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Research Article

Agro-economic importance of the use of draught animals in rice cultivation: Case of the say hydro-agricultural management

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Abstract

The aim was to assess the agro-economic impact of animal traction on rice farms in the commune of Say. A questionnaire was administered individually to 100 randomly selected farmers. The study showed that the majority of respondents were married men (88%). Among these respondents, some farmers worked solely with cattle (72%), others who used both cattle and donkeys (25%) and those who worked exclusively with donkeys (3%). The most common way of using these animals is to pull them in pairs for cattle (99%), while for donkeys, single traction is the most common (89.29%). Cattle are used for ploughing, harrowing and transport, while donkeys are only used for transport in this area. The study revealed that animals are used in cultivation operations during two seasons: the rainy season (51%) and after the rainy season (41%), which correspond to the two (2) rice-growing seasons. From an agronomic point of view, animal traction is an asset for farms and has an overall satisfactory impact on soil quality by facilitating tillage, crop maintenance and improved yields. On the economic level, the provision of external services, the transport of people and goods constitute a source of income for operators who own draft animals. However, this practice faces some constraints that condition it such as the risk of disease, the lack of financial means, the lack of pastoral spaces and the driving of animals to pasture.

1. Introduction

The use of animal energy is a very old technology in the world [1, 2]. Despite the enormous technological changes of the last century, in agriculture as in other economic fields, its use is still very important in many agrarian societies [3]. The current situation of this technique is very diverse: the use of animals for energy in agricultural production systems has been abandoned in industrialised countries, but it is still used in some developing countries [4], such as Niger. Among the major irrigated perimeters of West Africa, the Office of Niger (ON) is one of the references where animal traction plays a key role in land development, being one of the main factors that can explain the profitability of family farms [5]. A large proportion of farmers use cattle for soil preparation and donkeys for transport.

However, the effectiveness of their use depends on the attention that producers, craftsmen, advisers and support and research services are willing and able to pay to this capital. The introduction of animals for

work is an important form of the association between Agriculture and Livestock.

It generally results in a new combination of human and animal labour, and a significant reduction in the drudgery of manual labour (i.e. human labour). This often justifies the use of animal labor [3]. Overall, the productivity of human labour can be greatly improved.

One of the major concerns of most developing countries is to combat famine, unemployment, disease and so on. This can only be achieved through harmonious development of the rural environment, including the agricultural sector, which is a fundamental pillar of rural development [6]. Niger is no exception to this rule. This sector plays an important role in the socio-economic sphere through job creation and food security. It employs more than 80% of the working population. Improving the performance of this sector could be the key to solving the problems of famine and poverty [7]. However, it is currently very difficult to imagine a developed agricultural sector without equipment [8], and the adoption of animal traction today continues to give rise to debate due to several materials, economic and sociological factors [6,9]. To help alleviate this problem, it is essential to know the contribution of animals to agricultural and economic activities. The main aim of this study is to assess the agro-economic impacts of animal traction on rice farms.

2. Materials and methods

2.1. Presentation of the study area

2.1.1. Geographical location of the commune of Say

The present work was carried out at the level of the Hydro-agricultural development of Say Urban Municipality (SUM). This Commune Urbain is one of three (3) communes in the department of Say in the Tillabery region. It covers an area of 673 km², representing 10.35% of the total area of the department of Say. This administrative entity, the SUM (Fig. 1), is located between longitude 5°50' and 6°00' East and latitude 14°40' and 14°50' North.

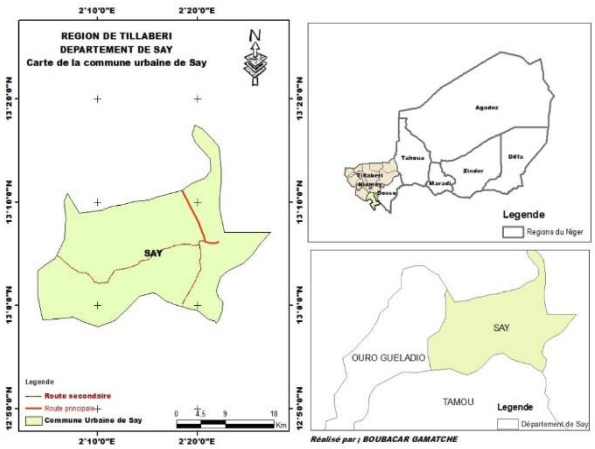

Figure 1. Administrative map of Say urban municipality

2.1.2. Climate

The physical environment of this locality is characterized by a Sahelo-Sudanian climate. The north has a Sahelo-Sudanian climate with rainfall of around 450 to 600 mm/year. The south has a Sudanian climate with rainfall of up to 800mm. The temperature has a maximum and a minimum, the maximum being in April and May with a temperature of over 40°C and the minimum being between December and January with a temperature of 20°C.

2.1.3. Soil

There are three main types of soil: (i) Tropical ferruginous soils with little or no leaching, commonly known as low-fertility dune soils; (ii) Leached ferruginous soils of little agricultural interest; (iii) Hydro-morphic soils, commonly known as lowland and basin soils, which are relatively fertile and located along the River Niger.

2.1.4. Vegetation and fauna

The main components of this vegetation are generally: a discontinuous tree and shrub layer dominated by the following species: *Acacia Sp, Balanites aegyptiaca, Bossia senegalensis, Acacia Senegal, Guiera Senegalensis, Piliostigma reticulatum, Bauhinia rufescens, Combretum micranthum, Acacia albida.* These species are often irreversibly degraded.

Two herbaceous carpets overgrazed and dominated by annual species such as *Cenchrus biflorus, Pollidapen nisetum, Eragrostis tremula, Schoenefel diagracilis, Alysicarpuso volifolius, Zornia glochidiata, Cyperus rotundus, Cacia mimosoïdes, Ceratotheca sesamoïches*, etc. This carpet is heavily colonised by *Sida cordifolia.*

2.1.5. Hydrography

In terms of water resources, a distinction must be made between surface water and groundwater. In terms of surface water, the urban district of Say has access to the River Niger, which is almost 25 km long. The river has just one tributary in the commune, the Goroubi. There are also four (4) ponds, including a permanent one (Tokeye). These surface water

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resources are used for market gardening, animal watering and sometimes for human consumption. The commune of Say is part of the Liptako-Gourma formation, a crystalline basement that only contains water-bearing layers in its altered parts. As a result, it has very little groundwater.

2.2. Equipment

In order to carry out this work, it is necessary to use: (i) Human resources, i.e. the producers of the rice farms; (ii) Technical equipment; (iii) A survey sheet; (iv) Computer equipment: for data processing and analysis.

2.3. Methods

2.3.1. Data collection

2.3.1.1 Sampling

To collect the data, the method consisted firstly of sampling. The sample was composed of one hundred (100) producers chosen at random from among the operators (men and women) who own at least one draught animal (cattle or donkey).

2.3.1.2 Survey

This operation consisted of administering a questionnaire to each farmer who agreed to collaborate. They were interviewed in their rice fields during working hours and in their homes very early in the morning early in the morning before they left and, in the evening when they got off work.

2.3.2. Statistical analysis.

The data collected in this study was entered into Excel and then subjected to statistical analysis. The following software packages were used in this study. These were: SPSS 20 for the analysis and statistical processing of survey results. It was used to determine the number and percentage of producers with a particular answer for each question and to calculate the averages of certain results. The formula used to calculate the percentage is $\boldsymbol{p} = \frac{\boldsymbol{n}}{\boldsymbol{N}}$ X 100 with p: the proportion, N: the number of respondents and the section concerned.

3. Results

3.1. Socio-professional characteristics of respondents

3.1.1. Age of respondents

The ages of the respondents ranged from 15 to 68 years. Of the farmers surveyed, 46% were aged between 31 and 45.30% between 45 and 68 years and 24% between 15 and 30 years (Fig. 2). The average age

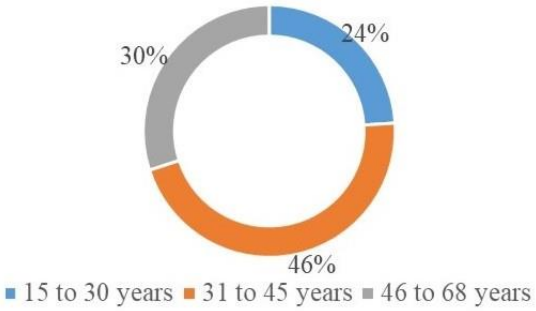

Figure 2. Age of respondents

of the sample was 39.88. These results suggest that older people are more active in using animal power for rice-growing activities.

3.1.2. Socio-professional status of the farmers surveyed

Analysis of these results confirms that the majority of those who practice rice growing in general and Animal Traction (AT) in particular are men, with a much higher proportion (95%) than women (5%) (Table 1).

Table 1. Situation of farmers surveyed

Survey Parameters	Status	Sample size	Frequency (%)
Gender	Male	100	95
	Female		5
Marital statu	Mariried		88
	Single		10
	Divorced		1
	Widowed		1
Profession	Farmer		74
	Retired		3
	Student		5
	Fonctionnaire		
	Civil servant		4
	Trader		2
	Marabout		11
	Bricklayer 1		1
Level of education	Primary		38
	Secondary		16
	Higher		2
	Koranic		16
	Uneducated		38

In terms of marital status, more than half (88%) of respondents are married, compared with 10% who are single and 1% who are divorced or widowed (Table 1). As for the occupation of the respondents, the majority of those interested in AT in the context of rice-growing activities have agriculture as their main occupation (74%). However, other people, such as civil servants (4%), students (5%), pensioners (3%), marabouts (11%), shopkeepers (2%) and bricklayers (1%), find it

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Table 2. Use and reasons for not using donkey cattle faeces as fertilizer rice fields

Use and reasons	Answers	Sample size	Percentage (%)
Use of cattle faces for fertilization yes	Yes	100	48
	No		52
Use of donkey faces for fertilization	Yes		17
	No		83
Reasons for not using cattle faces	reserved for millet fields		56
	favors the development of weeds		28
	Rice diseases		18
reasons for not using donkey faeces	not very fertile		46
	reserved for mile fields		41
	Favors the development of weeds		8
	Rice diseases		5

interesting and use it to carry out their activities (Table 1).

The study revealed that most (100%) of the farmers surveyed had had the opportunity to study. Only 28% had not been able to get an education. However, of those who had, 38% had primary education, 16% secondary education, 2% higher education and 16% had attended Koranic school (Table 1).

3.1.3 Use of animal traction

Animal species used for traction in rice-growing activities. The proportions of farmers using only cattle or donkeys for traction and those using both are shown in Fig. 3. Based on the survey, we found that 72% of rice farmers use cattle exclusively, 25% use both species and 3% use donkeys only. Based on these results, we can say that almost all rice farmers use cattle for traction.

3.1.4 Mode of acquisition of draught animals

Animals are acquired by purchase (80%), but some are inherited (16%) and donated (4%) (Fig. 4). Consequently, at the commune level, an analysis of the relative importance of the methods of acquisition allows us to deduce that the purchase of animals is the most common method of acquisition.

3.1.5 Reasons for choosing cattle and donkeys as draught animals

The reasons given by farmers for choosing cattle as draught animals were ease of handling (41%), speed of work (23%), ability to work in wetlands (18%), easy tracking (11%) and affordability (7%) (Fig. 5a). With regard to the choice of donkeys for pulling, the reason most given was that they were easy to follow (50%). Other reasons, such as the lower price, were cited by 36% of respondents and the endurance of the donkeys

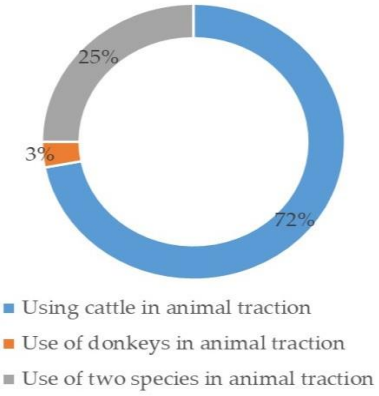

Figure 3. Different species used and frequency of use

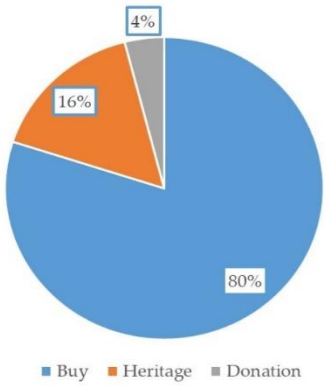

Figure 4. Method of acquiring draught animals

in carrying out the work by 14% of respondents (Fig. 5b).

3.1.6 Impact of animal traction on soil fertility

3.1.6.1 Contribution of draught animals to organic manure production

Table 2 shows the different proportions of farmers using organic matter from animals and those not using it, as well as the reasons why they have stayed away from its use. The table shows that most of these rice growers do not use cattle manure to fertilize their

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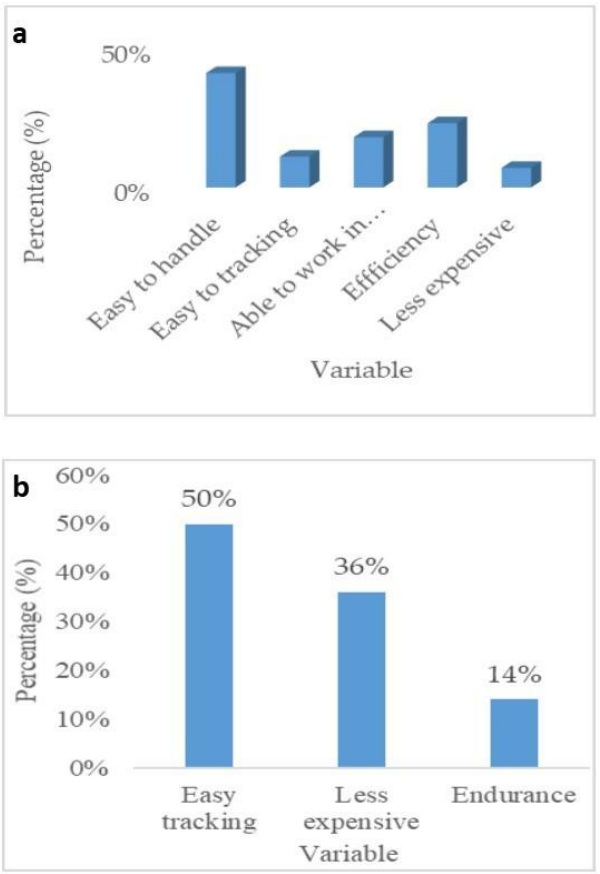

Figure 5. Reasons for using cattle (a) and donkeys (b) as draught animals

rice fields (52%), but the proportion who do use it is not negligible (48%). As far as donkey manure is concerned, only 17% of rice farmers say they use it to fertilize their rice fields, while 83% express resistance for reasons that we will outline below.

The reasons given by farmers for not using organic matter from cattle are that it is reserved for fertilizing their millet fields (56%), while 28% say that it encourages the development of weeds and 18% mention rice diseases.

As for the donkeys' organic matter, 48% underestimated its fertility, while 41% said that they used it to fertilize their millet fields, 8% said that it favored the development of weed infestations and 5% mentioned rice diseases as a reason for not using it.

3.1.6.2 Contribution of animal traction to agro-economic activities

According to the various points of view of our cattle-owning respondents, the contribution of this technology to agro-economic activities revolves around ploughing and harrowing (59%) and the transport of people and agricultural produce (41%). As for donkey traction, 100% of our respondents working with this technology confirm that it can only be used for transporting people and agricultural produce, as it is not suited to ploughing wet clay soils (Fig. 6).

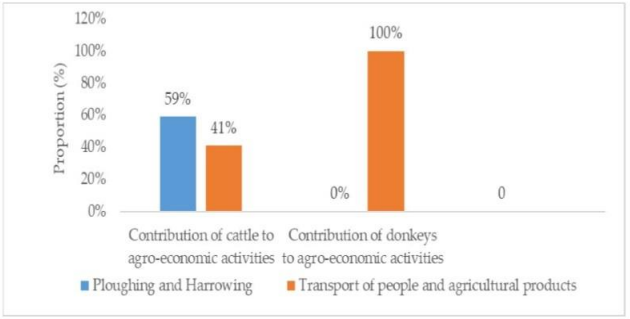

Figure 6. Contribution of animal traction to agro-economic activities

According to rice farmers working with cattle, the area that can be cultivated with a pair of oxen during a rice-growing season varies from 0.5 to a maximum of 15 hectares (Table 3). In this respect, 65% of respondents ploughed between 0.5 and 5.5 ha during a season, while 24% managed to plough between 6 and 9 ha per season and 11% between 10 and 15 hectares (ha), with an average area of 5.34 ha per season.

Table 3. Area cultivated with a pair of oxen during a rice-growing season and time taken to plough a hectare

Area cultivated with a pair of oxen in hectares	Percentage (%)
0.5 à 5.5	65
6 à 9	24
10 à 15	11
5.34	
Ploughing time per hectare with a pair of oxen in days	
1	6
2	16
3	18
4	52
5	5
6	4

The time taken to plough a hectare varies from 1 to 6 days if farmers use oxen as draught animals. More than half of rice farmers (52%) take four (4) days to plough a hectare, 18% take three (3) days to plough a hectare, 16% manage to plough a hectare in two (2) days, 5% take up to five (5) days to plough a hectare and 6% take only one (1) day to plough a hectare. The

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average time taken to plough a hectare is 3.5 days.

3.1.6.3 Impact of animal traction on soil quality

With regard to the effects of animal-drawn cultivation on soil quality, the perception of the respondents only took into account the favorable effects in terms of facilitating tillage (58%), facilitating crop maintenance (25%) and improving yields (17%). The negative effects were practically negligible (Fig. 7).

Table 4. Different prices for ploughing and harrowing half a hectare (0.5 ha)

Price of ploughing 0.5 ha in US dollar	Parentage (%)
24.94	56
20.78	25
26.6	5
10.63	4
19.95	2
15.79	2
12.47	2
11.64	1
21.61	1
28.66	1
29.93	1
Average price for ploughing 0.5 ha 20.78	
Price of harrowing 0.5ha in US dollar	
11.64	5
9.98	4
8.31	59
7.48	5
6.65	3
5.82	4
4.99	6
4.16	14

Average price for harrowing 0.5 ha 7.38 US dollar

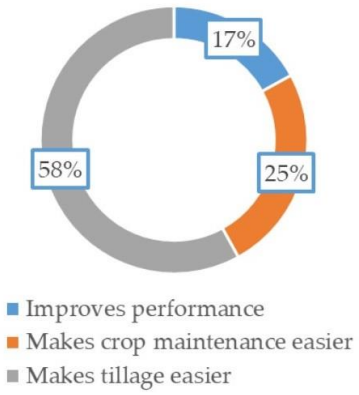

Figure 7. Impact of animal traction on soil fertility

3.1.6.4 Contribution of animal traction to income generation

According to the perceptions of our respondents, the external services related to rice-growing activities are, on the one hand, ploughing and harrowing and, on the other hand, the transport of rice-growing products such as sacks of rice and straw, which is considered a source of fodder for draught animals.

Table 5 shows the different prices for these services. As far as ploughing is concerned, prices range from 15.79 to 29.93 US dollar maximum, with an average price of 20.78 US dollar. Most farmers plough for 24.94 US dollar (56%), 25% for 20.78 US dollar, 5% for 26.6 US dollar and 4% for 1.66 US dollar per half hectare (0.5 ha). However, the proportion of those who plough at 12.47, 19.95, and 15.79 US dollar is the same (2%) and those who plough at 21.61, 28.26 and 29.93 US dollar represent 1% of respondents each.

Table 5. Constraints to traction

Factors limiting traction with oxen	N	Percentage (%)
Cost of livestock	100	16
Grazing management		14
Disease		12
Lack of financial means		21
Lack of space for grazing		37
Grazing management	100	6
Disease		36
Lack of financial means		23
Cannot work in damp conditions		6
Lack of space for grazing		29

Prices for harrowing half a hectare (0.5 ha) vary from 2,500 to 12.47 US dollar maximum, with an average price of 7.38. The largest proportion (59%) of the rice farmers surveyed set the price at 8,31 US dollar, 14% set it at 2500, 6% set it at 4.16 US dollar, 5% set it at 12.47 and 74.81 US dollar respectively, two proportions (4%) set it at 9.98 and 5.82 US dollar respectively, and 3% set it at 6.65 US dollar.

3.1.7. Constraints to the use of animal traction

The main constraints hindering animal traction (Table 5) among our cattle-owning respondents are mainly due to the lack of space for grazing the animals (37%), followed by others such as the lack of financial means (21%), the cost of acquiring animals (16%), the grazing of the animals (14%), and diseases that appear from time to time (12%). As for farmers using donkeys as draught animals, they complain about constraints linked to disease, with a proportion of 36%, which is not very far from those relating to the lack of space for

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grazing (29%). These were followed by constraints such as lack of financial resources (23%), grazing behavior (6%) and working in wetlands (6%).

4. Discussion

4.1 Social and occupational characteristics of farmers

The age of the farmers varies from 15 to 68 years, with an average of 39.88 years. The average age of the heads of farmers in the Amenagement Hydro-Agricole de la commune urbain de Say is slightly higher than the 38.7 years obtained in Benin by Amadou [10] and lower than the 41 years obtained in Burkina Faso by Tapsoba [6] and the 48 years obtained in the Central African Republic by Mbetid-Bessane [11]. Analysis of the age distribution shows that the sample includes a significant proportion of older rice farmers. According to Tapsoba, older farmers are more effective because of their experience, as reported by Amadou in 2018. This study revealed that more than half of rice growers are educated (72%). This literacy rate is higher than the 21% literacy rate reported by Mbetid-Bessane [11] in the Central African Republic.

4.2 Use of animal traction

The first use of harnessed oxen for agricultural work (ploughs) or transport in what is now the Middle East, in the 'fertile crescent', dates back to the 4th millennium BC; the use of cattle for work did not occur at the same time as the domestication of this species, which dates back to the 8th millennium.

In the case of equids, some recent studies seem to indicate that horses were domesticated more recently than cattle, and that they were very quickly used as pack animals or mounts, before being harnessed to different types of tillage and transport implements. The use of animal power was therefore a logical extension of the agrarian revolution of the Neolithic period [1, 2, 12, 13].

In Africa, a large proportion of agricultural energy is still manual (human energy), which leaves a great deal of scope for progress in the use of animal energy. Although this technique is very old, it also presents research and development with major new challenges, given the changing global economic context.

In French-speaking sub-Saharan Africa, animal power has been used since time immemorial for backpacking and digging. Animal-drawn cultivation first appeared at the end of the 19th century. It has undergone vigorous development since the 1950s, driven by projects to develop export crops such as cotton and groundnuts. In 2000, there were an estimated 1.4 million draught animals and 2 million units of agricultural equipment in French-speaking sub-Saharan Africa [14].

In the savannahs of Central Africa, the real boom in animal traction began in the 1950s with the introduction of cotton growing. From the outset, the development of animal-drawn mechanisation was geared towards ploughing with a pair of oxen because the cotton plant, with its taproot, makes good use of this type of cultivation method, but also because of the presence of a locally available herd of cattle [15].

Most of the farmers surveyed use cattle power, with donkeys coming in second place. Similar results were obtained by Batamoussi and colleagues in 2015 [16] and Amadou in 2018 [10] in Banikoara. According to Havard [17], in Mali, Burkina Faso and Niger, cattle traction is predominant, followed by donkey traction and horse traction.

According to a study carried out by Vall [18], family farms are small, generally between 2 and 5 ha, which leads to the use of a donkey team for small farms and a pair of oxen or more for large farms. These results are similar to those obtained in our study in the commune of Say, where the average area cultivated with a pair of oxen is 5.34 ha. In this study, depending on the type of farming, almost all users of cattle as draught animals practised bi-bovine traction (use of cattle in pairs), whereas donkey users farmed with one, two or even three donkeys. This result is close to that of Havard [17] quoted by Tapsoba [6], where he stated that the use of cattle in pairs has been disseminated by development projects and programs for over 40 years.

The cart and plough are the most commonly used animal-drawn implements in the commune of Say. This observation was made by Havard [16] in French-speaking sub-Saharan Africa. The results obtained in this study are slightly higher than those of this author, who reported that 33% of agricultural equipment was ploughs and 31% carts. It can be said that the non-use of other equipment such as seed drills indicates either a relatively low technological level of animal traction in the area, or the predominantly traditional nature of

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agriculture, or possible specific difficulties linked to the acquisition of this equipment. Further investigations should be carried out to identify the technical and commercial characteristics best suited to seed drills or other equipment that are still unknown to rice growers.

4.3 Contribution of animals to agro-economic activities

Ploughing and harrowing are the cultivation operations for which bovine traction is most widely used. On the other hand, transport is the operation most commonly carried out with donkey traction, as donkeys are not suited to ploughing in the wet conditions revealed by this study [2].

These results show that cattle are used for ploughing and crop maintenance, while donkeys, which are not widely used, are used for transport. According to Fielding [18], donkeys are used in dry areas for a variety of services: riding, pack animals, drainage and water transport. He also states that this use for traction is not specifically intended for cultivation operations but rather for other purposes such as the transport of materials, equipment or goods; which is in line with the level of contribution of donkeys to cultivation operations in this study. It can be deduced from this that the impact of animal traction on soil quality is perceived as being globally satisfactory, facilitating the increase in surface area, crop maintenance and tillage [19]. According to Pingali et al [20], reported by Amadou [10] a World Bank study showed that the introduction of animal traction on farms in Sub-Saharan Africa resulted in an increase in labour productivity, but not in land productivity. The rice farmers surveyed stated that they used organic matter from animals to fertilize their rice fields, but cattle were used much more than donkeys. Vall et al [21] stated that among agro-breeders in Burkina Faso, the organic manure produced covers only a small part of the farm's needs. More advanced research into the comparative analysis of manures based on donkey and cattle faeces would be desirable [2].

4.4 Contribution of animal traction to income generation

The proportion of farmers using animal traction for outdoor services unrelated to cultivation operations is higher than that not using it for these services. However, the use of donkeys for services such as ploughing and harrowing in rice fields is practically non-existent throughout the commune. In addition to animal-drawn cultivation, animal traction fulfils a number of economic functions (saving on feet, sources of income, etc.) and social functions ("prestige of the ploughman"), and is involved in crop management depending on the type of production system envisaged. Taking into account the trends observed in the sample, we can deduce that whether or not external services related to transport are carried out cannot be considered to be independent of the type of animal used for traction. A similar study made the same observation for cotton farms [14].

The main advantage of using animals for farm work is most often the increase in human labor productivity. This is fairly well recognized and demonstrated in the literature, but the results vary and are sometimes the subject of debate when it comes to the real efficiency of this technology. Similarly, when it comes to improving productivity per unit area, the results vary widely depending on the environment and the conditions in which users master the technique [22]. However, there is no doubt that animal traction, if used properly, can make a major contribution in a number of ways: (i) Soil-working efficiency: ploughing, ridging and weeding, for example, can be carried out more efficiently by animal-drawn cultivation than by hand, with a harness suited to the implement used and the objective sought; (ii) Speed: the work is done much more quickly, which is sometimes a major agronomic advantage, to take advantage of the first rains, for example, or to reduce the speed of weeds at the start of the growing season. The productivity of human labour is improved through the use of draught animals, which allows for greater efficiency and quality of work (ploughing, ridging, for example), greater speed of intervention (sowing) and better 'output' (draught transport, for example). In general, farmers are very sensitive to improvements in human labor productivity. They are not always looking first to improve the productivity of the land, but rather to relieve their suffering and increase the "output" of their work. Draught animals can contribute to this. However, animal-drawn cultivation often helps to improve crop yields, which also depend on many other factors (crop varieties, animal/mineral manure, etc.). The same applies to the contribution made by animals to transport (various

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materials, crops, water, wood) and the movement of people; they improve efficiency and speed while considerably reducing the arduousness of these operations [23].

4.5 Constraints to the use of animal traction

The main constraints on the use of animal traction are the grazing of animals, the risk of disease [24-26], the limited space available for grazing, the lack of financial resources, the high cost of acquiring animals and other constraints. The first constraint is a major concern for farmers in that it seems to impose either a certain level of always being behind the animal or a risk of insecurity for it in a grazing situation.

According to Starkey and Faye [27], in Senegal some farmers considered that feeding their animals was a constraint, and expressed the desire to obtain information on how to improve the dietary balance of their animals, while others stated that the difficulties encountered in obtaining equipment and spare parts for animal traction represented a major constraint. In Togo, Azouma [28], states that the multiplication of areas thanks to the use of animal traction has led to a significant increase in the volume of work, the large-scale destruction of trees and shrubs and the reduction or elimination of fallow land, which confirms the finding made in this study that where animal pastoral areas are insignificant.

This confirms the observation made in this study that animal grazing areas are insignificant. Whatever the animal species, the main constraints to traction are disease, the lack of grazing space and the grazing of animals. In Togo, Azouma [28], states that the multiplication of areas thanks to the use of animal traction has led to a significant increase in the volume of work, the large-scale destruction of trees and shrubs and the reduction or elimination of fallow, which confirms the finding made in this study that where animals graze areas are insignificant. Whatever the animal species, the main constraints to traction are disease, lack of grazing space and the grazing of animals.

5. Conclusions

Based on our data processing and observations it could be concluded that animal power is used with a number of species (donkeys and cattle), the most widely used of which is the bovine. The many social and economic advantages that this practice offers farmers in the Commune of Say provide an opportunity to promote this technology. Animal traction services (tillage, transport, etc.) often provide additional income for farmers who own harnesses. It also makes it easier to market farm produce. The choice of cattle or donkeys is based on determinism and a precise rational approach on the part of the farmers, despite the constraints linked to disease, the lack of grazing areas and the driving of these animals. From an agronomic point of view, animal traction is an asset for rice-growing farms and has an overall satisfactory impact on soil quality by facilitating crop maintenance, tillage and improving yields. However, the adverse effects (erosion, soil impoverishment ....) of animal traction on the soil may be due to poor use of agricultural equipment and soil type.

Authors' contributions

Designed and planned the study, H.A.; Collected the data, M.A.D., S.S.H. and H.A.; Wrote the first draft of the manuscript, H.A.; Performed the statistical analysis. H.A.; S.S.H. and H.M.

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Availability of data and materials

All data will be made available on request according to the journal policy

Conflicts of interest

The authors declare that they have no competing interests.

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