

# Enhancing agricultural mechanization for small and marginal farmers through draft animal power: Its prospects and constraints

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■ **ABSTRACT** : The present utilization of draught animals for agricultural operations is declining mainly due to drudgery involved in the use of animal operated traditional tools and implements. The younger generations show resistance to walk behind the animals for field operations and instead prefer tractor/mechanical powered implements for cultivation. However, considering the merits of animal based farming system, the younger generation need to be educated and motivated for improved use of work animals including the byproduct utilization for higher economics. Improved riding type cultivation equipment for multiple cropping, single/paired animal carting, pack load transport, rotary mode operation for agro processing equipments, electricity generation, water lifting and by-product utilization for organic farming are the pertinent avenues to increase the potential use of animal power which would ultimately reduce the demand for additional electrical and mechanical power in agricultural farming system resulting into savings of fossil fuels and electricity for other requirements. Use of animal energy in Indian agriculture may remain as a continuing priority for small farms due to prevailing land holding pattern, socio-economic condition of farmers and ecological compulsions.

■ **KEY WORDS** : Agricultural mechanization, Draft animal power, Animal based farming

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**D**raught animal power has been traditionally the main source of power in Indian Agriculture. Draught animals are mainly used for tillage operations as well as transport (Ramaswamy, 1979) in rural areas through animal cart especially for short distances. During the last decade there has been a rapid growth of power operated and self propelled machinery in agriculture. As a result, many of animal operated technologies became obsolete causing animal based farming operations uneconomical. This resulted in a sharp decrease (22.5 %) of draught animals from 72 million in 1997 to 55 million in 2007. However, two factors have prevented drastic decline of draught animals. One has been the socio-religious factor which prevents open slaughtering of cattle and secondly, with increase in human population there has been the division of land holdings resulting in increase in number of small and marginal farmers. On the other hand, rising cost of diesel and electricity have resulted in significant increase in the cost of operation of power operated machinery. For small and marginal farmers, except for primary tillage operations, all other farm operations can be economically carried out by animal

operated machinery as compared to power operated machinery. Draught animals are used for carrying out tillage, sowing, planting, weeding, inter-culture, earthing, plant protection and digging operations. They are the major source of farm power for small and marginal farmers of our country who possess nearly 80 % of the operational holdings with about 30 % of the total cultivable area (Singh, 2007).

Small and marginal farmers are poor, risk minimiser and cannot afford to purchase or hire costly power operated machinery. They are even reluctant to adopt improved animal drawn implements. Thus although a large number of improved animal drawn implements have been developed in the country, only few have actually been adopted by farmers.

Considering the above situation, there is a need for systematic studies on all aspects of draught animal power. In order to utilize animal energy effectively and economically all aspects of draught animals need to be looked into. Besides improved yokes and implements, the food and nutrition, health and housing also need to be attended to so that the draught animals are able to give maximum power output without fatigue and health hazards. In order to improve the

economics of draught animal power, it is necessary to increase the annual utilization of animals and also to utilize by-products such as animal dung and urine for making useful products. The animals mainly consume crop residues and other agricultural by-products which unless otherwise will be a waste and will also cause environmental pollution. The dung and urine excreta of the animals are used for the production of compost and farmyard manure that facilitates organic farming. The decreasing reserve of fossil fuels, increasing cost of conventional energy sources and awareness about environmental pollution are some of the factors that would advocate the use of draught animal power which are also known as renewable and eco-friendly power sources (Bhat *et al.*, 2004).

Moreover, the modern concept of agriculture focuses on conservation agriculture, organic farming, climate resilient technologies and prevention of environmental pollution. Farm operations based on draught animal power are more suited for application of conservation agriculture because of lesser compaction. It is suited for organic farming since draught animals provide manure which is essential in organic farming. In short, a systems approach is necessary for effective and economic utilization of animal energy.

#### **Draught animal status:**

At present, Indian agriculture is supported by 55 million draught animals and bullocks constitute about 91% of the total draught animal population. The total draught animal population of Orissa is 5.05 million as per 2007 livestock census (Anonymous, 2007). The draught animal population of India and Orissa during 2007 is presented in Table 1. There are about 26 prominent breeds of draught, dual purpose and milch cattle and seven prominent breeds of buffaloes in India. Some of the popular Indian draught breeds of bullocks are Nagori, Kankrej, Tharparker, Amrit Mahal, Kangayam, Ongole, Malvi and Haryana etc. (Yadav, 2001). In addition to these recognized breeds, there are many non-descript local breeds of bullocks found in different parts of the country. The bull calves are also available as by products of dairy farming.

The area cultivated by a pair of draught animal varies from 1.5 to 6.0 ha in different states of India. It was observed that Himachal Pradesh, Manipur, Bihar, West Bengal, Assam and Jammu & Kashmir have less than 1.5 ha per animal pair and Utter Pradesh, Orissa, Madhya Pradesh, Andhra Pradesh, Tamil Nadu and Karnataka have 2.9 to 4.3 ha per animal pair,

while Maharashtra, Rajasthan, Punjab, Haryana, Gujarat and Kerala have 5 - 10 ha per animal pair (Singh, 2007).

#### **Technology available:**

Draught animals are generally used for various agricultural operations like ploughing, puddling, levelling, harrowing, bund forming and ridging, seeding, planting, weeding, threshing and carting. The different implements and tools presently available are plough, leveller, puddler, harrow, cultivator, bund former, ridger, seed drill, planter, interculture plough, weeder, tool carrier and cart (Table 2). These implements are mostly of indigenous designs and are being manufactured by local artisans and small-scale industries. Implements are generally made up of locally available materials.

#### **Potential operations that can be performed by animals:**

There are many agricultural operations for which implements are not available. So, farmers depending on animals are not able to use their animals throughout the year and they remain idle most of the times. Presently, the animals are mainly used for specific farm operations like tillage and transportation. So, the total annual use of animals is limited to 250-300 hours only. Though, farmers feed the animals throughout the year, they are put to work for a lesser period. Thus, the farmers have to spend a substantial amount on feeding and management of the animals without getting the equivalent benefits.

The potential use of animals in a year is nearly 800 hours. To achieve this target, the animals are to be used for other farm operations like water-lifting, chaff cutting, crop cutting, threshing, sugarcane crushing, oil expelling, milling and de-husking etc. Animals can also be used in rotary mode for electricity generation.

#### **Advantages:**

The animal based farming has many advantages over mechanized farming. They are as follows :

#### **Appropriate farming system for small and marginal farmers:**

The small and marginal farmers constituting 80% of the total farming community have small and fragmented land holdings, which restricts the use of larger machines. So, animal based farming with improved tools and implements is most suitable for them.

<b>Table 1 : Draught animal population during 2007 (millions)</b>									
	Bullock	Buffalo	Camel	Horse	Donkey	Mule	Yak	Mithun	Total
India	50.309	3.039	0.349	0.520	0.463	0.138	0.040	0.149	55.007
Odisha	4.497	0.546	-	-	0.007	-	-	-	5.05

Table 2 : Bullock-drawn tools and implements available				
Sr. No.	Operation	Tools and implements	Weight (kg)	Field capacity (ha/h)
1.	Tillage	Wooden plough	6.5-8.0	0.10-0.18
		Mould board plough	6.0-8.5	0.24-0.03
		Harrow	25.0-28.0	0.053-0.06
		Cultivator	15.0-18.0	0.058-0.065
		Puddler	16.0-22.0	0.10-0.12
		Leveler (bamboo)	8.0-9.0	0.31-0.35
		Leveler (wooden)	10.0-12.0	0.31-0.35
2.	Seeding and planting	Seed drill	18.0-22.0	0.09-0.12
		Seed-cum-fertiliser drill	20.0-25.0	0.07-0.10
		Zero-till drill	15.0-18.0	0.06-0.07
		Inclined plate planter	19.0-25.0	0.16-0.20
3.	Interculture	Intercultural plough	4.5-5.5	0.035-0.040
		Weeder	20.0-22.0	0.08-0.10
4.	Harvesting	Groundnut digger	10.0-12.0	0.035-0.047
		Potato digger	9.0-11.0	0.032-0.036
5.	Transport	Bullock cart	-	-
6.	Other	Tool carrier	18.0-20.0	-
		Bund former	15.0-18.0	0.032-0.036
		Ridger	15.0-18.0	0.035-0.040

#### Low investment:

The mechanized agriculture requires tractors and power tillers and their matching implements, diesel or electric pump sets, reapers and harvesters, threshers and other specialized and specific machines for different post harvest operations. The costs of these machines are comparatively high. On the contrary, animal -farming system requires lower investment. The marginal and small farmers can own the improved animal operated tools and implants at a lower cost.

#### Non- requirement of skilled labourers:

The different agricultural machines including tractors and power tillers needs to be operated by skilled personnel. On the other hand, the operation, maintenance and adjustment of animal operated tools and implements are easy and can be done by unskilled labourers and farmers. They do not require any special training for operation of these implements.

#### Crop waste and by-product utilization:

The agricultural by-products are mainly dried plant, crop straw, chaff, half-filled grains, husk and hulls. These by-products are produced in large quantities along with grains. Most of paddy, wheat and corn straw produced are useless and simply burnout to use as alkali fertilizer emitting carbon dioxide or discarded on the fields emitting methane by fermentation. Both the gases can cause global warming seriously. The animals mainly consume these agricultural

by-products. If these are not handled properly it will create severe environmental hazards.

#### Facilitates organic farming:

Excessive use chemical and synthetic fertilizers in the field crop have many disadvantages. It deteriorates the physical condition of the soil and pollutes surface water of the field. It also creates human health hazards. One of the inputs of the organic farming is organic manure like compost and farmyard manure. These are produced from the dung and urine excreta of the animals. The production and productivity of the crop with organic manure is at par with that of non-organic farming. Moreover, organic farming is an eco-friendly farming, as it has no detrimental effect on the soil environment.

#### Avoids soil compaction:

Soil compaction is a regular problem in mechanized farming. The heavy machines including tractors, power tillers and other self-propelled machines cause soil compaction. The soil compaction is acute when the heavy machines are operated in the field at higher soil moisture content. As the heavy machines are used continuously on a particular field, hardpan is formed which prohibits the leaching of soluble salts thus causing the top fertile soil salty. This phenomenon reduces the crop yield severely. On the contrary, animals and animal powered tools and implements do not cause soil compaction and also do not change the soil texture and

structure and thus ensures a good soil environment.

#### **Renewable farm power sources:**

The depletion of petroleum products has forced to think of renewable sources of energy. The draught animals are one of the major source of renewable energy used in Indian agriculture. The cost of non-renewable farm power sources like petrol, diesel and kerosene are increasing day by day. More over burning of these fossil fuels in the engine emits toxic gases thereby causing environmental pollution and creating severe health hazards. On the other hand the animal based farming is eco- friendly and do not cause environmental pollution.

#### **Subsidy on animal operated tool and implements:**

Most of the small and marginal farmers of our country depend on the animal power. Their economic condition does not permit them neither to purchase the costly machines nor use them on hiring. So, both the state and central Governments are giving 30-50 per cent subsidy on the improved animal operated tools and implements. This will certainly help majority of these farmers.

#### **Socio-religious point of view:**

In countries like India and Nepal, cattle rearing are a part the lives of majority of the rural households. Social, mythological and religious attachments are felt towards the cattle in these countries. Draught animals particularly bullocks are being worshipped by the Hindus in India and they oppose cattle slaughtering. So, in our country the bullocks should be used effectively for on-farm as well as off- farm purpose, otherwise they will be a burden to our society.

#### **Constraints and limitations:**

Though animal based farming has many advantages, it also has some constraints and limitations. These are given below :

#### **Lack of timeliness:**

One of the concepts of commercial farming is timeliness of agricultural operations. To make the farming a profitable business, the farmers have to take up 2-3 crops in a year where assured irrigation is available. In this case, between two crops, the farmers get less time for the land preparation. As the animal operated implements have less field capacity, it is not possible to complete the land preparation in time to take up the next crop. Research results have showed that delayed transplanting beyond the optimum duration reduces the rice yield to a considerable amount.

#### **Involves animal and human drudgery:**

In animal based farming, the animals have to work in

trashy as well as muddy land and also in a field full of clods. The farmer has to walk behind the animals and at the same time operate the implement. Both the animal and the man have to perform the task in adverse weather conditions. This causes serious health hazards and reduces the work efficiency. Research studies showed that a man has to travel a distance of 66 kilometers to cultivate one hectare of land. Animal and human drudgery can be reduced considerably by adopting suitable work-rest cycles in different seasons.

#### **Unavailability of matching tools and implements:**

The animals vary in type, breed height and weight from region to region. They also vary with respect to their draft load carrying capacity. So, a particular tool may not be suitable for all the animals. Moreover, the matching tools and implements are not available for all the agricultural operations.

#### **Lack of interest of commercial manufacturers:**

The cost of the animal operated implements is comparatively less than tractor and power tiller operated implements. So, the profit margin is less. As there is large variation among the animals with respect to size and type, the demand for a particular design is less. Therefore, commercial agricultural implement manufacturers are not coming up for large-scale production of these tools and implements.

#### **Lack of awareness among the farmers:**

The farmers are not well aware of improved animal operated implements. So, the line departments of the Government, NGOs and the Agricultural Universities should arrange demonstrations in farmer's field at each block/ panchayat levels. Besides demonstrations, farmer's fair/ kissan mela should be organized regularly by involving the commercial manufacturers and local artisans. This will certainly create awareness among the farmers and beneficiaries.

#### **Conclusion:**

The draught animals contribute significantly to Indian agriculture. This is a non-renewable source of farm power. The animal based farming is most suitable for the small and marginal farmers. The appropriate and matching tools and implements should be manufactured on large scale to meet the growing demand of the farmers and should be available at block levels and manufacturer's outlets. Field demonstrations and farmer's fair on improved animal powered implements should be organized to create awareness among the farmers. So, animal based farming with improved tools and implements has great importance for sustainable agriculture in India.

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