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DRAUGHT ANIMALS AS A SOURCE OF POWER FOR SMALL FARMERS IN SRI LANKA: POSSIBILITIES FOR IMPROVEMENT

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ABSTRACT

Draught animals in Sri Lanka, cattle and buffaloes, are badly neglected by policy makers and planners despite their significance in the small farm sector. This study highlights significance of the draught animals for small farmers, and points out some possible measures that should be adopted to promote the draught animal power for the benefit of small farmers.

INTRODUCTION

Miracles of technology in space, electronics, nuclear and a wide range of other fields have remarkably enhanced the productivity of men but unfortunately benefits of these modern technologies are not equally distributed. While the minority of some privileged groups enjoy the benefits of modern technologies, the majority still produce with primitive technologies. Draught animal power (DAP) is an ideal example of a primitive technology which is still widely used by underprivileged small farmers in the Third World. For a variety of reasons they will have to continue with the DAP in the near future. Therefore, for the benefit of the millions of small farmers in the Third World, it is necessary to improve the DAP technology. Such an improvement of DAP technology would enable the small farmers to increase their production and income, and also it will reduce the drudgery of work. Any effort being made to improve the DAP technology calls for a deep knowledge about the existing constraints to the use of DAP, and the possible ways to overcome those constraints. The present study is an attempt to provide this knowledge with respect to the DAP in Sri Lanka. This study is mainly based on secondary data supported by primary data collected by the author in his previous studies.

DISCUSSION

Buffaloes and cattle are the common draught animals in Sri Lanka, and they are used for tilling of paddy fields, threshing the harvested paddy and for pulling carts. In addition, they provide food and organic manure too. Draught animals represent an additional source of income for small farmers through their use for hire and haulage, and provide a sort of insurance against unexpected crop failures since they are a disposable property. The use of draught animals enable the farmer to integrate livestock with crops because while the animals are fed on crop residues and by products available in the farm, the animals themselves are used for draught for farm operations.

As the small farm sector has not yet developed to afford the expensive far machines and motorized vehicles, small farmers will continue with draught animals. In view of the foreign exchange scarcity, inadequate infrastructure for repairs and maintenance, and small size of farms, it seems that DAP is the most appropriate and economically viable source of power for the small farming sector. It is a well observed fact that the use of machines in place of draught animals aggravate the unemployment situation and income inequality. Therefoie, mechanical power should not be discouraged though it may be the ultimate goal. It has already been pointed out that the use of DAP is less expensive to individual farmers as well as to the national economy than tractor ploughing (Farrington and Abeyrathne, 1920).

The bullock cart plays a very important role in the small scale transportation in the rural sector where the road system both inter-villages and intra-village has not yet been improved upto the standard required for motorized vehicles. The small farmers often want to transport small loads-farm products to the market and farm inputs and consumables to the village-over a short distance. Most of their out going faim products and incoming farm inputs are bulky and their loading and unloading operations are time consuming. For transportation of such loads, bullock carts are more economical than trucks. It utilizes locally available renewable sources of energy-DAP-and therefore saves non-renewable energy which costs foreign exchange resources.

According to statistics, total buffalo population is 0.8 million and 55 percent of them are used for draught purpose (Census of Agriculture 1982). On the other hand, total cattle population is 1.3 million but only 15 percent of them are used for draught. While cattle are used for both farm operations and pulling carts, buffaloes are used for farm operations only. Both male and female buffaloes are used for working whereas only male cattle are used for work. However, the low degree of heat tolerance of buffaloes limit their work output when working under tropical conditions. It has been pointed out that a pair of cattle can develop 1 HP, and can work 6 hours a day. The economic life of cattle is 6—10 years. A pair of buffaloes can develop 1 to 1.5 HP but work slowly. The buffalo is recognized as an efficient working animal in situations where speed is unimportant. Their economic life is 12—13 years (Hoften, 1969).

Districtwise data on the paddy extent tilled by draught animals indicate that although tractorization is getting momentum since 1940s considerable extent of paddy fields is still tilled by the DAP. It is as high as 64 and 55 percent in the Intermediate Zone and Wet Zone respectively. In the Dry Zone where paddy cultivation is highly mechanized, only 26 percent of the paddy extent is tilled by draught animals (Census of Agriculture). In some cases, tractors and draught animals are used for first and second ploughing respectively. It has been pointed out that there is a negative correlation between the size of paddy holdings and the percentage of paddy extent tilled by ADP (Ulluwishewa, 1986). It points to the fact that the smaller the size of paddy holdings the greater the farmers tendency to use ADP.

The major criticism against the DAP is its comparatively low work output which disqualifies it form being a part of modern agriculture. However, if its work output could be improved, it would be a suitable and viable source of power for small farmers. Although the work output of animals is dependent upon many factors, there is greater potential to promote the animal's work output through the improvement of:

(1) the feeding system
(2) animal training, yoking and harnessing, and
(3) attached implements and bullock carts.

Therefore, in this paper, attention is focused on these three aspects, with a view to exploring the possibilities of improving the work output of buffaloes and cattle.

Feeding System

Generally, draught power which could be generated by any kind of working animals is determined by its body weight and size. Draught power of an animal is approximately 10 percent of the body weight. Since the body weight of a indigenous working animal is largely determined by the quality of feeding, the improvement of the feeding system is vital. The traditional feeding system in Sri Lanka has been the free grazing system and tethering system under which animals are fed on naturally available grass and wild plants. Although cost of feeding is almost zero, animals are not properly fed under these feeding systems. The volume of green leaves and water available for animals vary seasonally. This is particularly true in the Dry Zone which experiences a prolonged dry season. During the dry season, apart form the food and water shortage, there is a danger of sickness and epidemics. Consequently, at the beginning of the rainy season when animals are needed to draw the plough, they are not able to generate sufficient power owing to their poor physical conditions. It has also been pointed out that the naturally available green leaves are not enough to provide a balance diet for cattle and buffaloes (Ibrahim, 1985).

The stall-feeding system under which animals are kept in sheds and fed with cut-grass and concentrates is effective in keeping animals in a better condition throughout the year, enabling them to generate higher draught power. This system provides an opportunity to have animals in good condition at the beginning of the cropping season. Maintaining the liveweight of animals throughout the year is better than allowing them to lose weight and then regain it just prior to the peak period (Smith, 1980). This system permits them to maintain their body weight and to preserve energy which would otherwise be spent by them on travelling long distances during grazing to find water. The supply of concentrates and cut-grasses especially provides TDN (Total Digestible Nutrient) in standarded levels which is not possible when grazing on natural pastures along except during the early part of the wet season. Better care given to each animal and keeping them away from epidemics also contributes towards enhancing their physical condition. All these factors result in increased work output. On account of the situation there is a strong case for Sri Lankan farmers who keep draught animals to shift from the traditional free-grazing and tethering systems to the stall feeding system. Such a shift would considerably contribute towards improving the animals work output. Apart from this, the stall feeding system will prevent the animals from causing damage to crops, which has now become a serious problem. It would also save the expenses that animal owners are compelled to pay as compensation for crop damage caused by their animals. Furthermore, the large volume of dung and urine which could be collected from animal-shades would also provide very scarce fertilizer.

The prevailing free grazing and tethering systems are not longer suitable to the new irrigated settlement schemes which are expanding at a high rate in the dry zone. Lands for grazing are not allocated there. It is extremely difficult to keep the animals from causing crop damage in unfenced farms. The trespassing animals have already become a serious problems in many settlement schemes. Therefore, if animal husbandry is to be developed, a shift from the prevailing free grazing and tethering system to the stall feeding system is inevitable. There is evidence to prove that feasibility of the stall-feeding system in irrigated settlement scheme. For instance, among the farmers in the Kaudulla irrigated scheme, buffalo management is successfully done under the stall feeding systems (Ryan, Abeyratne, and Farrington, 1981). However, the cost per animal was found to be comparatively high under this system. Therefore, as it has been pointedout, more income generating measures have to be adopted in association with the shift to the stall feeding system. Needless to say, any shift from such a long standing tradition needs to be made over a long period, as a drastic change may not be readily acceptable to farmers. Therefore, it is necessary to find a suitable strategy.

It can be suggested that the strategy should include (1) the introduction of an appropriate feeding system, and (2) the enhancement of the income generating capacity of the animal husbandry. Under the stall feeding system, farmers have to feed their animals those are kept in pens or sheds. Therefore there should be a feeding system which could provide a balanced diet throughout the year. In this case, much emphasis should be given to fodder trees rather than pastures because trees need not much land when compared to pasture. They can be planted along the fences without competing scarce land of the small farmers. Furthermore, trees can withstand the drought due to their long root system, and therefore fodder trees can provide feeds to animals throughout the year. Apart from this, the paddy straw which is now only little used for feeding animals, has a considerable potential value as a feed when supplemented with feeds rich in protein and energy (concentrates) fortified with minerals and vitamin A (Ranjan and Chadokar, 1984). In view of its low cost and easy availability, it can be said that utilization of straw to feed draught animals is highly appropriate to the low-incom small farmers. Furthermore, where appropriate cultivation of improved varieties of grass should also be encouraged.

The proposed stall feeding system will invariably involve higher cost and labour. Apart from the overhead costs such as buildings, equipment and other infrastructure facilities, animal feeding which is a costless item under the traditional system, will become a cost item under the stall feeding system. Daily supply of feeds and water, and cleaning the animal sheds or pens would take up much of the farmers' time. Therefore, if the animal husbandry cannot generate an extra income sufficient to cover the extra cost, the stall feeding system would not be acceptable to the farmers. Any attempt to promote the income-generating capacity of the animal husbandry for draught power would call for the diversification of the use of animals so that the animals could be used for a wide range of income generating activities throughout the year. For such a diversification, the strategies that can be suggested are (1) development of duel purpose animals that could be used for both draught and milk, (2) use of cattle and buffaloes for a wide range of works, i.e. as a source of power for rural industries, as pack animals for the trasportation of firewood, water, etc., and for water lifting, (3) use of buffaloes for pulling carts, (4) promotion of buffalo, management for meat production, and (5) introduction of single animal ploughing Last three suggestions seem to be quite strange in the Sri Lankan situation, but buffalo meat production and use of buffaloes for pulling carts are common in some other countries. Evidence are available to prove that buffalo could provide low-cost meat under a better management system. "Meat from buffalo that are reared and fed for early slaughter is of excellent quality. Because the buffalo is superb converter, meat can be provided at a lower cost" (Cockrill, 1980). Experience in buffalo meat production in Australia, China, Thailand and Itally proved that it is a highly profitable enterprise (Johnson, 1981). It is not common in Sri Lanka to use buffaloes to pull carts but experience in India, China, and the Philippines have proved that they can successfully be used to pull carts if proper training is given. At present animals are used in pairs when they are used for polughing, regardless of the amount of power actually required for the given operation. Under certain conditions, there may be some field conditions which require less draught power than that generated by a pair of animals. Therefore, the method of single animals ploughing which is widely used in many South-East Asian countries may be suitable to Sri Lanka too and such a method would increase the income generating capacity too.

Training, Yoking and Harnessing

Training, yoking and harnessing largely determine the capability of work animals. The accuracy and quality of work performed by draught animals is greatly influenced by ease and effectiveness of control which depends on an effective guidance system, good training and regular practice. Therefore, animal training is very important in any attempt to improve their work output. Concerning buffaloes in Sri Lanka, training has not yet been given sufficient attenttion. Some field surveys pointed out that lack of trained cattle and buffaloes considerably prevented farmers from using these animals for tillage operations (Ulluwishewa and Tsuchiya, 1984). The draught animals have been neglected over the last three decades since the invasion of tractors in the 1950s. So, the currently available animals in some areas are not trained; and furthermore young farmers do not possess any experience in training animals. Therefore, if DAP is to be revived, animal training is inevitable. Experience in some of the West African countries suggests that proper animal training programmes could considerably contribute to raise their work output. For example, in Sierra Leone, animal training centres and village-level training programmes play an important role in popularizing ADP among small farmers (Starkey, 1982). Sri Lanka also needs such a strategy to improve the buffaloes and cattle as draught animals.

Most of the yokes that are used in developing countries have not changed in design for many centuries. Consequently, there would seem to be considerable scope for their improvement. The most ancient types of yokes are primarily designed for a sure and easy control of the animal rather than for the best utilization of their power ; whereas in the modern harness attention is particularly given to power efficiency, and proper control of the animal is done by careful training. In the former case the harness was used mainly to control animals, and transmission of power was a secondary matter. The use of poorly designed harnesses and yokes causes inefficient transfer of power from the animal to the implement. Improper hitching requires the animal to exert a greater tractive effort than is actually needed to overcome implement draught. It has been pointed out that "the majority of yokes used for controlling cattle and buffaloes in Africa and and South and East Asia do not allow for optimum working efficiency" (Goe, 1983). This is the situation in Sri Lanka too. However, in many other Asian and African countries, research and experiments are being conducted in order to improve the traditional methods of yoking and harnessing, and some countries have already obtained encouraging results. In Bangladesh Agricultural University, a study was undertaken to design and develop a suitable neck harness for local cattle with the idea of improving the efficiency with which power is transmitted from the animal to the implement (CTVM, 1985). From the first introduction of oxcultivation in Kenya early this century, the harnessing system has hardly been changed. Neck yokes, long wooden poles with sticks through it, to fix and seperate the animals, are common. These yokes are not adapted to the shape of the neck and are not covered with any lining. Steering and guiding is done orally and with the help of sticks. Often the animals do not walk in straight lines which results in poor field conditions for operations like ploughing. In the mid seventies an improved steering system ("Indian method") consisting of a nose rope and reins was introduced and the wooden sticks were replaced by a big U-bolt. At present, research projects are being conducted to develop more efficient collar type harness (CTVM, 1983). Many research projects like this are in progress in Botswana too (CIVM, 1985). The double neck yoke in South America has remained unchanged since the Spanish Colonial era and few if any attempts have been made to replace it by better designs. In Bolivia where animal power is the principle source of power for the peasent farmer, some research projects have recently been undertaken to develop a yoke that will enable the power of the animal to be better used.

It has been found that when the traditional yoke was used, a pair of oxen could not pull a metal plough for a whole day since they got tired rapidly (CTVM 1985). These studies have revealed that the maximum force developed by oxen was 26.7 percent greater when the oxen were harnessed which a Bavarian yoke rather than when they were harnessed with traditional one. From this study they realized the significance of constructing a yoke which combined the advantage of the traditional yoke, which is similar to the traditional one but more efficient in controlling animals and making use of the animal's power. This was made of wood in a manner similar to the traditional yoke, but simpler, lighter, and cheaper, In Japan, in the 1940s and 1950s many research projects were undertaken in order to improve the traditional methods of harnessing methods (shoulder, breast, and body) and found that breast types had merits over the shoulder type. In Costa Rica, Maxico and Peru too research projects aiming at better yoking and harnessing are in progress (CTVM, 1985). Some research centres in Eurpope have also shown the possibility of obtaining better work output by improving the methods of harnessing and yoking. A research project conducted at CTVM has found that wearing a collar, which results in spreading the load more evenly around the animal's shoulders, improved the net efficiently of both Brahman cattle and water buffalo. It has been pointed out that the use of an improved harness employing a breast strap or an adjustable padded yoke allows for increased tractive effort and better animal control and comfort. Recent experiments have revealed that when an uncomfortable yoke was used, a 380 kg. steer was willing only to pull a load of 30kg. but when the yoke was padded with foam rubber it willingly pulled a 50 kg. load (Smith, 1981). On account of these encouraging results it can be assumed that the traditional methods of yoking and harnessing in Sri Lanka, which have remained unchanged over the past centuries, may have been a reasons for the low work output of animals. Therefore, if these traditional methods are improved, work output of these draught animals could considerably be improved.

Furthermore, the dobule yoke harness which is used in Sri Lanka with animal pairs has some disadvantages. Historically the double yoke harness which had been used in Northern India was brought to Sri Lanka by early settlers who migrated from Northern India to the Dry Zone of Sri Lanka. Since then, double animal ploughing has been practised. Centuries ago, the double yoke harness was changed to the single yoke in China and in Central

Europe. The Chinese took it to Korea, Japan, the Philippines, Thailand, Vietnam, Indonesia and other countries of South-East Asia (Hopkin, 1969), but it did not reach Sri Lanka. Therefore, Sri Lankan farmers have always been using animals in pairs for various field operations regardless of the amount of power actually requied. The amount of power requied for a given operation is determined by the technological characteristics of the implement, soil type, soil moisture content, etc. Under certain conditions there may be some field operations which require less draught power than that generated by a pair of animals. But in the absence of a single yoke harness, farmers are to use forced animal pairs, which results in power wastage. Furthermore, the present practice of using a double yoke harness has some more disadvantages. When several animals are hitched as a team it incurs a loss of energetic efficiency. In principle, the total draught power increases as more animals are hitched together but on the other hand the draught power per animal decreases (Smith, 1980).

Apart from this, animals of two different sizes do not fit into the same yoke. Therefore, those who possess only one animal have to make an effort to hire or borrow a second animal of the same size. This extra effort is a real loss in the case of operations which could be more easily and more effectively done by a single animal. In view of the cost that the farmers have to bear for hiring draught animals it is advisable to introduce an efficient single yoke harness. Instead of using two animals, only one animal would be required if the single yoke harness is popularized in Sri Lanka. Consequently, as the number of animals that are employed to carry out the field work is cut down to half, the cost of operaton will be eventually reduced. In fact, a new method of single animal ploughing has already been demonstrated (Weerakkody, 1983). However, it is necessary to conduct intensive training of animals for a single for a single source of power.

Implements and Bullock Carts

Since the technological characteristics of animal drawn implements affect the work output of draught animals, improvement of the animal drawn implements also has potential to raise the work output of animals. Therefore, research projects have to be conducted in order to identify the technological defects of the implements presently being used and to improve them so that higher work output from draught animals could be gained. During the animal powered farming era in the developed countries, many research projects, aiming at the improvement of the quality of animal drawn implements were conducted but in the developing countries where animal draught power is still dominant, such research projects are yet few. The primitive animal drawn implements being used in many developing countries tend to reduce the work output of draught animals. However, research projects in some developing countries have shown encouraging results.

Paddy farmers in Sri Lanka too, just as in many other developing countries, still use primitive animal drawn implements which have not changed over many centuries. The Sri Lankan indigenous plough which is pulled by a pair of animals has a long rigid plough beam extending upto the animal yoke line. It is characterized by the short plough sole and limited throat clearance. It is non-adjustable and therefore the ploughman cannot adjust the plough to change the ploughing depth and the inversion direction of furrow slices. These limitations constraint the work output of draught animals and the quality of work performance. Therefore, if animal draught power is to be promoted it is necessary to improve the indigenous animal drawn implements which are in use at present. Such an improvement will undoubtedly increase the work output of draught animals.

At this point it is worthwhile to mention how the Japanese agriculturists improved their plough. Initially the Japanese also used two types of non-adjustable ploughs called non-sole plough and long-sole plough, which had been adopted from Northern China and Korea respectively. Each type had its own advantages and disadvantages. The non-sole plough had the advantages of less friction between the sole and furrow bottom, but holding the plough in proper position was difficult. The long-sole plough was easy to hold in proper position but the friction at the bottom was fairly great. Due to the individual efforts of certain ardent inventors in the 19th century, the advantages of these ploughs were mixed in the short sole plough, which had reasonable length of sole, so that the friction was less than that of the long sole plough; and handling of the plough was easy. Thus, the fundamental construction of the modern plough was completed around 1900. At the same time, the material and geometry of mould board curvature were improved so that the plough could be drawn by lesser draught power. The power required to draw the plough was further reduced by adding an extra smaller front body. This smaller front body cuts off about half of the furrow-slice and throws it into the path of the main body which cuts the lower half of the furrowslice and turn both soil layers together to the side. Thus, the double plough supplements the running action of the single plough mechanism, and gives pulverization of soil, which makes harrowing easier. This Japanese plough was further improved by adding some adjustable mechanism which enables the ploughman to control ploughing depth, width and inverting direction of furrow slices. In this way the Japanese plough became an excellent animal drawn plough (Ulluwishewa, Tsuchiya, and Sakai, 1985).

In Thailand too the improvement of the local drawn ploughs has shown encouraging results. In 1979 the IRRI-Thai co-operative farm Machinery Project undertook an experiment that aimed to reduce the draught of the animal drawn plough. It has been found that a mouldboard with a larger radius of curvature required less specific draught and further reduction could be obtained when the plough point and mouldboard assembly was rotated 20°—25° clockwise about a horizontal axis, providing a more gradual approach to the soil. The lower draught requirement apparently resulted in higher work output (Rojansaroj, Fisher, and Chakkaphak, 1981). The Sri Lankan traditional plough which remained unchanged over centuries has to be improved. Such an effort is needed to enhance the work output of draught animals. Recently a new single animal drawn plough (Weerakkody plough) has been invented and effort are being made to introduce it to farmers. This plough has a better feature than the indigenous plough. It is constructed in such a way that it has a longer plough sole (to make the plough stable during ploughing) and a wider throat clearance (to minimize build-up of mud and trashes in front of the mouldboard). It is also light weight like the indigenous plough (Weerakkody, 1985). However, a sustaining effort is needed to improve the traditional implements and to train draught animals.

The bullock carts in Sri Lanka, both single and double have not yet been improved, and they are still same as they were hundreds years ago. Therefore, the conventional catrs are still poor in loading capacity and speed. The loading capacity of a conventional cart is less than 1 ton. Its most serious disadvantage is its low speed which makes it unsuitable for the modern transport needs. The iron-rimmed wooden wheels cut into road surfaces, and damage those resulting in further repairs and maintenance exepenses. The traditional harnessing system exerts a part of the weight on the animal's neck, reducing animals's draught capability. Some studies in India have pointed out that the constant friction of the wooden yoke on the neck causes calluses and subsequently a condition of yoke-galls which render the animal unserviceable (Ramaswamy, 1983). When the animal pull carts on the tarred roads their hooves worn out rapidly. Even the horse shoes which protect the hooves, worn out and therefore have to be replaced 3—5 times a year.

These carts are made of wood. Price of timber has increase rapidly, and therefore cost of carts and repairs have become extremely high. Today, price of a new cart is about Rs. 5,000—Rs. 7,000. On the other hand, due to the poor loading capacity and slow speed, these conventional carts cannot compete with motorized vehicles. Therefore, as the trucks and tractor drawn trailers become popular, carting becomes lesss ignificant as a source of income. Trailers pulled by tractors now compete with bullock carts. Trailers pulled by tractors have a greater speed and loading capacity than bullock cart, and they can run on unpaved paths and muddy roads in the rural areas. However, Indian experiences have pointed out that the bullock carts can even compete with motorized vehicles if they are improved (Ramaswamy, 1983). They have pointed out that the traditional bullock carts can be improved by the provision of friction eliminating bearings, pneumatic tyres, lighter platforms, brakes and improved harnessing designs. The improved carts with the weight reduced by half, have double the capacity, and require only half the effort to pull thus raising productivity four times and doubling earning.

CONCLUSION

As it has been pointed out the draught power of the available animal population could be increased by improving the current traditional feeding systems, methods of harnessing, yoking, and animal training, and the technological characteristics of the traditional animal drawn implements and bullock carts. Such improvements would cause higher work output and lower cost of operations which provide incentives for wider use of draught animal power in the small farm sector. However, apart from this, some supporting services such as subsidies, extention, training and research are also necessary to promote the draught animal technology.

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