BUFFALOES AS A SOURCE OF FARM FARM POWER: POSSIBILITIES FOR IMPROVEMENT

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In many developing countries a large part of the farm population depends on the draught animals as a source of power for production and distribution of food. The significance of draught animals as a source of power for tillage operations increases as the market price of non-renewable energy sources rise. Their significance cannot be over looked even in the near future because the alternative energy sources such as bio-gas, solar, wind and hydropower which are often recommended for non-oil producing developing countries are less applicable to the tillage operation. Therefore, as population increases and the land available per family decreases, draught animals will assume even greater importanace. The draught animals represent an additional source of income for the farmer through their use for hire and haulage. Apart from this, draught animals provide a sort of insurance against unexpected crop failures since they are disposable property on which maintenance costs are very low. However, the work output of draught animals may be limited because of poor nutrition, disease or a poorly designed harness and equipment. Furthermore, the animal population is often smaller than desirable because of problems involving economics, genetics and reproduction.

In Sri Lanka too, just as in many other developing countries, draught animals, mainly buffaloes, play a significant role as a source of power, providing low-cost power for small farmers. It is evident that the cost of buffalo tillage is less than that of tractor tillage almost everywhere in the country. Apart from its cost advantages, many farmers claim superiority of the quality of land tilled by buffaloes in relation to that undertaken by the tractor (Ulluwishewa and Tsuchiya, 1983).

However, the major criticism against buffalo draught power is its comparatively low work output which disqualifies it from 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.

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

Feeding System

Generally, draught power which could be generated by any kind of working animal is determined by its body weight and size. It is approximately ten percent of the body weight.

Since the body weight of a domesticated animal is largely determined by the quality of feeding, the improvement of the feeding system is vital. The traditional buffalo feeding system in Sri Lanka has been the free-grazing method under which animals are allowed to stray in search of wild plants. Although the cost of feeding is almost zero, animals are not properly fed under this method. The volume of green leaves and water available for animals vary seasonally. This is especially true in the dry zone which experiences a prolonged dry season.

During the dry season, apart from 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 condition.

The alternative method: stall-feeding system, under which animals are kept in sheds and fed by cut-grasses and concentrates is effective in keeping animals in a better conditon throughout the year, enabling them to generate higher draught power. This method 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 work period (Smith A:J. 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 standard levels; which is not possible when grazing on natural pastures long, 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.

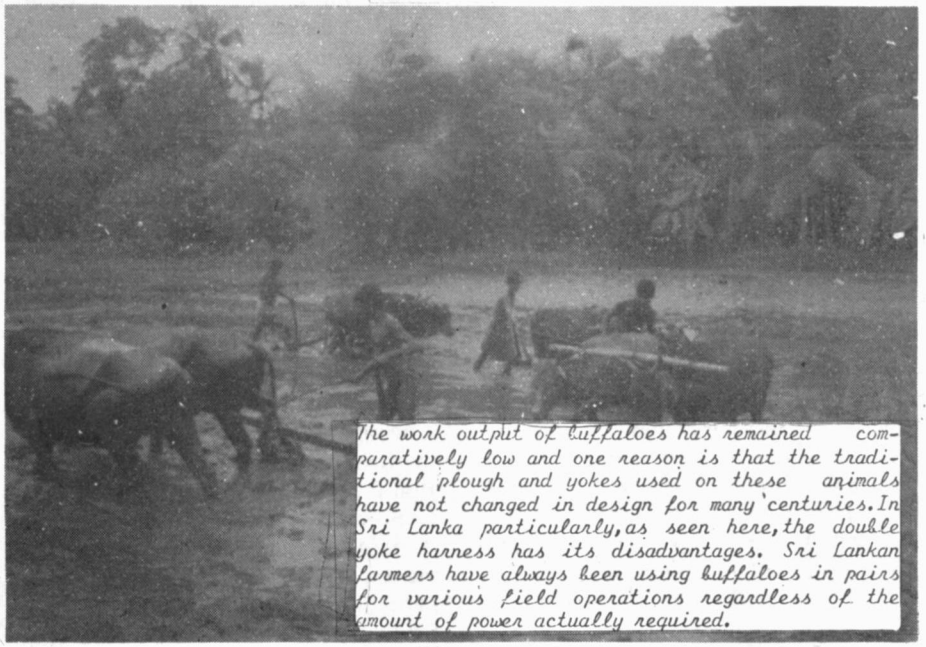
The water buffalo has come to be regarded as the tractor of Asia, as exemplified in this pair of buffaloes at work near Malang, East Java, in Indonesia. Rising energy costs over the past decade have brought about a revaluation of the role of the buffalo as a draught animal and significant source of power.

On account of the situation there is a strong case for Sri Lankan buffalo-keepers to shift from the traditional free-grazing system 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. The large volume of dung and urine which could be collected from animal-sheds would also provide very scarce fertilizer.

However, this system would add an extra work load to farmers. Daily supply of cut-grasses or concentrates and water, and cleaning animal-sheds would take up much of the farmer's time, and the farmers are unfamiliar with this type of work. If the animals are used only for draught power for farm operations theextratime and cost (for purchasing concentrates, housing, etc) spent for animals would not generate any extra income. In such a situation, although the animals are used only once or twice a year the extra burden they cast upon farmers would remain throughout the year. Therefore, the stall-feeding method is highly unlikely to be acceptable to farmers unless buffalo management is developed on a commercial basis in that it could generate an extra income. If the stall-feeding system is to be practised it needs to be developed to provide milk and meat to the market, which would provide an extra income. It has been found that buffaloes could generate a high income even as much as cattle, if they are properly managed. The idea that the buffalo is incompatible with cattle has been found to be false. "The truth is that with good livestock management, the two animals are a natural complement to one another" (Cockrill, W. Ross, 1981). Another myth is that buffalo meat is tough and that it cannot be marketed on a large commercial scale. "When the bufflao is reared primarily as a beef animal, its meat is tender and tasty. Buffalo veal is particularly good" (Johnston, P. 1981). Evidence is available to prove that buffaloes could provide low cost meat under a better management system. "Meat from buffaloes that are reared and fed for early slaughter is of excellent quality. Because the buffalo is superb converter, meat can be produced at a lower cost than in the case of cattle and without the need of expensive fodders and conentrates" (Cockril, W. Ross 1980). Apart from meat, the buffalo milk has also been

found to be similar to cow's milk. It is very rich in both butterfat and in non-fat solids, but is otherwise closely similar in chemical composition, physical properties and acceptability to cow's milk. Futhermore, its quality could be improved more by feeding it high level concentrates. It seems that there is no other strong scientific barrier in developing buffalo keeping under the stall feeding system, although there may be cultural barriers which must be eliminated for the sake of the development of this sector.

The prevailing free-grazing system is no 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 and it is prohibited to drive animals to irrigation channels for water. It is extremely difficult to keep the animals from causing crop damage in un-fenced farms. The trespassing animals have already become a serious problem in many settlement schemes. Therefore, if buffalo keeping is to be developed, a shift from the prevailing free-grazing system to the stall-feeding system is inevitable.



The work output of buffaloes has remained comparatively low and one reason is that the traditional plough and yokes used on these animals have not changed in design for many centuries. In Sri Lanka particularly, as seen here, the double yoke harness has its disadvantages. Sri Lankan farmers have always been using buffaloes in pairs for various field operations regardless of the amount of power actually required.

There is evidence to prove the feasibility of the stall-feeding system in irrigated settlement schemes. For instance, among the farmers in the Kaudulla irrigated settlement scheme, buffalo management is successfully done under the stall-feeding system (Ryan M. F. Abeyratne and J. Farrington 1981). However, the cost per animal was found to be comparatively high under this system. Therefore, as it has been pointed out, more income generating measures have to be adopted in association with the improvement of buffalo management.

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, further research is needed to find a suitable strategy.

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 practise. 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 attention. Some field surveys pointed out that lack of trained buffaloes considerably prevented famers from using buffaloes for tillage operations (Ulluwishewa R. and K. Tsuchiya 1984).

Buffaloes have been neglected over the last three decades. since the invasion of tractors in the 1950s. So the currently available animals are not trained; and furthermore young farmers do not possess experience in training buffaloes. Therefore, if buffalo power 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 capacity. For example, in Sierra Leone, animal training centres and village-level animal training programmes play an important role in popularising animal draught power among small farmers (Starkey, P.H. 1982). Sri Lanka also needs such a strategy to improve buffaloes 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 South and East Asia do not allow for optimum working efficiency" (Goe M.R.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. From the first introduction of ox-cultivation in Kenya early this century, the harnessing system has hardly been changed. Neck yokes, long wooden poles with sticks through it, to fix and separate 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 harnesses. Many research projects like this are in progress in Botswana, Zambia and Zimbabwe too. (CTUM 1985). The double neck yoke in South America has remained unchange 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 principal source of power for the peasant 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. These studies have revealed that the maximum force developed by oxen was 26.7% greater when the oxen were harnessed with a Bavarian yoke rather than when they were harnessed with a 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 1940's and 50s, many research projects were undertaken in order to improve the traditional methods of harnessing and yoking. Niiseki (1957) studied three types of harnessing methods (shoulder, breast and body) and found that breast and body types had merits over the shoulder type. In Costa Rica, Mexico and Peru too research projects aiming at better yoking and harnessing are in progress (CTYM 1985). Some research centres in Europe have also shown the possibility of obtaining better work output by improving the methods of harnessing and yoking. A research project conducted at CTYM has found that wearing a collar, which results in spreading the load more evenly round the animals shoulders, improved the net efficiency 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 30 kg. but when the yoke was padded with foam rubber it willingly pulled a 50 Kg. load (Smith A.J. 1981). On account of all 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 reason for the low work output of buffaloes. Therefore, if these traditional methods are improved, buffalo work output could considerably be promoted.

Furthermore, the double yoke harness which is used in Sri Lanka with animal pairs has some disavantages. 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, J.T. 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 required which is mainly 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 buffaloes. But, in the absence of a single yoke harness, farmers are forced to use animal pairs, which results in power wastage. Furthermore, the present practise 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.

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 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 operation will be eventually reduced. In fact, a new method of single animal ploughing has already been demonstrated (Weerakkody, W. A. S. 1985). However, it is necessary to conduct intensive training of the animals for a single source of power.

Implements

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 buffalo work output. Therefore, research projects have to be conducted in order to indentify 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 up to the animal yoke line. It is characterised by the short plough sole and limited throat clearance. It is non-adjustable and therefore the ploughman cannot adjust the plough to change the plouging depth and the inversion direction of furrow slices. These limitations constrain 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 buffalo work output.

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 and long-sole, which had been adopted from Northern China and Korea respectively. Each type had its own advantages and disadvantages. The non-sole plough had the advantage 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 farily 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 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. (Sakai, J. 1984). At the same time, the material and geometry of mould board currature 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 furrow-slice and turns both soil layers together to the side. Thus, the double plough supplements the turning action of the single plough mechanism, and gives better pulverisation of soil, which makes harrowing easier. This Japanese plough was further improved by adding some adjustable mechanisms 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 R. K. Tsuchiya and J. Sakai 1985).

In Thailand too the improvement of the local animal drawn ploughs has shown encouraging results. Six years ago the Thai-IRRI Co-operative Farm Machinery Project undertook an experiment that aimed to reduce the draught of the buffalo plough. It has been found that a mouldboard with a larger radius of curvature requried 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 (Rojanasaroj, C., Fischer R.C. and C. 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 ainmal drawn plough (Weerakkody plough) has been invented and efforts 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, W. A. S. 1985). However, a sustaining effort is needed to improve the traditional implements and to train draught animals.

In this way the draught power which is generated by the available buffalo population could be increased by improving the current traditional feeding system methods of harnessing, yoking and animal training, and the technological characteristics of the traditional animal drawn implements. Such improvements would cause higher buffalo work output and lower cost of tillage which provide incentives for wider use of buffaloes for village operation.

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