Agricultural Reviews, 37 (1) 2016 : 49-54
Print ISSN:0253-1496 / Online ISSN:0976-0539

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
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Relevance of draught cattle power and its future prospects in India : A review

Akila Natarajan*, Mahesh Chander[1] and N. Bharathy

University Training and Research Centre,
(TANUVAS), Karur-639 001, Tamil Nadu, India.
Received: 15-05-2015 Accepted: 05-01-2016 DOI: 10.18805/ar.v37i1.9264

ABSTRACT

Domestic work animals exist in all regions of the world. In India, the energy for ploughing two-thirds of the cultivated area comes from animal power and they haul up to 15 per cent of the total freight in the available 14 million animal drawn carts. Thus the stock of 60 million working cattle and buffaloes were used for various agricultural operations, saving fossil fuel worth Rs 60 billion, annually. With nearly 83 million land holding (more than 75% of the land holding) being less than 2 ha in size, the animal power can play a very important role in Indian agriculture. But the cropping season in India generally lasts for only 30 days during *kharif* and 30 days in during *rabi* or a total of 60 days in a year. Atleast 200 days of work was necessary to get the breakeven point considering the cost of maintenance and market hire rate for draught animals. The annual use of Draught Animal Power should be expanded through haulage and rotary mode of operation for agro processing and electricity generation and the new research findings should be communicated to the farmers through training.

Key words: Animal power, Draught cattle, Small farmers.

Livestock provides a large share of draught power. Since ancient times man has utilized animals like cattle, buffaloes, horses, elephants etc. for carrying out different types of work. At the turn of this century, more than 300 million cattle were employed as draught animals around the world (Wilson, 2003 and Conroy, 2007) and Oxen continue to be an important, yet overlooked draught power source (FAO 2010). It offers the greater population of developing nations a means of sustenance in food production and inseparable part of agriculture (Agriculture 21, 2007). Draught animal power (DAP) is a classic example of large-scale application of appropriate technology concepts to millions of small and marginal farmers for cultivation and small-scale transportation. Draught animal power is still relevant and useful due to the fact that it is suitable to the needs of the farmers with small land holding and the areas where mechanized implements cannot be put to use (Singh *et al.,*. 2007). The work bullocks not only contribute manure, conserve natural resources like fossil fuel, but also create employment opportunities and generate income particularly for the small scale farmers in India (Akila and Chander 2011).

DAP-World Scenario: In assessing the economic future of draught animals in the Asian-Australian zone, Campbell (1993) emphasised that "the DAP system represents a fundamental component in the social, agricultural and economic fabric of Asian countries. It is stable, productive and underpins the economy of most of the states of South and East Asia. Kiff *et al*., (2000) in an assessment of livestock production systems in the mid hills of Nepal concluded that DAP is indispensable within the mixed hill farming systems of Nepal.

In the cotton production area of Ghana, for example, the tractors that were introduced in the 1960s and 1970s are falling into disuse and are being replaced by animal power. Animal traction technology was introduced into Uganda in 1909, the use of work animals rapidly spread and created remarkable impact in increasing the acreage under cultivation (Omoding and Odogola, 2003). In Sub Saharan Africa, in particular, the use of work animals for agriculture and rural transport is increasing every year. As indicated in Agriculture 21, (2007) the FAO Agricultural Engineering branch (AGSE) reported that even in highly developed European Union, animal power remains important in Spain, Portugal and Greece where farms are of small size and in the United States Amish farmers run their farms profitably using only animal power. Guthiga *et al*. (2007) reported that use of DAP resulted in higher yields at a higher economic efficiency of smallholder maize producers in central Kenya. There are also parts of Asia and Latin America where animal power is expanding and diversifying. In countries like India, Mexico, Brazil and South Africa that are rapidly urbanising and industrialising animal power remains important and persistent. In these countries many small scale farmers and local transports continue to use animal power (FAO, 2010).

DAP in India: The Working Group on Animal Husbandry and Dairying, 11th five year plan (2007- 12) reported Zebu cattle (*Bos indicus*) and buffalo (*Bubalus bubalis*) were major sources of draught animals in India. Fully-grown Zebu draught cattle provide 0.5 HP and one draught cattle pair cultivates about 0.33 ha land in six hours of working per day. The extent of dependence of farmers on bullocks, for

*Corresponding author's e-mail: nakila@rediffmail.com. [1]Division of Extension Education, IVRI, Izatnagar.

farming and other activities assessed by Akila and Chander (2009) in the seven agro-climatic zones of Tamil Nadu indicated that 91.43 per cent large farmers and 40 per cent of the medium farmers maintained the animals mainly for their own use and the small farmers utilized their bullocks for commercial ploughing (28.57 per cent), commercial carting (25.71 per cent) and for both the activities (45.71 per cent). Pal and Chatterjee in 2013, reported that the weight carrying capacity for a pair of buffalo bullock of 18.2 ± 0.65 kg, distance travelled per day of 72.0 ± 0.57 km, speed of travelling of 9.00 ± 0.04 km/h, working period during agriculture (approx 4 months in a year) of 8.0 ± 0.05 h and at other times of 9.5 ± 0.06 h, an average cost of feeding/ day of Rs. 38.5 ± 0.61 per bullock, working area ploughed of 1805.976 ±15.483 sq m, and speed of ploughing of 5.2 ± 0.02 km/h.

Population trend of draught cattle and buffaloes: Indian agriculture is characterized by small and marginal farm holders with the population of more than 60 million bovine for draught power (Singh 2002). India has about 70 million draft animals (Shastry and Thomas, 2005). There was a decline of more than 20 million number of working animals at all–India level between 1972 and 2007.

Population trend of working cattle and buffalo bullocks from 1972 to 2007

	1972	1982	1987	1992	1997	2003	2007
Cattle	73.2	61.1	63.6	70.3	55.8	54.3	53.3
Buffaloes	7.6	7.3	6.8	7.4	6.8	5.8	5.6
Total	80.8	68.4	70.4	77.7	62.6	60.2	59.0

Source: Livestock census 1972, 1982, 1987, 1992, 1997, 2003 and 2007.

In India, the energy for ploughing two-thirds of the cultivated area comes from animal power and animal drawn vehicles haul two-thirds of rural transport. They haul up to 15 per cent of the total freight in the available 14 million Animal Drawn Carts. Draught animals especially bullocks are still the predominant source of mobile power, on about 60% of the cultivated area consisting of about 85million ha. They are ideal for rural transport, where proper roads are not available (Srivastava, http://agricoop.nic.in/ Farm%20Mech.%20pdf/05024-04.pdf). Thus the stock of 60 million working cattle and buffaloes were used for various agricultural operations, saving fossil fuel worth Rs 60 billion, annually (GoI, 2007). It's a fact that the farm power sources in India has increased from 0.32kw/ha in 1971-72 to 1.21 kw/ha in 2000-2001 and human and draught animal power that largely meets the farm requirement has reduced from 58% to 17% during the same period (Alam and Singh, 2003). It is also beyond doubt that much of this decline occurred during the 1980s. Due to economic advantage of rearing animals for milk, the relative importance attached to draught animal power is gradually declining. Mechanization is also a main reason for the reduction in draught cattle population. The number of tractors increased to 167/10000 ha in 2003 from 109 in 1991-92 and the number of draught animals declined to 40/100 ha from 59/100 ha (Birthal *et al.,* 2006). Ofcourse tractor density negatively influenced work cattle density, but the elasticity is low at -0.09, implying that work cattle are maintained despite increase in tractor density for several other operations besides land preparation (Rao *et al*., 2004). The mechanization scenario existing in India is also quite diverse due to socio-economic disparities and agro ecological diversities. The tractor density per 1000 ha is diverse from 1.92 tractors in Assam to 71.45 tractors in Punjab with all India average being 17.03 (Singh, 2006).

Role of draught cattle power in agriculture: In 1996-97, the contribution from animal power reduced to 14% while mechanical and electrical power increased to 79%. But in terms of area coverage, draught animals continue to dominate with more than 54.3% area cultivated by them and only 19.6% by tractor and power tiller (Singh 1999). With nearly 83 million land holding (more than 75% of the land holding) being less than 2 ha in size, the animal power can play a very important role in Indian agriculture (Rao & Dass, 2005). Further, it is visualized that by 2020 the availability of farm power will be on the following pattern (Srivatsava, http:// agricoop.nic.in/Farm%20Mech.%20pdf/05024-04.pdf)

Farm power availability	– 2 kw/ha
Share of animate power	– 5%
Mechanical power	- 70%
Electrical power	- 25%
Total cultivated area	- 143 million ha

But at the same time, the contrary statements like that the animal power provide energy for 60% of area under cultivation, and also hauls 14 million carts are not uncommon. Kurup (2003) found that cattle and buffaloes constitute the exclusive draught animal species in Orissa and crop production is almost entirely dependent on work animals on farm power and the primary objective of the farming community, in the breeding of cattle and buffaloes consequently continues to be the production of work animals. Animal power saves petroleum worth Rs.40000 crores a year. Replacement by tractors and trucks may need one million crores of rupees which is beyond the capacity of farmers and the economy (Ramaswamy, 2007). Phaniraja and Panchasara in 2009, reported that the draught cattle were exclusively used over 60 days, for cultivation @ 6hrs/day, account for a total power output of some 9450 million KWH. For purposes of calculation of energy availability, a low average of 0.5hp is assumed, based on animal exerting about

50 kg of draft and walking at the rate of two miles per hour over a sustained period of time. On this basis, the energy made available by 60 million work-animals in India may be around 30 million hp. This is equivalent to 20000 megawatts of electrical power. Animal power would cost about Rs. 10000 crores only, whereas, to produce the same power in electrical energy, an investment of Rs. 30000 crores is required. Thus, when animal energy is abundantly available at about a third of the cost of electrical energy and cheaper even than petroleum energy; it will be wise to utilize the animal energy for other applications in India. Moreover productive use of draught animals will reduce the increasing dependence on petroleum products and thermal power by increasing the share of non-commercial primary energy sources in the total energy use in the country, in agricultural operations and in rural transportation. India would require 6.0 million tractors for the complete replacement of the working animals stock of over 60 million and, to run this much number of tractors for agricultural operations, it is required about 13 million tonnes of diesel each year. If this much amount of fuel were to be burnt through combustion to run the tractors in the absence of the working animal stock of over 60 million in India, it would have caused an emission of over 6.14 million tonnes of carbon dioxide. These effects are highly valuable from the perspective of both national energy budget as well as global warming (Dikshit and Birthal, 2010). But the cropping season in India generally lasts for only 30 days during *kharif* and 30 days in during *rabi* or a total of 60 days in a year. Atleast 200 days of work was necessary to get the breakeven point considering the cost of maintenance and market hire rate for draught animal (Prabakaran and Selvakumar, 2000). The unit operational cost of DAP could be substantially reduced by their increased use. Using the rotary mode to operate agro-processing machines can increase the present utilization of the animal power (Seth 2008). Hence draught bullocks are better than tractors especially for small and marginal farmers when the farmers can meet out the feed cost by their own source of feed and the number of work days improved (Akila and Chander 2009).

Constraints in use of draught cattle power: The topographic variation, problem in soil, imbalanced land use, changing floristic composition are the resource related constraints and the lack of improved harnesses and implements, improper and inadequate health care and mishandling of animals are the management related constraints and poor economic status, lack of grazing facility, poor access to veterinary services and local traditional remedies were some of the factors that can be attributed for the inefficient utilization of draught animals (Singh and Tej Partap, 2002, Urga and Abayneh, 2007 and Chanie *et al*., 2012). Since the farmers could not get much profit from the draught cattle, they couldn't meet out the feed cost and they were also unaware of the new implements that could improve the work efficiency of draught cattle (Subrahmanyam and Nagasree, 2005 and Akila and Chander, 2010). The age old practices and the old implements were used by majority of the farmers, and since they did not know any new implements, they couldn't differentiate the constraints with the old implements. They felt that information about and training on new implements might have helped them to make work easier, if the implements were really worth than the older ones (Akila and Chander, 2012).

Scope for draught cattle power in future: There are a number of reasons why draught cattle continue to hold an important place in rural life. Joshi *et al*. (2005), Mishra and Tripathi, (2006) and The working group on Animal Husbandry and Dairying, 11th five year plan (2007- 12) revealed that although use of mechanical and electrical power has increased over the years, the draught cattle shall continue to be a major source of farm power in India in future for small and marginal farmers. Mpanduji *et al.,*(2007) reported that animal traction technology is more suitable both socially and economically viable for farmers with tradition in animal keeping. Therefore, there is a need for studying the genetics and draught ability in dual and draught cattle breeds and its application in identification and multiplication of superior genotypes for draught power. Abubakar and Ahmad (2010) found that utilization of animal traction would be increased significantly if more fund are injected in animal traction technology. But considerable lack of knowledge with regard to draught animal power and the negligence from the policy makers, the importance of draught animals is day by day getting down. Even people feel that research and development into animal power, is holding back scientific and technological development. The important constraints in draught animal research include lack of a systematic and proper breeding programme for improvement of draught breeds, intense crossbreeding for high milk production, feed and fodder constraints as well as economics of rearing (Madhan, 2008). Karanjkar and Patil (2008) felt that the future thrust area in draught power research is to increase the efficiency of draught animal utilization through improvement in management, nutrition, harnessing and equipment. The quality of work from the draught animals depends upon the power developed by them. The design of traditional implements is based on long experience and these have served the purpose of the farmers. Kahlon (1981) found that the link between the implement-manufacturer, researcher and the farmer is very weak in India. However, there is plenty of scope to improve the design based on animal –machine-environment interaction so as to have more output and increased efficiency without jeopardising animal health. Improved package of farm equipment technology operated by draught animals need to be introduced to make efficient use of draught animal power (Singh 2002). Future draught animal research should be focused on the improvement of

draught animal as such or improvement of equipments (Alex *et al*., 2013).

Alternate use of draught cattle power: With a view to increase the annual utilization and overall efficiency of draught animals, an ad–hoc project from Agricultural Produce fund in the name of "Coordinated Research Programme on Increased Utilization of Animal Energy with Enhanced System Efficiency" was started in January 1985 by the Indian Council of Agricultural Research (ICAR) at the Central Institute of Agricultural Engineering, Bhopal, India which was later converted into a regular all India coordinated research project from 1st July 1987. This project has undertaken various draughtability studies and developed various equipments for the effective utilization of draught animal power in production and processing of various agriculture products as well as for transportation. A prototype animal powered electricity generator, the "designed power mill" has also been proposed with negligible running cost (Paras *et al*., 2012). Chandrakar *et al*. (2013) experimentally studied the animal powered electric generation system for home lighting and found that the equipment needed less maintenance and any person can run They have concluded that Animals are the great energy source for generating power even running at low speed at least for 6pm – 10pm at night for rural and isolated areas. Nage *et al*. (2011) developed and fabricated animal drawn rotary tiller with L-shaped blades at the workshop of Faculty of Agricultural Engineering, Raipur and found the effective field capacity of animal drawn rotary tiller (18 blades) was found to be 0.12 ha/h at a forward speed of 2.5 km/h. The field efficiency of 62.85% was observed during the field performance.

CONCLUSION

It is quite evident that present approaches to mechanization in the country have generally emphasized larger machines like tractors, combine harvesters, etc., which makes it more difficult to smallholders to use such machines (Sharma and Paul 2010**)**. Enhancement of DAP utilization efficiency through appropriate harnesses and matching equipments for different breeds should be evolved. The annual use of DAP should be expanded through haulage and rotary mode of operation for agro processing and electricity generation. When suitable implements identified, the work efficiency can be improved and the cost of maintenance can be managed by increasing the number of work days. Hence focused research should be carried out in improving the utilization pattern of draught cattle and its efficiency. The new research findings should be communicated to the farmers through training. With training, farmers can change their farming systems to suit the application of techniques. The real achievement in efficient utilization of draught animals cannot be attained, if the animal user lacks thorough knowledge in this area. Thus information packages covering all aspects of draught animal usage should be collated and appropriate forms of transferring this information to the owners should be identified (Akila and Chander 2012).

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