

# ECONOMICS OF SINGLE ANIMAL PLOUGHING IN BANGLADESH: PRESENTATION OF SURVEY RESULTS

S. M. A. Rahman<sup>1</sup>, A. Sayeed and J. Alam

Bangladesh Livestock Research Institute, Savar  
Dhaka 1341, Bangladesh

## Summary

In this study attempts were made to identify the areas of single animal ploughing (SAP) in Bangladesh, causes of its localization and the socio-economic constraints hindering the expansion of the system. To determine the areas of single animal ploughing, 123 upazilas of 15 districts were surveyed. Of them, 16 upazilas were found heavily engaged with this system. A detailed investigation of 469 SAP and 439 double animal ploughing (DAP) farmers revealed that there was significant difference between the two systems in respect of cost of production and yield per unit of land. The benefit/cost (B/C) ratio was higher in SAP system. However, no significant difference was observed in respect of time required for ploughing, intensity of cropping, cost of implements, and cost of repairing implements (except yoke). The study recommends for expansion of SAP system in areas where buffaloes are concentrated. For this purpose, logistic and institutional supports need to be made available.

(Key Words: Single Animal Ploughing, Double Animal Ploughing, Benefit-Cost Ratio, Cropping Intensity, Ploughing Implements)

## Introduction

The draft animal power is the principal source of farm power in Bangladesh. About ninety five percent of total cropped area is being cultivated by draft animal power. However, the size of draft animals is small. They do not have the required body weight to plough land effectively. As a result there is an acute shortage of draft power in the country. The extent of draft animal power shortage appears to be 7.3% in terms of total number of draft cattle heads, but the proportion rises to 40.9% when the estimate is made on the basis of power unit (Alam, 1987). The situation has been more accentuated by a decline of power output of each work animals from 0.25 HP in the seventies to 0.17 HP in the eighties.

To lessen the draft animal shortage, a number of suggestions are given by various organizations and individuals. They include rapid mechanization, effective breeding programme for draft animals, modification of the design of draft implement

and harnesses, and the extension of single animal ploughing.

Farm mechanization is a quick solution to the current draft power problem, but its socio-economic consequences limit widespread operation of tractors and tillers for cultivation. Animal breeding programme is a long-term solution and is conditional to sound feeding and health programmes. Increasing the number of draft animals is unrealistic in view of the limited land and feed resources available in the country. Under the above circumstances, adoption of single animal ploughing (SAP) system would be the most logical way of alleviating the draft power shortage of the country.

Single animal ploughing is popular in the Indian state of Assam, Thailand, Burma, China, Malayasia and the Philippines. The widespread use of single animal ploughing in Bangladesh will have far-reaching economic, social and technological effect on agro-based economy of Bangladesh (Rahman et al., 1990). The adoption of SAP will release one animal per plough making the total number of ploughs almost double the present number. It may also release cows from draft use. As a result, milk production may be increased (Barton, 1987). Moreover, SAP will help those farmers who have only one animal to cultivate

<sup>1</sup>Address reprint requests to Dr. S. M. A. Rahman, Senior Scientific Officer, Economics and Marketing Research Division, Bangladesh Livestock Research Institute, Savar, Dhaka 1341, Bangladesh.

Received May 3, 1992

Accepted August 4, 1992

land. Thus timeliness of land preparation will be ensured and production per unit of land will be increased (ILCA, 1983). Furthermore, this system will help large farmer to cultivate their land speedily thus releasing animals earlier for those who have no work animals.

There is evidence of using work animals as singles for ploughing in some North-eastern areas of Bangladesh (Jabber, 1984). However, those areas are not yet identified. The economics of single animal ploughing in relation to double animal ploughing is also not known to the people. Hence, this study was undertaken with the following objectives:

- to identify the locations where single animal ploughing is in practice,
- to find out the causes for localization of the SAP system,
- to study the economics of the system, and
- to detect the socio-economic constraints responsible for hindering the development of the system.

The hypothesis was that there is no significant difference between the double animal ploughing (DAP) and single animal ploughing (SAP) in respect of cost of production, cost of implements, depth of and time required for ploughing, intensity of cropping, and yield per unit of land.

### Materials and Methods

In order to achieve those objectives, the study was divided into two phases. In the first phase, areas of single animal ploughing was identified. In the second phase, economics of single animal ploughing in Bangladesh was determined.

Considering the possible areas of single animal ploughing, 15 districts were selected for investigation in the first phase. Those districts were: Sylhet, Sunamgonj, Moulvibazar, Hobigonj, Thakurgaon, Panchogarh, Brahmanbaria, Netrakona, Khagrachhari, Rangamati, Bandorbon, Chittagong, Cox's bazar, Bhola and Patuakhali. The study covered all 123 upazila (upazila is an administrative unit of Local Government, consisting of several Union Councils), of those districts. All the Chairmen of those upazilas were interviewed through mail by sending a questionnaire. Side by side, Field Assistants were engaged to collect the same information following the same

interview schedules by organising group interviews of the farmers of different upazilas under study. The Field Assistants were trained properly for this purpose. The investigation covered 6 months from January, 1988 to June, 1988.

In the second phase, data were collected from selected farmers for in-depth study. For this purpose, a multi-stage random sampling design with upazila as the primary, mouza/village (mouza is a Land revenue collection unit, consisting of one or more villages) as the secondary and house-holds as the ultimate sampling unit was followed. Sixteen upazilas, where SAP is being practised, were selected for investigation. In all, 32 mouzas/villages were chosen at random taking 2 from each upazila. A total of 908 farm households were interviewed. Of them, 469 were SAP farmers and 439 were DAP farmers. A previously tested questionnaire was used to collect information from the respondents. The Field Assistants were trained properly to ensure quality of the data.

The upazilas covered by this study were: Sylhet Sadar, Balagonj, Fenchugonj, Golapgonj, Zakigonj, Kanairghat of Sylhet district; Moulvibazar Sadar, Srimongal, Kulaura, Rajnagar, Komolgonj, Boralekha of Moulvibazar district; Hobigonj Sadar, Bahubal, Chunarughat of Hobigonj district, and Brahmanbaria Sadar of Brahmanbaria district. The period of field investigation was confined from January, 1989 to June, 1990.

'T' test was applied to determine the significant mean difference of depth of ploughing, time required for ploughing, cropping intensity, cost of production and yield per hectare of land, cost of implements and cost of repairing implements between SAP and DAP systems in the study area.

### Results and Discussion

#### Places of Single Animal Ploughing

For determining the places where single animal ploughing is in practice, all Upazila Chairmen were interviewed through mailed questionnaire. The Chairmen responded to the questionnaire very quickly. It was observed that the questions, in most cases were filled in by the Upazila Livestock Officer or the Upazila Agricultural Officer. However, this survey through mailed questionnaire provided a partial information about the existence of the system. To get reliable information, the

## SINGLE ANIMAL PLOUGHING

Field Assistants visited all the upazilas of the selected districts and collected information by personal contact holding group interviews with the farmers of the localities. From the survey, it was found that the SAP was in practice in Sylhet, Moulvibazar, Hobigonj and Brahmanbaria districts. The system was also reported to have been prevailing in Bholā and Patuakhali districts

(table 1).

During the survey, it was learnt from the farmers of the Baniachong upazila of Sunamgonj district that there is a system of driving ploughs by men. The rich farmers purchase the labour of the poor farmers and use them as draught power. A few farmers reported that this practice is becoming popular day by day.

TABLE 1. THE UPAZILAS WHERE SINGLE ANIMAL PLOUGHING IS IN PRACTICE

| Name of districts | Name of upazilas   |
|-------------------|--|
| 1. Sylhet         | Sylhet Sadar, Balagonj, Fenchugonj, Golapgonj, Zakigonj, Kanaighat. In Goainghat, Jaintapur, Bianibazar this System exists in a limited scale. |
| 2. Moulvibazar    | Moulvibazar Sadar, Kulaura, Srimongal, Rajnagor, Komolgonj and Borolekha.  |
| 3. Hobigonj       | Hobigonj Sadar, Bahubal, Chunarughat.  |
| 4. Brahmanbaria   | Brahmanbaria Sadar (very limited).   |
| 5. Bholā          | Char-fashion (very limited).   |
| 6. Patuakhali     | Galachipa (very limited).  |

### Socio-economic Status of the Farmers

Socio-economic status of the farmers using double animal ploughing (DAP) vis-a-vis single animal ploughing (SAP) is presented in table 2. It is evident from the table that the average family size, literacy rate, number of service-holder per family and area under cultivation were higher for those who used the SAP, but the average number of earning members and the number of animal heads per household were higher for those who used the DAP. Results indicate that the small number of family labours and animal heads per household encouraged cultivation with SAP in the study areas. It is to be noted that SAP is done only by buffaloes and DAP by cattle in the study area.

### Sources of Introduction of SAP System

About the sources of introduction of the SAP system, 58% farmers said that they inherited this system from ancestors. Twenty five per cent farmers told that they learnt about SAP from neighbours. Others opined that they received the message from relatives and friends. It was reported that the strength of the two buffaloes was much in excess of the requirement and the driver behind the plough became sick after ploughing. Moreover, ploughing with two buffaloes furrowed the land so deeply that it destroyed the lower layer of the soil which was believed to have prevented leaching of water. To overcome these difficulties and to economise the farm, the farmers started ploughing with one buffalo. But nobody

TABLE 2. SOCIO ECONOMIC STATUS OF SAP AND DAP FARMERS

| System of ploughing | Family size | Number of earning members per farm | Number of educated member per farm | Number of service holders per farm | Size of holding (hectare) | No. of animals per farm |
|---------------------|-------------|------------------------------------|------------------------------------|------------------------------------|---------------------------|-------------------------|
| DAP                 | 7.37        | 2.56                               | 2.14                               | 0.17                               | 1.41                      | 3.51                    |
| SAP                 | 7.86        | 2.33                               | 2.85                               | 0.19                               | 1.57                      | 2.17                    |

could mention when and how the system was introduced although the same is largely being practised in the neighbouring Assam State of India.

**Type of soil**

In order to determine the type of soil in which the single buffalo ploughing is being practised, the soil samples of 32 villages of 16 upazilas were collected. These soil samples were tested in the Analytical Services Division of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. The soil test results showed that clay loam, sandy clay loam, clay, and sandy loam covered 48%, 29%, 20% and 12% of samples, respectively. These results indicate that single buffalo ploughing may be possible, at least in those kinds of soil throughout the country.

Farmers operating under both DAP and SAP system reported to have ploughed their land in hard, soft, muddy, dry and wet conditions. At least 80.1% DAP farmers and 80.1% SAP farmers have been operating under those soil conditions. This indicates that the SAP ploughing is possible in all conditions of soil, and in all crop seasons of the year like DAP system.

**Depth of and Time Required for ploughing.**

The depth of ploughing was 0.6 cm higher in SAP than in DAP system. The deeper ploughing was attained due to a higher body weight and strength of SAP animals (buffaloes). The blades of the ploughs were of similar in size. The time required for cultivation of one hectare of land was 253.2 hours for SAP and 249.6 hours for DAP. The time required for cultivation was marginally higher (3.6 hrs) per hectare of land in SAP system. This was due to the fact that one buffalo is heavier than that of two cattle. Consequently, the speed of ploughing was lower (table 3) in SAP than in DAP.

'T' test was applied for the significance of the difference in depth of ploughing and time

TABLE 3. DEPTH OF AND TIME REQUIRED FOR PLOUGHING PER / HECTARE OF LAND BY SAP AND DAP SYSTEM

| System of ploughing | Depth (cm) | Time (hours) |
|---------------------|------------|--------------|
| DAP                 | 11.2       | 249.6        |
| SAP                 | 11.8       | 253.2        |

TABLE 4. CCST OF PRODUCTION PER HECTARE OF LAND UNDER DAP AND SAP SYSTEM

| System of ploughing | Labour cost (Tk.)              | Ploughing cost (Tk.) | Seed cost (Tk.) | Fertilizer cost (Tk.) | Insecticide cost (Tk.) | Irrigation cost (Tk.) | Total (Tk.)     |
|---------------------|--------------------------------|----------------------|-----------------|-----------------------|------------------------|-----------------------|-----------------|
| DAP                 | 3151.37<br>(43.1) <sup>†</sup> | 2636.26<br>(36.1)    | 611.84<br>(8.4) | 708.74<br>(9.7)       | 98.04<br>(1.3)         | 103.89<br>(1.4)       | 7310.1<br>(100) |
| SAP                 | 3074.95<br>(39.8)              | 3161.59<br>(40.9)    | 595.46<br>(7.7) | 703.44<br>(9.1)       | 95.19<br>(1.2)         | 102.32<br>(1.3)       | 7732.9<br>(100) |

<sup>†</sup> Figures in parenthesis are percentages.

required for ploughing between SAP and DAP system. Results show that depth of ploughing in SAP system was significantly higher than that of the DAP (at 1% level). Nevertheless, the time difference for ploughing was found insignificant. The similar result was obtained by Palis et al. (1983) in Burma.

**Cropping Intensity**

The intensity of cropping under DAP and

SAP system were 134.76% and 132.47%, respectively. It was 1.69% lower in SAP system. Results of t-test indicate, however, that the difference in cropping intensity between the two systems was insignificant.

**Cost of Production and yield**

The cost of production under SAP and DAP system is presented in table 4. It is evident that the total cost of production per hectare of land

## SINGLE ANIMAL PLOUGHING

under SAP system was higher (Tk. 7732.95) than that of DAP system (Tk. 7210.14). Of the total cost, ploughing cost per hectare of land was the highest followed by labour cost, fertilizer, seed, irrigation insecticide cost under SAP system while labour cost was the highest followed by ploughing, fertilizer, seed, insecticide and irrigation cost under DAP system. The highest cost of ploughing under SAP system was attributed to buffalo ploughing. An explanation is that the buffaloes furrowed land deeply. So there was a high demand for buffalo ploughing in those localities. This made the opportunity cost of SAP much higher than the DAP. Contrarily, the highest cost of labour per hectare of land under DAP system was related to more labour requirement for weeding. It may be mentioned that ploughing at shallow depth facilitated more weeds to grow under DAP system.

The yield and b/c ratio per hectare of land is shown in table 5. One can notice from the table that the yield per hectare of land was higher (2.52 tons) in SAP system than that of DAP

system (2.18 tons). The higher yield per hectare of land resulted in higher return to SAP farmers. The benefit-cost ratio was also higher for them.

To compare the significance of mean differences of cost of production and yield/hac between SAP and DAP system 't' test was carried out. It was observed that the difference in cost of production and yield/hac. between the two systems were significant at 1% level.

### Cost of Rearing Animals

In rearing animals, feed cost and permanent labour cost were found higher in DAP system, but the medicine cost was found higher in SAP system. The total cost of rearing per head of animal per year was Tk. 248.47 and Tk. 170.12 under DAP and SAP systems respectively (table 6). The low-cost of rearing animals under SAP system was related to the species of animals used for ploughing. Buffaloes are voracious animals. They eat more but eat less costly materials. Moreover, they can be grazed on marshy land or in water making the feed cost lower for them.

TABLE 5. YIELD AND BENEFIT-COST RATIO PER HECTARE OF LAND UNDER DAP AND SAP SYSTEMS

| System of ploughing | Yield (tons) |       | Value of output (Tk.) |          | Total value of output (Tk.) | Net B : C ratio |
|---------------------|--------------|-------|-----------------------|----------|-----------------------------|-----------------|
|                     | grain        | straw | grain                 | straw    |                             |                 |
| DAP                 | 2.18         | 2.18  | 10,606.79             | 2,906.66 | 13,513.45                   | 0.85            |
| SAP                 | 2.52         | 2.52  | 12,064.35             | 3,359.99 | 15,424.34                   | 0.99            |

TABLE 6. COST OF REARING PER ANIMAL PER YEAR UNDER DAP AND SAP SYSTEMS

| System of ploughing | Feed cost (Tk.) | Medicine cost (Tk.) | Permanent labour cost (Tk.) | Total cost (Tk.) |
|---------------------|-----------------|---------------------|-----------------------------|------------------|
| DAP                 | 145.68          | 11.81               | 90.98                       | 248.47           |
| SAP                 | 79.68           | 24.82               | 65.62                       | 170.12           |

### Cost of Implements

The home made ploughs, ladders and yokes used for both DAP and SAP were found more costly than the ready-made ones purchased from the market. However, the cost of home-made and ready-made ploughs and yokes used under SAP system was found higher than those under DAP system. The implements used for SAP were of special type, of good quality and required more

accessories than the DAP implements (table 7). To compare the difference in cost of implements under DAP and SAP system, 't' test was applied. It was observed that the differences for both home-made and ready-made ploughs and yokes were significant at 5% level. However, no significant difference in cost was found in case of ladders.

TABLE 7. COST OF IMPLMENTS UNDER DAP AND SAP SYSTEMS

| System of ploughing | Home made    |              |            | Ready-made   |              |            |
|---------------------|--------------|--------------|------------|--------------|--------------|------------|
|                     | Plough (Tk.) | Ladder (Tk.) | Yoke (Tk.) | Plough (Tk.) | Ladder (Tk.) | Yoke (Tk.) |
| DAP                 | 171.43       | 72.68        | 46.58      | 150.87       | 58.46        | 34.98      |
| SAP                 | 191.47       | 66.25        | 69.94      | 166.57       | 48.81        | 56.85      |

**Cost of Repairing Implements**

The repairing cost of ploughs and ladders under DAP and SAP system was almost the same. Nevertheless, the repairing cost of yokes was higher in SAP system. The reason is that the yokes under SAP are subject to frequent breakdown and a minor repairing of yoke means a total replacement of it. Thus the cost was high (table 8).

**Body weight and sex**

The body weight ranged from 457.10 kg to 552.35 kg with an average of 498.35 kg per animal under SAP. It is significantly higher than the average body weight of two cattle (415.91 kg). The male animals possessed higher body weight than the female ones in both the systems.

The majority (51%) of SAP farmers used

she buffaloes and the rest (49%) used he-buffaloes as draft. In DAP system, 52.5% farmers used cows and the rest 47.5% used bull or bullocks as draft. The female buffaloes and cows are mild in nature and they give both draft power and milk which have economic potential to the farmers.

**Adoption of SAP**

Results showed that 3.01% new farmers adopted SAP system and 0.38% abandoned it during the study period. The adopters of SAP system were mainly the large farmers who were able to buy buffaloes for ploughing. Those who abandoned the system were landless and marginal farmers. They were compelled to do so due to sudden death of buffaloes.

TABLE 8. COST OF REPAIRING IMPLEMENTS UNDER DAP AND SAP SYSTEMS

| System of ploughing | Plough                 |                     | Ladder                 |                     | Yoke                   |                     |
|---------------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|
|                     | Frequency of repairing | Cost incurred (Tk.) | Frequency of repairing | Cost incurred (Tk.) | Frequency of repairing | Cost incurred (Tk.) |
| DAP                 | 0.80                   | 22.65               | 0.66                   | 5.13                | 0.86                   | 3.30                |
| SAP                 | 1.00                   | 22.47               | 1.25                   | 4.78                | 0.80                   | 8.04                |

**Conclusions**

Sylhet is the rice-producing zone in Bangladesh. Most of the farmers are cultivating rice in Aus season it is crop season when seeds are sown during the months of March-April and are harvested during the months of July-August), Aman season (this season starts from March-April (in case of Broadcast Aman) and July-August (in case Transplanted Aman) but both of them harvested during November-December) and Boro

season (this season starts from November-December and crops are harvested during March-April) under SAP system. The key animals for SAP are buffaloes. Environmental, geographical and climatic conditions are favourable for rearing buffaloes in that region. Therefore, the SAP practice has been continuing in that region generations after generation. This practice can be extended in other parts of the country as well where buffaloes are raised and reared easily. Similarly, the DAP farmers who either possess

buffaloes or stronger and healthier bullocks having body weight like buffaloes may also adopt SAP system in all other districts of the country. However, the expansion of the SAP system would require modification of existing implements. This would also require training to the farmers and animals. Therefore, institutional facilities need to be developed to undertake extension programme on SAP system. A massive publicity of the system through radio, television and news papers would help popularize it throughout the country.

#### Acknowledgements

Financial assistance received from the Bangladesh Agricultural Research Council and the Ministry of Fisheries and Livestock is gratefully acknowledged by the authors.

#### Literature Cited

- Alam, J. 1987. The draft power shortage in Bangladesh. *Asian Profile*, Vol. 15, No. 6, pp. 563-80.
- Barton, D. 1987. Draught animal power in Bangladesh. Unpublished Ph. D. Thesis, submitted to BAU, Mymensingh.
- ILCA. 1983. The single ox: An innovation for the small farmers. *ILCA News letter*, Vol. 2(2). Addis Ababa.
- Jabbar, M. A. 1984. Potential of single animal ploughing in Bangladesh. *Bangladesh Journal of Agricultural Economics*, Vol. III, No. 2, pp. 53-61.
- Palis, R. K., A. Swe and K. Shinn. 1983. Comparative performance of one work animal, a Team of two work animals and an 8.5 HP power tiller in preparing lowland rice field. Yezin, Pyinmana, Burma.
- Rahman, A. and A. sayeed. 1990. Single animal ploughing in Bangladesh: A Bench Mark Survey, BLRI, Savar, Dhaka, Bangladesh.