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Research Article

Role of animal traction in agricultural development in Zalingei area, Darfur-Sudan

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Abstract
This study was conducted to assess the role of animal traction technology in agricultural development in Zalingei area, West Darfur. Tractors have small contribution as a source of power in this area duo to small farm size, lack of technical knowledge and the high costs of its purchase and use. The technology was introduced as a main component of Jebel Marra Rural development Project (JMRDP). To meet the objectives of this study a field survey was conducted to collect basic data on farmers' perception towards the spread and performance of animal drawn implements. A random sample of 200 farmers was interviewed using an adequate questionnaire. Also, complementary qualitative primary data was collected through interviews with traditional leaders and agricultural extension agents. The study findings indicated that animal traction implements had considerable positive socio-economic impacts in Zalingei area. These were reflected in increased cultivated area, increased productivity, reduced production cost, reduced drudgery and time allocated for field operations enabling other income generating activities. Covering weeds and crop residues improved soil fertility and saved soil moisture content. The results showed no serious constraints as almost all farmers, including women, owned draft animals, and implements are manufactured locally. The study ended with the recommendation that the technology be introduced in other areas as booster for agricultural development.

Keywords: Animal traction, Small farm, Animal drawn implements, Zalingei.

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Introduction

Sudan is ranked as one of the world greatest potential areas for agricultural production. The estimated arable land for agricultural production is more than 8.4 million hectares. This is equivalent to about 32% of total arable land in [1] and more than 46% of the land suitable for agricultural investment in the Arab world [2]. The Jebel Marra Rural Development Project (JMRDP) was started in 1971 with a main objective to develop farming in Zalingei area. One of its interventions was the promotion of animal traction technology. The project adapted the design of the traditional moldboard camel plough to suit loamy clay soils of Jebal Marra area, using the donkey as source of draught power. Donkeys, associated with poor people, are docile, friendly and owned by all including women. JMRDP supported small holders and distributed more than 10219 animal drawn ploughs [3].

There are many agricultural development projects established to improve rural living standard or farmers' lifestyle, through changing their knowledge, attitudes and behavior, by acquiring new skills. Promoting economic and social status will be a target itself as it leads to increase household income, which reflects positively on rural farmers' services and better life. It is an extension worker's job to encourage farmers to adopt innovation of proven value [4].

Animal traction may well have a direct impact on the quality of the life, by reducing drudgery. Working with draft animals as they cultivate, transport goods, grind or draw water may be tiring, but it is seldom as bad as the manual alternative. Many farmers would also add that their animals provide them with a valuable form of friendship that improves their life. This benefit is seldom discussed in West Africa, but it can be best appreciated when an apparently unsentimental farmer shows signs of regret or even grief when a well-used draft animal is sold or dies. It has already been noted that animal traction may lead to intensification, with larger farm areas being less intensively managed. Although it has been suggested that changes in overall crop mixture may be small, farmers may well put an emphasis on those crops most likely to yield cash revenues. Animal traction as intermediate technology has been widely adopted since long time throughout Africa, Asia and Latin America.

There are considerable differences in level of development and types of the technology as well as differences between the areas in which it has been introduced. The timeliness in field operations promotes the achievement of higher and more reliable crop yields, so that in many countries particularly in sub-Saharan Africa use animals for agriculture and rural transport [3].

An animal traction implement of moldboard plough type was introduced from Egypt to Darfur by nomad traders in 1965 and spread all over Darfur states. The Jebel Marra Rural Development Project handed out many plough implements to farmers seeking to generate both horizontal and vertical agricultural development through improving water infiltration, seed-bed preparation and reducing time and

drudgery in weeding and planting. So, it saves labor, time and secures extra crops [5].

The modern perspective recognizes change that we as individuals of societies, we should take an action, for instance reduce mortality and improve livelihood through information transfer [6]. Rural development is the improvement in overall rural community conditions, including economic and other qualities of life considerations such as the environment, health, infrastructure and housing. For most small communities, this improvement involves population and employment growth. However, such growth is neither a necessary nor a sufficient condition for rural development [7].

Human power is used in traditional farming through hand tools in all cultural practices from land preparation to harvesting mainly in small farms. Human power is considered as essential source of power for more than 80% of the farmers in West Africa. It has many disadvantages like limited cultivated lands, low productivity and hence, low returns [8]. Design of hand tools is inefficient due to technological limits at the time when the opportunity cost of labor was high; farmers would not tolerate wasted efforts if alternatives were available. It is unlikely; therefore that significant increase in food production could be made by design improvements to locally manufactured tools [9]. Tractor power is used under certain condition and often unavailable for rural societies because of small farm size, lack of technical knowledge and the high costs of its purchase and use. Therefore, tractors have small contribution as a source of power in rural areas [10]. The need for small farm mechanization in developing countries has been growing in recent years; as it is imperative that these countries become fairly self-sufficient in food [11]. In many parts of the world horses, donkeys, oxen, buffaloes, mulls and camels are used for draft purposes, as single or groups of two or more animals.

An interesting feature of draft animals used in Morocco is that they are paired in teams [12]. Therefore using animal draught in ploughing and/or weeding is the most important operation for crop productions [13]. In some parts of the world draft animal power is traditional; in others it is a relatively new technology.

When thinking about draft animals selection it is important to be aware of some parameters e.g. type and age of the animal, sex, location, body weight, general health, feeding, soil type and the role they may play [14, 15]. The production of a certain block weeded by animal drawn implements is two times while the cost of weeding is only 35% compared with those of manual hoe [16]. Animal power is a renewable energy source that is particularly suited to family-level farming and to local transport. Animal power is generally affordable and accessible to the small holder farmers, who are responsible for much of the world's food production.

The availability of animal power allows women and men to increase their efficiency and reduce drudgery, compared with manual alternatives. The combination of timeliness and timesaving in field operations promotes the achievement of higher and more reliable crop yields. Therefore the goal of this study is to evaluate the performance and role of animal drawn implements in Agricultural production in Zalingei area as seen by farmers.

Material and Methods

Study area

Zalingei locality lies in the far west of Sudan to the south- west of Jebel Marra, between latitudes of 12.30 and 13.30 North and longitudes of 23.30 and 23.45 East. Its area is about 33100 square Kilometers 13.5% of which is mountain the rest being valleys and plain land. The locality is bounded from the north by northern Darfur state, from the east by southern Darfur state and Jebel Marra locality, bounded from the west by Geniana locality and from the south by Wadisalih locality [17].

Data collection

The primary data for this study was collected through direct survey, while the secondary data was collected from institutional reports. The main survey was conducted in December 2010 for the collection of data using a comprehensive questionnaire, which was prepared comprising all information required to satisfy the objective of study. The data was collected from a sample of 200 farmers via direct individual interviews; in addition and extension workers were contacted.

Tools used in JMRDP

Manual hoe consist of front blade and wooden handle about 150cm long with a diameter in the range of 3-5cm; it has many shapes depending on soil type Fig. 1. Moldboard plough is one of the important tillage implement in Jebel Marra area Fig. 3. Moldboard plough does four jobs namely a) cutting the furrow slice b) lifting the furrow slice c) inverting the furrow slice and d) pulverizing the furrow slice. The plough basically consist of consists of a) plough bottom b) beam and c) hitch bracket or clevis [18].

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Fig.1: Hand Hoe configuration used in Zalingei area

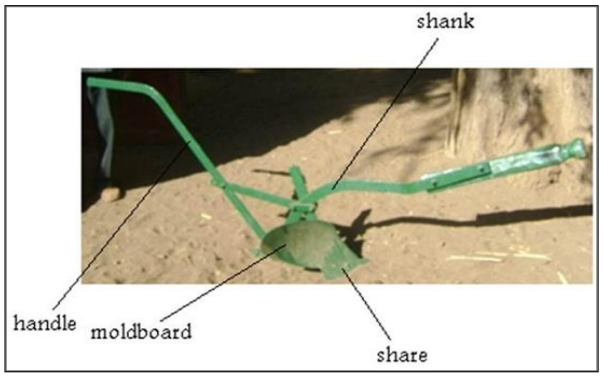

Fig. 2: Animal drawn moldboard plough

Fig. 3: Jabel Marra modified toolbar

Data analysis

Statistical Package for Social Science (SPSS) was used to analyze the collected data by creates histograms and frequency distributions to determine percentage.

Results and Discussion

This study formulates a theoretical framework of diffusion and adoption of agricultural tools especially animal drawn implement. It uses social survey to obtain the influence of animal drawn implement and its role in agricultural development in Zalingei locality.

Study area education level

Table 1shows that most of the respondents (60%) were female which reflects the tradition in Darfur. Males are normally working in other jobs such as animal's trade or, even, abroad. Table 2 shows the distribution of respondents by education level. It is well recognized that education plays a vital role in increasing and improving farmer's productivity. Through education people knowledge, attitude and skills can be improved. Big percentages (35%) of the farmers are illiterate and that affects production negatively.

Table 1: The study area population with reference to gender

Gender	Frequency	Percentage (%)
Male	80	40%
Female	120	60%
Total	200	100%

Table 2: The study area population with reference to education level

Education level	Frequency	Percentage (%)
Illiterate	70	35
Basic or khalwa	50	25
Secondary	54	27
University	26	13
Total	200	100

Table 3: The study area arable land with reference to farm size

Area (Mukhamas)	Frequency	Percentage (%)
2-4	132	66
4-6	43	21.5
<6	25	12.5
Total	200	100

Field owners and farm size

Fig. 4 shows that 70 % of female respondents had their own land; against 67.5 % of male respondents. Women have better access to land; and this is a positive indicator as women are the main producers in Darfur and many other regions of Sudan. Of course, this is not the case in many aspects of the society. Table 3 shows the distribution of respondents by farm size. Most of the farms (66%) lie in the size range of 2–4 Mukhamas (1Mukhamas= 1.25 feddans = 5250 m^2). Labor, especially for weeding limits the area that can be cultivated each year.

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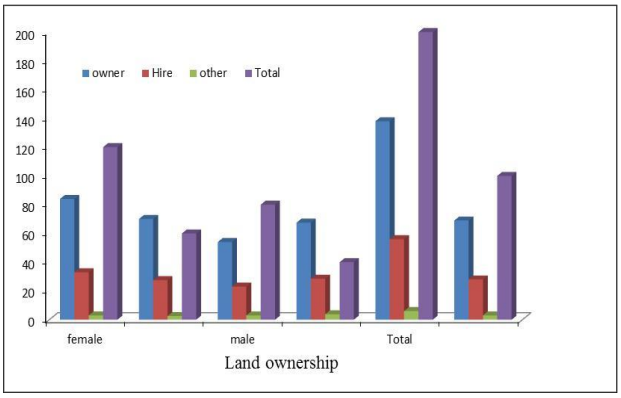

Fig. 4: The study area referred by field Ownership

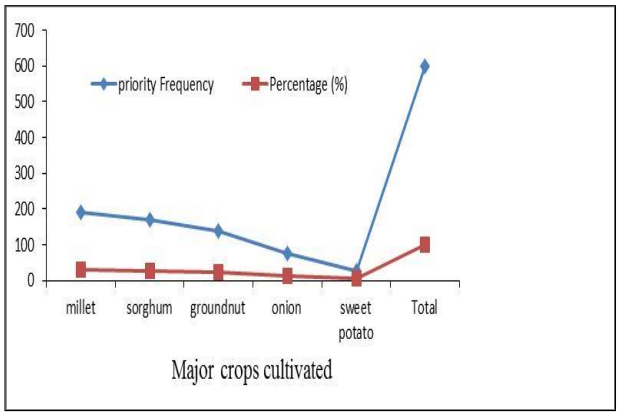

Fig. 5: Major crops cultivated in Zalingei area

Fig. 6: Operation with untrained animal

Major crops and plough used in Zalingei area

Millet and Sorghum are the dominant crops in the area covering 80% of the annual cultivated area, they are mainly grown for household consumption Fig.5. This is in agreement with [19]. Groundnut, onion and sweet potato are grown as cash crops on the banks of Wadi land. Traditionally, sorghum, millet, Groundnut, cowpea and water melon were inter-cropped, this is increasingly abandoned due to the introduction of animal plough as it reduced the amount of labor needed for land preparation. Table 4 shows the sources of animal plough used in the area. Most (68.5%) of the ploughs are procured from the local market which manufactured from scrap metal by traditional blacksmiths. This implies that the technology is well adopted and disseminated in the area.

Cultivation and yield of plough Vs. hoe

Table 7 shows that, in most cases (76.0%) ploughing by animal drawn implements is less costly than using the hoe. This agrees with report by [20] in which the cost of cultivating by animal drawn implements was found to be only 53% of the cost of cultivating the same area using manual hoe. The high cost of ploughing with manual hoe besides the labor constraints during the critical period of weeding and the low yield of crops ploughed manually labor are negative indicators against the manual hoe.

Type of the animal draught in Zalingei area

Table 5shown that the most frequent (81.5%) draught animal is the donkey (local breed). This is because it is cheap (almost owned by everybody), easily handled (especially children and women) and generates less exposure to risk (theft). Table 6 shows that 30% of the animals operate without guidance whereas 70% needed to be guided being less trained. As seen in Fig. 6, untrained animals need more than one person to operate the plough; this has a negative effect on the production rate.

Table 4: the sources of animal plough used in study area

Plough source	Frequency	Percentage (%)
JMRDP	43	21.5
Local market	137	68.5
Other sources	20	10.0
Total	200	100

Table 5: Types of draught animal in study

Draught animal	Frequency	Percentage (%)
Bull	7	3.5
Camel	17	8.5
Donkey	163	81.5
Horse	13	6.5
Total	200	100

Table 6: Draught animal with reference to training

Animal drive	Frequency	Percentage (%)
Alone		30
Guided		70
Total		100

Table 7: Cultivation cost (plough VS hoe) in study area

Cost	Frequency	Percentage (%)
Greater	36	18
Equal	12	6
Less	152	76
Total	200	100

Table 8: The animal plough utilizations

Objectives	Frequency	Percentage (%)
Remove weeds	101	50.5
Improve soil fertility	72	36
Improve soil moisture	27	13.5
Total	200	100

Table 9: Field performancewith reference toAnimal plough field capacity

Capacity (mukh/day)	Frequency	Percentage (%)
0.50	86	43
0.75	67	33.5
1.00	40	20
1.25	4	2
1.50	3	1.5
Total	200	100

Table 10: Field performancewith reference toHand hoefield capacity

Capacity(mukh/day)	Frequency	Percentage (%)
0.125	149	74.5
0.25	43	21.5
0.5	8	5
Total	200	100

Table 11: Animal plough VS hoe with reference to crop yield

Crop yield	Frequency	Percentage (%)
Greater	171	85
Equal	15	7
Less	14	7
Total	200	100

Table 8 shows the main objectives of animal plough utilization. Weeding is the most frequent purpose (50.5%) followed by soil fertility improvement through mixing weeds (36%). It seems obvious as weeding linked with labor constraints limit the extension of cultivated area. Table 9 shows prevailing animal plough field capacities; whereas, Table 10 shows prevailing manual field capacities. The animal plough field capacity was about 1 Mokhumas/day and it was four times compared to hand hoe (0. 25 Mukhamas/day). Thus draught animal technology enables the farmers to increase cultivated area and hence increase their income and assure food security.

Table 11 shows that great majority of cases (85.5%) yield from land cultivated by animal plough was higher than that from hand hoe. So, the use of animal plough played a vital role in increasing crops production both vertically (increased productivity) and horizontally (increased cultivated area).

Conclusions and Recommendations

Form the foregoing discussion, it can be concluded that:-

- Usage of animal drawn implement has contributed in agricultural development in Zalingei area.
- Usage of animal drawn implements, with higher field capacity, saves labor and time that can be used in other activities.
- Agricultural operations can be achieved in time and on wider land compared to the hand hoe.
- Mixing weeds conserve soil and improves its fertility.
- The cost of the ploughing process is less when using the animal drawn implements compared to the manual hoe and this will increase the income of the farmer.
- Animal traction technology is well adapted in Zalingei area as implements are locally manufactured and farmers possess animals.
- Women have equal access to the technology and this goes in line with the fact that they are the main producers in the area.
- More research in field of animal drawn implements, particularly for inter-row cultivation, will help small farmers to improve their production.
-Coordination between related authorities is to be strengthened to provide support to farmers including finance.
- More extension effort is to be exerted for spreading and applying animal drawn implements through farmer training and awareness rising.
- Animal drawn implements are to be introduced in other areas for their effectiveness in boosting agricultural production.

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