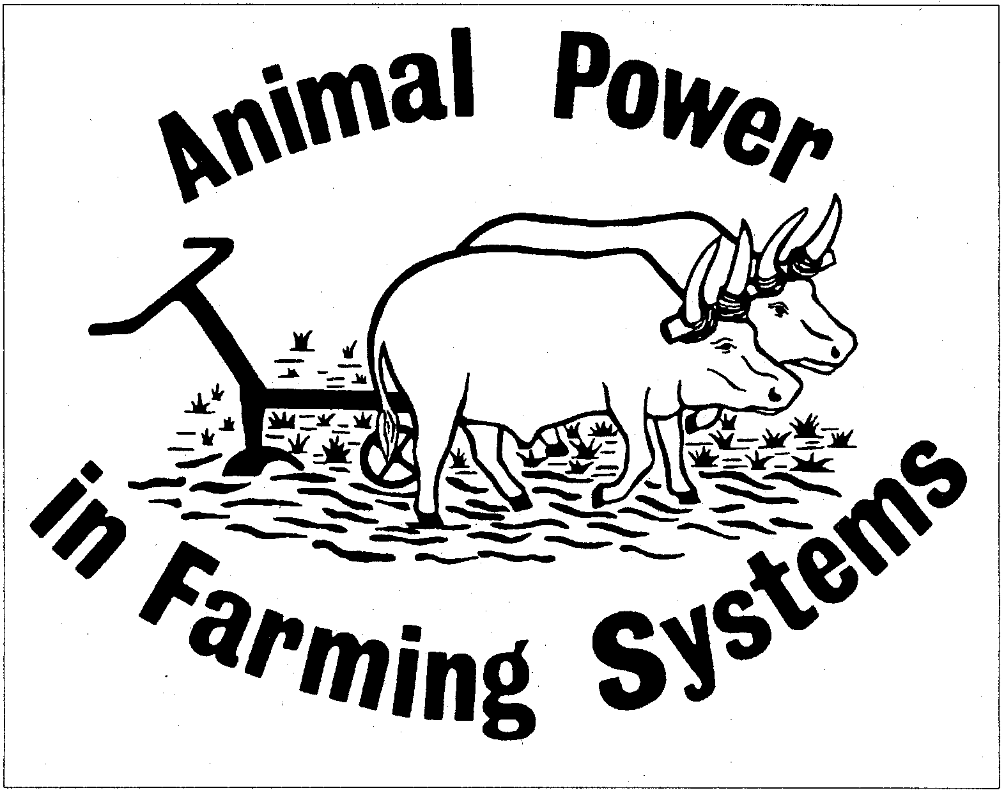
# Part 2




**Papers prepared for the Networkshop**

*Title photograph (opposite)*
*Donkey cart and boy, Senegal*
*(Photo: Paul Starkey)*

# The Potential for Animal Power in West Africa

# Farming systems in West Africa from an animal traction perspective

*Keynote address*

*by*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## Introduction

In this address I intend to first of all describe what is generally accepted as Farming Systems Research and Extension (FSR/E) or Research with a Farming Systems Perspective (RFSP). Secondly, I will attempt to spell out the conditions under which animal traction as a technological innovation could be expected to fit into farming systems in West Africa, given the agro-ecological and socio-economic variability of the region. Next I discuss the chances of successfully introducing animal traction on a large scale into farming systems in West Africa. Finally I will briefly highlight some practical problems relating to on-farm studies incorporating animal traction.

## Research with a farming systems perspective

The literature on farming systems research is quite voluminous. A vast array of terms and terminology has developed and each writer or speaker on the subject seems to coin a new term! But the general principles and activities in FSR are relatively few. Plucknett, Dillon and Vallaeys (1986) have in my opinion adequately described the objectives that farming systems research should aim to meet as follows:-

- To understand the physical and socio-economic environment within which agricultural production takes place.
- To gain an understanding of the farmer in terms of his or her skills, constraints, preferences, and aspirations.
- To comprehend and evaluate existing important farming systems, in particular the practice and performance of these systems.
- To enhance the capacity of research organizations to conduct research on priority problems.
- To conduct research on new or improved practices or principles and to evaluate these for possible testing on farms.
- To evaluate new or improved systems, or system components, on farms in major production areas under normal farm conditions.
- To assist the extension, monitor the adoption, and assess the benefits of improved farming systems.

It is now generally agreed that the above objectives could be met within the context of three interlinked multidisciplinary activity areas referred to as base data analysis (BDA), research station studies (RSS), and on-farm studies (OFS) (Plucknett *et al.*, 1986). BDA involves the collection, collation and analysis of data on the many factors characterizing the environment and farming systems of a region, with particular emphasis on the constraints facing farmers. RSS involve a focused research programme aimed at the development of components for the improvement of existing systems or for the putting together of new systems. OFS involve studies of existing systems, on-farm experimentation, studies of technology adoption, and assessment of the impact of new technology - all in relation to the farm household. It should be emphasized that research with a farming systems perspective is not only limited to OFS. It is an interactive process starting and ending on farm, but including on-station (component and farming systems) research.

I would also like to stress that although the name farming systems research might be relatively new, the concept or approach is not new in agricultural research. E.T. York provided an example of such a program conducted by North Carolina University in the 1950's although it was not so named. The agricultural anthropology of de Schippe in the 1950's was a classic example of farming systems analysis although it did not involve on-farm tests, while the "Paysannats" in Belgian Congo incorporated a sort of on-farm testing of new farming systems by the Institut National pour l'Etude Agronomique du Congo Belge (INEAC) (Fresco, 1984).

**Table 1. Francophone and Anglophone approaches to FSR**

| | Francophone R-D | Anglophone FSR |
|---|---|---|
| **1. Objectives** | | |
| . explicit mention of national policy | xxx | x |
| . generation of technologies relevant to small farmers | x | xxx |
| . ex-post analysis of technology adoption results | xx | x |
| **2. Problem diagnosis** | | |
| . interdisciplinary | xxx | xxx |
| . emphasis on hypothesis formulation | xxx | x |
| . holistic approach | xx(x) | xx(x) |
| . time perspective | long-term, several seasons | short-term, rapid appraisals |
| **3. Target group categorization** | | |
| . farm enterprise as a unit of analysis | xxx | xx |
| . socio-economic criteria for categorization | xx | xxx |
| . geographical and physical criteria for categorization | xxx | x |
| **4. On-farm experiments** | | |
| . farmer participation | x | x |
| . size of trial plots | entire fields | part of farmer's field |
| **5. Types of interventions** | | |
| . dissemination of technology | xxx | xx |
| . spatial reorganization of agricultural production | xxx | (x) |
| . organization of delivery systems | xxx | xx |
| . scale | area/subregion | pilot |
| **6. Institutional context** | | |
| . close ties with/integrated in IARCs | x | xx(x) |
| . linkages with extension services | xxx | x |
| . links with (rural) development programmes | xxx | x |

*Note:* x = *degree of emphasis*
*Source: Fresco (1984)*

Much has been written about the differences between the Francophone approach (Recherche-Développement) and the Anglophone approach to FSR/E. As is shown in Table 1, the similarities are much more than the differences, which appear to be one of scale and time frame (Fresco, 1984). This group should not spend any time discussing methodological differences. It is sufficient to accept the broad objectives of FSR/E, which are common to most programmes in order to proceed with an examination of the introduction, intensification and diversification of the use of animal power in West African farming systems.

## Animal traction as a technological innovation

Farmer adoption of a technological innovation will depend on the degree to which the innovation reduces the unit costs of inputs used in the production process (Binswanger, 1986). Since unit costs depend on input levels per unit of output as well as on input prices, economic as well as agroclimatic and soil factors are important in assessing the potential for farmers' adoption of any technological innovation in a farming system.

If we define animal traction as the use of livestock (cattle, horses, donkeys and camels) as a source of power for transportation, field cultivation and processing, its effect on any farming system in terms of input savings per unit of output would be to save labour as crop area per unit of labour increases. Yield-increasing effects of mechanization are negligible (Pingali, Bigot and Binswanger, 1987), and therefore area required per unit of output is usually unaffected. This means that the savings achieved in labour input per unit of output must be more than offset by the extra livestock and equipment cost. Thus, the higher the wage rates in an area (cost of labour), the greater the potential benefits from animal traction.

Given the considerations above we can begin to examine the agro-ecological conditions and farming systems in which we could expect animal traction to be attractive at the farm level in West Africa.

Participants at the Togo networkshop on "Animal traction in a farming systems perspective" considered four factors as important in developing a typology of animal traction in West Africa, namely, agroclimatic zone, livestock traditions, project influence and socio-economic resource levels. Using these factors and following Ruttenberg (1980) we could classify farming systems in West Africa into two broad categories, namely, natural fallow systems in which the land is left fallow for many years after a short period of cultivation, and permanent cultivation systems in which the soil is cultivated nearly every year and the proportion of area under cultivation in relation to total area available for arable farming is more than 66%. Natural fallow systems could be subdivided into forest, bush, savanna and grass fallow systems.

The distribution of the four natural fallow systems follow broad agroclimatic zones with grass fallows predominating in the Sahel zone, savanna fallows in the savanna, and bush and forest fallows in the forest zones of West Africa. Where population densities are high permanent cultivation systems such as intensive cultivation of valley bottoms and use of manure and other crop residues on uplands become important in all agro-ecological zones.

We can distinguish three levels of animal traction use, namely, use of livestock as pack animals, use in pulling carts, and use in field cultivation and post-harvest operations. The appropriateness of each level of animal traction for each type of farming system is discussed in the next section in relationship to the theme of the networkshop.

## Introduction, intensification and diversification of animal traction into farming systems in West Africa

As already pointed out, animal traction must have the potential of reducing unit costs of production in a farming system into which it is being introduced if it is to have much chance of success. This means that the saving in labour cost must be greater than the cost of the animals and equipment. Consequently the lower the capital and operational costs of the animals and equipment, and the higher the wage rates in an area, the greater the chances of successfully introducing animal traction.

**Table 2.**
**Prospects for introducing animal traction**

| | Level of Animal Traction | | |
|---|---|---|---|
| Farming System | Pack | Cart | Field work |
| Permanent Cultivation | xxx | xx | xx |
| Forest Fallow | x | - | - |
| Bush Fallow | xx | - | - |
| Savanna Fallow | xxx | xx | x |
| Grass Fallow | xxx | xx | x |

Notes:
- No chance
x Poor chance
xx Average chance
xxx Good chance

There will be of course variations within the broad categories of farming systems in terms of unit costs of animal traction. The many factors that will affect these costs will be discussed during this networkshop and could only be precisely determined under actual farm conditions during on-farm tests. These include the actual labour supply in households, availability of adapted animals, household capital and credit, as well as availability of key services such as equipment supply and repair, animal health, training, extension, and research (Starkey, 1986).

For purposes of introducing the discussions I have provided in Table 2 my evaluation of the *a priori* chances of introducing the three levels of animal traction into farming systems in West Africa. Considering that it is in permanent cultivation systems that wage rates are likely to be highest and operational costs of field cultivation are likely to be lowest because, for example, stumps have been removed over the years, it is in these systems that animal traction is likely to have the highest chances of being adopted by farmers. There is hardly any chance of adoption of animal traction for field cultivation in forest and bush fallow systems where the land is cropped for one or two years, stumps are left to encourage fallow regrowth and wage rates are likely to be quite low. There are only slightly higher chances of adoption in the savanna and grass fallow systems because resident populations are already familiar with livestock, and the sparse vegetation cover makes operational costs reasonably low.

Use of animals as pack animals has the highest chance of success in all farming systems since investment costs would be lowest as only an animal needs to be purchased and maintained.

In summary, I believe that the use of animal traction in field cultivation on a large scale should only be contemplated where permanent cultivation systems currently exist, i.e. where land is fallowed a maximum of one year in three. Use of pack animals may be considered in the other systems, particularly the savanna and grass fallow systems.

Consideration of issues relating to intensification and diversification is only relevant in farming systems in which animal traction is already utilized, i.e. in permanent cultivation or savanna and grass fallow systems. It would mean for example using pack animals for field cultivation or using oxen for weeding or post-harvest operations where they are already being used for plowing.

As is the case for introduction into farming systems, intensification and diversification of animal traction use are not expected to increase yield or quality of produce. Consequently the rate of increase will depend, as with introductions, on their unit cost reduction effect. The lower therefore the cost of the change, the higher the prospects of its adoption by farmers. In this regard we can expect diversification into the use of animals in weeding, where they are already used in plowing, to be the easiest to extend. Movement from use as pack animals to use of carts or plows would be more difficult as that would entail greater increases in capital cost and operational costs, e.g. training animals to plow or increased nutritional requirements, etc.

## On-farm tests of animal traction technology

As indicated earlier it is through on-farm tests that the unit cost effect of animal traction in farming systems can be measured. On-farm tests could be researcher-managed, jointly managed by researchers and farmers or completely farmer-managed. Researcher-managed trials are useful in examining the performance of a new technology under environmental conditions that are different from those of the experiment station, but it is in farmer-managed or jointly managed trials that the socio-economic effects of technological innovation are best evaluated.

Assuming that all the necessary base data analysis has taken place and it has been decided that some level of animal traction is likely to be a profitable innovation in the farming system, there would remain a number of practical issues to be addressed in the design and implementation of the tests. The steps to be followed in designing alternative production systems were discussed by Zanstra (1986) at the First West Africa Animal Traction Networkshop.

It is well recognized that there is a long learning process involved in the proper use of animal traction, particularly for people unfamiliar with large ruminants. Even for people familiar with livestock the process may take four to seven years (Jeager and Sanders, 1985). The dilemma that arises relates to whether long-term farmer training should precede on-farm tests, or whether animal traction should be provided on a custom basis to farmers, thus reducing on-farm test to a measurement of labour-saving effects without observation of the farmer management effect, a potentially important bottleneck for adoption of animal traction.

Furthermore tillage may have important long-run effects on the physical and chemical properties of soils, particularly in the more humid environments. Such effects usually only become evident after three or more years of tillage even in permanent cultivation systems. Long-term monitoring of soil degradation and the measurement of the cost of soil fertility maintenance must therefore be included in the on-farm trials.

Also, as indicated earlier, the most important effect of animal traction is on the quantity and distribution (seasonality) of labour use. But labour is probably the most difficult input to measure accurately in West African conditions. This is due to the great variability in the type of labour used in terms of age and sex, and the multiplicity of contractual arrangements (family versus hired labour, daily wage or piecework, payments in cash and in kind, etc.).

The net effect of all the above factors is that on-farm trials with animal traction could be expensive, complicated and must be long-term in nature. This explains why such trials have tended to take on more of an extension or demonstration rather than a research focus in the past. But we must resist the temptation to go into widespread demonstrations before we have verified and established the economic viability of the technological innovation. This workshop will provide participants with the opportunity to examine many of the practical problems related to on-farm tests of animal traction.

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