Booklet and film strip). Food and Agriculture Organization of the United Nations (FAO), Rome, Italy. 64p.

Gautier D and Dagba E F, 1992. Introduction à la culture attelée. Manuel de culture attelée. Tome 1. Projet amélioration de la culture attelée et promotion de l'artisanat rural (FAO projet BEN 84/007), Boko, Benin. 23p.

Gautier D and Dagba E F, 1992. Les animaux de trait. Manuel de culture attelée–;Tome 2. Projet amélioration de la culture attelée et promotion de l'artisanat rural (FAO projet BEN 84/007), Boko, Benin. 68p.

Gautier D and Dagba E F, 1992. Les techniques culturales à la culture attelée. Manuel de culture attelée. Tome 3. Projet amélioration de la culture attelée et promotion de l'artisanat rural (FAO projet BEN 84/007), Boko, Benin. 56p.

Gautier D and Dagba E F, 1992. Le matériel de culture attelée, son reglage et son entretien. Manuel de culture attelée. Tome 4. Projet amélioration de la culture attelée et promotion de l'artisanat rural (FAO projet BEN 84/007), Boko, Benin. 58p.

Gautier D and Dagba E F, 1992. Culture attelée et protection de l'environnent. Manuel de culture attelée. Tome 5. Projet amélioration de la culture attelée et promotion de l'artisanat rural (FAO projet BEN 84/007), Boko, Benin. 62p.

Inades, 1983. Gros élevage et culture attelée. Agripromo 41. Inades-Formation, Abidjan, Côte d'Ivoire. 24p.

Inades, 1985. La culture attelée. Cours d'apprentissage agricole, Inades-Formation, Abidjan, Côte d'Ivoire. 60p.

Mignolet B and Lecca M, 1986. Sélection et dressage des bovins de trait. Fiche Technique No 1, Ministère de l'Agriculture, Niamey, Niger. 18p.

Mignolet B, Lecca M, Ashburner J and Romero G, 1987. Utilisation du matériel de culture attelée. Fiche technique No. 3, Projet Recherche, Formation et Production pour l'Utilisation de Matériel Agricole en Zone Sahélienne, Tahoua, Niger. 23p.

Mungroop, R. R. 1989. Dressage des jeunes bovins en culture attelée: guide pratique d'un stage de 21 jours. Institut d'Economie Rurale, Bamako, Mali, Compagnie Malienne pour le Développement des Textiles, Bamako, Mali et Institut Royal des Tropiques (KIT), Amsterdam, The Netherlands. 62p. (plus 47 minute video).

PROPTA, 1991. Guide pratique de la traction animale. Projet pour la promotion de traction animale (PROPTA), Atakpamé, Togo. 167p.

Sambou P, 1981. Dressage des boeufs pour la culture attelée. Environnement et Développement du Tiers-Monde (ENDA), Dakar, Sénégal. 15p.

Sodefitex, 1987. Le livret du vulgarisateur. Société de Développement des Fibres Textiles (SODEFITEX), Ministère du Développement Rural, Dakar, Sénégal. 42p.

Starkey P, 1994. Systèmes d'attelage et matériels à traction animale. Vieweg for German Appropriate Technology Exchange, GTZ, Eschborn, Germany. 278p.

Zweier K, 1986. Manuel des agriculteurs en culture attelée dans la province de Nord-Oust Cameroun. German Appropriate Technology Exchange (GATE), Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Eschborn, Germany. 124p.

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